**WILLIAM CULLEN (1713-1790), CONSECRATED HERETIC: A STUDY IN**

**EIGHTEENTH-CENTURY SCIENCE AND PATRONAGE.**

ABSTRACT

Focusing on the life and career of William Cullen, I argue that during the eighteenth century no physician or surgeon, no matter how well qualified, could succeed in establishing himself in practice without having recourse to the system of patronage which dominated medical life at the time. In order to do so, I have utilised the concept of *capital* developed by the French sociologist, Pierre Bourdieu in his book, *Homo Academicus*. I start by showing how Bourdieu’s concept of capital can be extended to cover not only French universities in the twentieth century, but also eighteenth-century Scottish universities, the way Scottish society operated and the system of patronage upon which Cullen’s career depended. In his book, Bourdieu introduced the concept of a *consecrated heretic.* This was his term for someone who did not teach a mainstream subject but managed to become an academic because their expertise introduced new topics to the university curriculum.

The term consecrated heretic is I argue, a good description of Cullen, whose aim in life was to become a physician and teacher of medicine. He realised however, that he did not have the patronage needed for a university appointment, so he turned to chemistry as a means of gaining *entrée* into the system. Chemistry had been introduced to medical schools in order to teach students something about *materia medica*. Cullen expanded his courses to cover all forms of chemistry. The nature of that chemistry and the natural philosophy on which it was based form a large part of my thesis. The final chapter shows how Cullen was able to reach outside of the university to men who were interested in using chemistry to improve Scotland’s industrial base. They were able to provide him with the patronage he needed to achieve his goal.

**WILLIAM CULLEN, CONSECRATED HERETIC: A STUDY IN EIGHTEENTH-**

**CENTURY SCIENCE** **AND** **PATRONAGE.**

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Reference system, *Isis*

I confirm that this thesis has been written by me and that the work is my own. Where I have obtained information from other sources, these have been acknowledged.

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CONTENTS

INTRODUCTION 6

CHAPTER 1. How Does Bourdieu’s Concept of Capital Explain Eighteenth-Century Scottish Universities and the Patronage System? 24

CHAPTER 2. How Did Cullen Acquire his Capital? A study of his life. 56

CHAPTER 3. Who were Cullen’s Students and how did he Use Natural Philosophy to Justify the Study of Chemistry to Them? 97

CHAPTER 4. How Did Cullen Use Practical Chemistry to Gain 136 Patronage from Students?

CHAPTER 5. Cullen and his medical students: How did 161 his *Materia Medica* gain him Patronage?

CHAPTER 6. How Did Cullen’s Agricultural Lectures Gain Him Patronage? 189

CHAPTER 7. How Did Cullen’s Industrial Chemistry Earn Him Aristocratic Patronage? 218

CONCLUSION 249

Appendix 1. Cullen’s Chemical Principles 259

Appendix 2. Cullen’s *Materia Medica* Students 261

Appendix 3. Cullen’s Chemistry Students and their publications. 264

BIBLIOGRAPHY 295

WILLIAM CULLEN, CONSECRATED HERETIC: A STUDY IN EIGHTEENTH-CENTURY SCIENCE AND PATRONAGE

INTRODUCTION

William Cullen (1713-1790) is remembered today as both an Enlightenment chemist and a physician. [[1]](#footnote-1) His early years, however, gave no indication that he would become one of the most revered figures in eighteenth-century chemistry and medicine because he started life as the second surviving son of an impoverished provincial lawyer. As his father died when he was in his teens, Cullen was forced to earn his living from an early age without any formal qualifications. Yet he eventually succeeded in obtaining the senior chair in the Medical School in Edinburgh when it was considered to be Europe’s leading medical school. As an outsider, his ascent up the academic ladder was far from easy but he finally achieved his goal when he became Professor of the Practice of Medicine in 1773. How he achieved that feat and the other aspects of his legacy are the subject of this thesis.

Cullen’s success rested on his pedagogic abilities and the fact that he saw the potential for chemistry to improve life in eighteenth-century Scotland. At the beginning of the century, for many educated people, chemistry was something artisans did in their workshops. As that was something done by the lower orders, it was not considered worthy of study in universities. Cullen had a much greater breath of vision. Although he was employed to teach chemistry as an adjunct to *materia medica,* he refused to confine himself to that brief. As a result, he is credited as one of the people who made chemistry “a study worthy of a gentleman.” [[2]](#footnote-2)

Shortly after he arrived in Edinburgh he was elected a Fellow of the Royal College of Physicians. [[3]](#footnote-3) It was as a member of this organisation that he played a major role in the revision of the *Edinburgh Pharmacopoeia.* This publication is credited with raising the standards of medical treatment by removing some of the outdated and largely discredited medications. He was also a founding member of both the Royal Medical Society and later of the Royal Society of Edinburgh. Today he is remembered for coining the word *neurosis*, although the word has changed its meaning since he invented it.[[4]](#footnote-4)

Another reason for Cullen’s fame is the survival of many of his students’ notebooks as well as his published textbooks: *First Lines in the Practice of Physic, Nosology* and *A Treatise of the Materia Medica.* These documents give us insights into his ideas*.* He also had an extensive medical practice, including consultation letters, which he took great pains to preserve and which are now available on-line.[[5]](#footnote-5) Finally, there is also a biography of Cullen, *The Life, Lectures and Writings of William Cullen* written by John Thompson in the early nineteenth century. *[[6]](#footnote-6)* Thompson’s book details not only Cullen’s life, but also his teachings. Despite the fact that Thompson, like many of Cullen’s biographers, does not allude to the topic directly, I will argue that patronage was the most important factor in Cullen’s success. Thompson did not discuss the subject in depth because he did not need to; all his contemporaries were aware of it. Patronage was a fact of life for almost everyone above the rank of labourer in the eighteenth century and has been extensively investigated in a political context.[[7]](#footnote-7) Yet it was equally important in universities. With the exception of Roger Emerson’s books*,* this vital ingredient of any successful eighteenth-century medical career has received very little attention. [[8]](#footnote-8) Indeed, Ludmilla Jordanova once remarked that “although we know in general terms how important patronage networks were in medicine, we have only a few cases where these have been worked out.”[[9]](#footnote-9) By investigating William Cullen, this thesis aims to make a start on filling that gap. I argue that without his ability to manipulate the patronage system, Cullen would probably have spent his life as a provincial surgeon.

Emerson’s book, *Academic Patronage in the Scottish Enlightenment* covers the history of patronage in Glasgow, Edinburgh and St Andrews Universities for the whole of the eighteenth century. But because it covers such an enormous topic, it could not possibly explore all the biographical details of every individual mentioned. Furthermore, as Emerson pointed out, university patronage reflected the politics of the day. [[10]](#footnote-10) For that reason the book dealt mainly with those who were already in positions of power, in politics or in the universities. Emerson did not investigate how clients, who were further down the social scale, conducted their search for patrons. My perspective differs from that of Emerson’s in that I tell the story of eighteenth-century academic patronage from the point of view of the patronised, not the patron. When Cullen was struggling to establish himself, most academic appointments in Scotland were controlled by Archibald Campbell, Duke of Argyll (1682-1761). While undoubtedly Argyll was both effective and shrewd, studying his life and work gives little indication of how his clients fared. Because Cullen came from a much lower social stratum than the Duke, his struggle to influence patrons provides a good example of the difficulties men from his position had to face in order to make a career for themselves.

Cullen’s difficulties with patronage arose from the fact that during the eighteenth century anyone with his education and training struggled to obtain the help he needed to become an academic physician. As a result, Cullen turned to chemistry as a means of gaining a foothold in a university. Once established as an academic chemist, he was able to manipulate the system to obtain a medical chair. By starting his career this way, Cullen became part of a movement which later generations termed the Industrial Revolution. That revolution involved a profound change in the way the educated elite thought about the world. Those ideas created an interest in what is now known as science. As that interest developed, men like Cullen, who were knowledgeable enough to teach the new branches of learning, were increasingly in demand. There was however, more to eighteenth-century science than simply this sociological aspect. In his book on the science of that period, Martin Rudwick argued that, “the political, economic, social and cultural dimensions (of the history of science) have little historical significance if their analysis neglects the precise claims to knowledge and epistemic goals that were the ostensible *raison d’etre* of scientific work.” [[11]](#footnote-11) This thesis will demonstrate the truth of that statement by discussing Cullen’s knowledge of the various branches of chemistry and demonstrate how he used that expertise to target specific groups of potential patrons.

**Patronage and Capital**

In analysing how Cullen eventually became Professor of the Practice of Medicine, I will adopt several ideas of the French sociologist, Pierre Bourdieu. As I will explain in Chapter 1, Bourdieu’s ideas on the nature of academic patronage are set out in his book, *Homo Academicus.* This book provides an excellent description of the way the academic world functions. Bourdieu developed the concept of *capital* to explain his ideas and I demonstrate how Cullen accumulated such capital. Bourdieu’s concept of capital encompasses knowledge and expertise, termed cultural capital and also social skills which Bourdieu described as social capital. Finally, by using cultural and social capital a man can gain honour and prestige which Bourdieu defined as symbolic capital. Because Bourdieu’s concept of capital is so broad it can also be used to analyse eighteenth-century patronage systems.

As a full discussion of every facet of patronage would be well beyond the scope of this thesis, I have attempted to apply Bourdieu’s ideas to eighteenth-century patronage as it effected Cullen. Patronage in general can be divided into four different types, Aristocratic, Familial, Institutional and the type of patronage which was exercised by members of that section of society usually described as the “Middling Sort.” To summarise this briefly: Aristocratic patronage was the equivalent of what Bourdieu described as symbolic capital. It was the birth right of the titled members of the few land-owning families who governed Scotland. Familial patronage was the help given to individuals by their family and friends and consequently, a form of social capital. Institutional patronage developed mainly as the result of the members of the professions acting together to form the many and varied organisations which characterised eighteenth-century Scotland. While being a member of one of the institutions usually conferred symbolic capital on the man concerned, he needed both cultural and social capital to join it. The Middling Sort were a much more variable group which included the professional classes. Although most people know instinctively what the term means, no-one has yet been able to give a precise and widely accepted definition of it. As it is a very large topic, I am limiting my discussion of this type of patronage to how it affected Cullen. Because this thesis concentrates on how Cullen used his cultural capital to become a teacher of medicine, I have entitled this section “student patronage.”

In addition to the concept of capital, Bourdieu also coined the term *consecrated* *heretic,* which he defined as anyone who did not have an academic background yet managed to obtain a teaching post in a university*.* This term is a good description of Cullen. In the eighteenth century, Edinburgh’s medical elite were usually men from wealthy families who had studied in Leiden, Paris or other continental centres. They used their influence with their own patrons to resist the appointment of men like Cullen who did not come from a similar background. Bourdieu maintained that it was possible for a few well-qualified men, without the right family and academic connections, to get professorial chairs in leading universities, provided they were not teaching mainstream subjects. He termed such men consecrated heretics. This thesis will demonstrate that this was the route that Cullen took, that his heresy was his chemistry and his success was due to his ability to manipulate the patronage system.

**Primary Sources**

In this section, I give an introduction to the sources used in the writing of this thesis. One of my main authorities was John Thompson’s biography which was based on the numerous letters and documents left by Cullen. Because Cullen did not write a textbook of chemistry, my discussion of that topic will be based on the notes students made at his lectures. Cullen’s textbook, *A Treatise of the Materia Medica,* which was also based on student’s notes,was my main source for Chapter 5. The following chapter on Cullen’s agricultural chemistry uses his own lecture notes and the last chapter, mostly his correspondence.

Chapter 2, Cullen’s biography is based on Thompson’s book but because there are omissions in Thompson’s account of Cullen’s life, particularly his early years, in order to present a more complete picture, I have supplemented Thompson’s work with eighteenth-century documents held by the National Records of Scotland (NRS) and the English National Archives in Kew. I have also consulted letters written to Thompson by Cullen’s family and friends when he was compiling the biography. The letters are held in the Special Collections of the Glasgow University Library.[[12]](#footnote-12) By investigating Cullen’s early life more intensively than Thompson, I have filled in some of the gaps he left, which show that Cullen had much more of a struggle to achieve his goal than has previously been documented.

Chapters 3 and 4, which address Cullen’s natural philosophy and his chemistry, will use manuscript student note books held by the Wellcome Library in London.[[13]](#footnote-13) Student notebooks are a very important source of eighteenth-century science. They have survived because it was standard practice for students to take detailed notes during lectures. They were bound together and used *in lieu* of a textbook.[[14]](#footnote-14) Although the survival of any individual notebook seems to be a matter of chance, during the eighteenth century the notes themselves were regarded as valuable and could change hands for significant sums of money.[[15]](#footnote-15)

There is a fair amount of variation between the note books because Cullen not only updated his lectures constantly, but also because of the sheer mass of information he needed to impart. How Cullen structured his courses was explained by James Anderson in his obituary of Cullen in the *Bee*.

*Doctor Cullen was so full in his course of lectures that he never had time to undertake the whole course in one session even though he usually gave double lectures for a month or six weeks before the end of the session. His practice was to omit one branch of his subject one season and taking that in the next season, omit another part that had been given in the former year; so that those who attended two sessions might be shure (sic) of the whole.*[[16]](#footnote-16)

William Wightman, who studied as many of Cullen’s manuscripts as he could, stated that “towards the end of his career, his ideas became much more settled.”[[17]](#footnote-17) This thesis has taken advantage of that fact by consulting notebooks compiled mainly in the 1760s, i.e. in Cullen’s final years as a teacher of Chemistry. Wellcome manuscript, MS MS49 dated 1762 contains the most meticulous account of the practical procedures, so I have made good use of that particular manuscript.[[18]](#footnote-18) There are also accounts of the substances actually used by chemists in three note books, “Chemistry for Medical Students,” “Lectures in Chemistry” and another manuscript dated 1765, so they were consulted as well. [[19]](#footnote-19) Notes on the History of Chemistry was the part of Cullen’s course least likely to survive. My discussion of this topic in Chapter 3 is based on a manuscript held by the Wellcome Library. It was written by Clement Daniel MD and is undated.[[20]](#footnote-20) The contents of the notebooks have been supplemented with Cullen’s own lecture notes and some of his letters, both those he wrote and the ones he received from various individuals, including Lord Kames. They are in the Special Collections of Glasgow University Library.

The chemistry discussed in Chapter 5, which deals with Cullen’s interaction with his medical students, is based on his lectures on *materia medica.* While some students’ notebooks on this subject have survived, for ease of reference it is his textbook, published in 1786, which was used as the basis of this chapter. [[21]](#footnote-21) Cullen’s agricultural chemistry, the subject of Chapter 6, is based on his own lecture notes, held in the Special Collections of Glasgow University Library.[[22]](#footnote-22) Because the notes are not dated it is impossible to determine whether they were used for his Glasgow lectures, the private lectures he gave in Edinburgh in 1768, or both courses. There is however, no reason to suspect that his views on agricultural chemistry changed significantly between the late 1740s when he was lecturing students in Glasgow and the lectures he gave in Edinburgh in 1768. The primary sources used for the final chapter are letters from Cullen to the Duke of Argyll and Lord Kames.

**Secondary Sources**

The background knowledge needed to apply Bourdieu’s concepts to eighteenth-century Scottish society has come mainly from the works of Roger Emerson, Stephen Shapin, Richard Sher and Jan Golinski.[[23]](#footnote-23) Because Cullen was one of what would now be described as the middle classes, I consulted Jonathon Barry’s and Christopher Brooks’ *The Middling Sort of People: 1707-1837* and Rosemary O’ Day’s, *The Professions in Early Modern England.* Although these works are based on English sources, there were so many similarities between English and Scottish middle class life that they are helpful in elucidating Cullen’s situation. Thompson’s account of Cullen’s time in the Caribbean is also rather vague but T.M. Devine’s book, *Recovering Scotland’s Slavery Past* explains why. [[24]](#footnote-24) Richard Sheridan’s *Doctors and Slaves, a Demographic History of Slavery in the West Indies* and hischapter in *The Oxford History of the British Empire* have also helped to build up a picture of the situation in the Caribbean when Cullen was there. [[25]](#footnote-25)

Matthew Eddy’s studies of chemistry in Edinburgh Medical School together with his work on eighteenth-century pedagogy have been invaluable in explaining Cullen’s chemistry and the way it was taught.[[26]](#footnote-26) The discussion of medical courses at the University of Edinburgh in Lisa Rosner’s *Medical Education in an Age of Enlightenment* has also been helpful. Donovan’s book, *Philosophical Chemistry* was consulted, too*.* [[27]](#footnote-27) As this book was based mainly on Cullen’s early lectures some of the information in the book does not apply to this thesis which is based on his later chemistry. [[28]](#footnote-28) In addition, Donovan appears to have been unaware of the state papers in Kew and the papers in the National Records of Scotland.[[29]](#footnote-29) Much of the background information on Scotland’s industry at the time Cullen was lecturing has come from the Archibald and Nan Clows’ book, *Chemical Revolution*.[[30]](#footnote-30) L.M. Cullen and T.C. Smout’s study of Scottish agriculture especially their book, *Comparative Aspects of Scottish and Irish Economic and Social Policy 1600-1900* was used to build up a picture of farming in eighteenth-century Scotland. [[31]](#footnote-31)

Although Cullen was not directly involved in the politics of eighteenth-century Scotland, without a knowledge of what was happening outside of university circles, it would be impossible to understand how the patronage system operated within universities. Because of this I have consulted several general works on eighteenth-century politics as they applied to Scotland. Roger Emerson’s biography of the Duke of Argyll was particularly valuable because the Duke played such an important part in Cullen’s rise to fame. This work has been supplemented with general studies on Scottish society in the eighteenth century, including works by T.M. Devine, Charles Camic, Jeremy Black and John Stuart Shaw.[[32]](#footnote-32) Linda Colley’s book, *Britons: Forging the Nation* gives a good account of the Scottish diaspora which Cullen joined for a short while. [[33]](#footnote-33)

By placing Cullen in a wider historical context, I hope to provide a much fuller picture of his life than that presented by accounts of his medical and chemical theories taken in isolation. To explain his success, he has to be considered in relation to the society in which he lived. However notable Cullen’s theories were, their intrinsic merit cannot, by themselves, explain how he managed to obtain the senior chair in what was then Europe’s leading medical school. To do that, Cullen needed to become a university teacher and without his chemical expertise he could never have achieved that feat. Once established in Edinburgh as a Professor of Chemistry, he had to be able to manipulate the patronage system to progress further. In this thesis I hope to show that Cullen was not only a man of his time, but also that his becoming Professor of the Practice of Medicine was a much greater achievement than studies of his academic work alone could possibly demonstrate.

**Outline of Thesis**

Having established my methodology in Chapter 1, the rest of my thesis will show how Bourdieu’s idea of capital can be invoked to explain the part played by patronage in Cullen’s life and work. Chapter 2 is an account of his life, emphasising the part this phenomenon played in his career. Mario Biagioli once described patronage as “an institution without walls, its reality made of etiquette bound rituals.” [[34]](#footnote-34) Cullen’s life illustrates this fact. There was a definite hierarchy among patrons and their clients. When he began his career, Cullen did not have the requisite connections to those with power over academic appointments. He was reliant on other members of his family to secure employment. Once he had obtained an MD degree, he could set his sights higher and eventually, like Galileo, he became a client of the leading nobleman of his day.

In my biography of Cullen I discuss how he started his climb up the academic ladder in Glasgow by utilising the patronage of his friends and family. What created this opportunity for him was the state of Glasgow’s Medical School in the early eighteenth century. While, thanks to professors like Francis Hutchinson (1694-1746) and Adam Smith (1723-1790), the Humanities were flourishing at that time, there was very little teaching provided for its medical students. This created a situation which was ripe for development by someone like Cullen, who was qualified to teach medicine and was willing to seek the patronage of students by providing that teaching.

The lack of proper instruction also extended to medicine’s associated disciplines, particularly chemistry. Chemistry had been introduced to medical schools as an adjunct to *materia medica.* Because Cullen realised that the subject had a much greater potential, he expanded his courses to cover the whole field of chemistry. This enabled him to attract students who were not interested in medicine *per se.*  It was undoubtedly Cullen’s chemical expertise which brought him to the attention of the Duke of Argyll, the leading patron of his day. There is little doubt that it was Argyll’s patronage which enabled Cullen to secure an Edinburgh chair. This chapter will also highlight the problems that Cullen had in obtaining patronage and the problems his patrons created for him.

Chapter 3 is a discussion of who Cullen’s students were and how he used his knowledge of natural philosophy to demonstrate that chemistry was not just something that artisans did in their workshops. It was this connection to natural philosophy which made chemistry an academic subject. I begin the chapter with a discussion of Cullen’s students and why they attended his courses. Then I discuss his natural philosophy. My account of this aspect of his teaching starts with his history of chemistry. Starting a course with a history of the subject was the usual practice at the time and Cullen used the subject to show that chemistry had only begun to make significant advances when it became a branch of natural philosophy.

Cullen’s own natural philosophical ideas were based primarily on his interpretations of the work of Francis Bacon (1561-1626), Isaac Newton (1642-1727) and Georg Stahl (1659-1734). Bacon’s concept of “useful knowledge” helped get the subject accepted as worthy of academic attention. Belief in Newton’s infallibility ensured that once his interest in the chemistry became known, its reputation was enhanced. Newton’s suggestions about how the topic could be investigated in the Queries at the end of his *Opticks* sparked an interest in the empirical methods Cullen taught. Finally, when it was realised that not even the mathematics of the great Isaac Newton could explain chemical reactions, then the way was open for the acceptance of Stahl’s ideas, many of which Cullen adopted.

Chapter 4 discusses a major problem for eighteenth-century chemists. While they could explain chemistry in natural philosophical terms, ironically, that philosophy was of no help when it came to actually doing chemistry. The experts on such chemistry were artisans who had learned their trade as apprentices. In the very class-conscious society of eighteenth- century Scotland, many educated men considered it beneath them to learn from workmen. The chapter shows how Cullen, who had acquired his expertise while working for a London apothecary, solved the problem by teaching students practical chemistry in a university. Because Cullen taught, not only chemistry as it related to *materia medica,* but also the chemistry which underpinned industry and agriculture, his courses were almost unique in Britain. Until Joseph Black took over Cullen’s lectureship in Glasgow in 1755, there was no-one else in the English speaking world whose courses covered such a range of chemical topics.

Chapter 5 explores Cullen’s medicine and his relationships with medical students. The chemistry in this chapter is based on his *Materia Medica* lectures. As he only gave one course, in 1761, there is no difficulty in dating it. Cullen, of course taught the subject piecemeal in all of his many clinical lectures but I have chosen to use the course because it sets out Cullen’s ideas on the topic systematically.[[35]](#footnote-35) *Materia medica* (now known as pharmacology)was the basis of all eighteenth-century medical practice. As Cullen’s classification of the various substances in his *materia medica* linked them to the diseases for which they were prescribed, the course not only gives insights into his pedagogical skills but also shows how his chemistry informed his medicine.[[36]](#footnote-36)

Chapter 6 discusses Cullen’s agricultural lectures. Agriculture chemistry was, at that time, a very new subject. At the beginning of the eighteenth century, there was a belief among certain members of the aristocracy that Scottish farming methods were inferior to those in England and needed to be upgraded. Cullen attempted to cater for this need by introducing the chemistry of agriculture into his university courses. This attempt to lecture on the chemistry of agriculture was a good example of how Cullen targeted his expertise at specific groups in his search for patronage. He did not lecture on the topic for long, almost certainly because the vast majority of his students had no interest in the topic. At the time, interest in improved farming methods in Scotland was confined for a small number of progressive land-owners. A more general interest in agricultural improvement did not develop until after Cullen had relinquished the Chair of Chemistry. As Cullen needed students’ patronage, he had to teach them what they wanted to learn. If the majority of students were not interested in a subject, then there was no point in him continuing to lecture on the topic.

In order to discover why the lectures failed to appeal to students, I will analyse them in detail. Even though Cullen had to remove this type of chemistry from his courses, agricultural chemistry ultimately helped his career prospects enormously because it gained him the patronage of powerful, influential men from outside the universities, most notably Lord Kames (1696-1782). In addition to being an advocate and writer, Kames was a land-owner who was interested in improved farming methods and unlike most students, he appreciated what Cullen was trying to do. Kames’ patronage proved vital for Cullen’s future career.

Chapter 7 expands the theme of the thesis and describes in detail how Cullen used his cultural capital in the form of his chemistry to target potential patrons from outside of the university. Using knowledge and expertise for personal advantage was a common tactic at the time. Another Scotsman, John Pringle, used his experiences of epidemic diseases in the army to become the personal physician of George III and President of the Royal Society.[[37]](#footnote-37) Cullen’s research into the chemical processes underlying Scottish industry earned him the recognition and the patronage of those who were actively involved in those industries. The men concerned were in a position to offer Cullen patronage because they were aristocrats and landowners and therefore were born with symbolic patronage. The most powerful of them was the Duke of Argyll. Chapter 7 describes how aristocratic patronage from the Duke ensured that Cullen was appointed to the Chair of Chemistry at Edinburgh Medical School.

To summarise, most studies of eighteenth-century academic physicians have concentrated on analysing their medical theories and how they were applied in practice. In this thesis I hope to show that this aspect of any eighteenth-century physician’s life was only part of the picture. No matter how knowledgeable a man was, he could not obtain a university appointment without the help of powerful patrons. With the exception of Roger Emerson’s work, the ubiquitous presence of patronage networks in universities has been neglected by historians. In my thesis I argue that Cullen’s chemistry was a means to an end and that end was to be recognised as an academic physician. I will show that it was not his medical knowledge (extensive as it undoubtedly was) which earned him his place in the academic world, but his use of chemistry to exploit the patronage system which permeated the whole of eighteenth-century society.

Today, Cullen is generally remembered as a physician and teacher of medicine and as a result, his knowledge and skill as a chemist have tended to be over-looked.[[38]](#footnote-38) Even though chemistry was primarily his way of obtaining an academic post that does not detract from his achievements as a self-taught chemist. Apart from a short time working for a London apothecary, Cullen learned his chemistry from the practice of pharmacology and from reading the works of other chemists. From these unlikely beginnings he managed to build up the knowledge and skill needed, not only to teach chemistry at university level, but to devise the classification system that became the foundation of eighteenth-century Scottish chemistry.

CHAPTER 1: HOW DOES BOURDIEU’S CONCEPT OF CAPITAL EXPLAIN EIGHTEENTH-CENTURY SCOTTISH UNIVERSITIES AND THE PATRONAGE SYSTEM?

This chapter aims to establish a framework for the rest of the thesis by discussing Bourdieu’s concept of capital and its relationship to patronage. I demonstrate how this idea can throw light on eighteenth-century Scottish universities and the patronage system which operated in Scottish society at that time. The *Oxford* *English* *Dictionary* defines patronage in two ways which are relevant to the present discussion. One definition is “the right or power to control appointments to public office or the right to privileges.” The second definition is “the action of a patron in using money or influence to advance the interests of a person, cause or art.” Patronage in one form or another has been recognised since the dawn of recorded history. The words *patronus* and *cliens* were originally coined in Ancient Rome, where patronage was an important means of controlling the masses.[[39]](#footnote-39) As it was such a ubiquitous phenomenon it is not surprising that it should be recognisable in eighteenth-century Scotland and its universities. [[40]](#footnote-40)

I start the chapter by showing that, although Bourdieu wrote his book, *Homo Academicus* with twentieth-century French universities in mind, his terms and concepts have a much wider historical relevance. Bourdieu’s ideas have a wider application, because universities since their foundation in medieval times, have a certain basic similarity. As a result, Bourdieu’s concepts can be used to describe eighteenth-century Scottish universities. Furthermore, those same concepts can be used to throw light on the society in which those universities function. In order to extend Bourdieu’s ideas to Scottish society, I classify the different types of eighteenth-century patronage and show how the concept of capital can be used to explain them, too. In the course of those discussions, I show how Cullen profited from the various types of patronage. The chapter finishes with a brief description of the problems the system created.

**Bourdieu and Capital**

At first sight there may seem to be no resemblance between Scottish Universities in the eighteenth century and France in the 1960s when Bourdieu’s book *Homo Academicus* was published. There are however, features common to most universities in the modern era which allows worthwhile comparisons to be made.[[41]](#footnote-41) While Bourdieu’s ideas have not been accepted completely by all sociologists, using Richard Jenkins’ principle that Bourdieu is “enormously good to think with,” I will demonstrate that Bourdieu’s concept of *capital* can be used to explain how eighteenth-century universities operated.[[42]](#footnote-42) The concept of *capital* is central to Bourdieu’s thought.[[43]](#footnote-43) He maintained that individuals gained power and authority by amassing capital in much the same way that people become millionaires by accumulating money. By adopting the term *capital,* Bourdieu hoped to “account for the structure and functioning of the social world (by) reintroducing capital in all its forms and not solely in the one form recognised by economic theory.”[[44]](#footnote-44) In his book *Homo Academicus,* Bourdieu used the concept to explore how power and authority were exercised in universities.

Capital takes various forms and includes not only power, but knowledge and expertise as well as social skills. Richard Jenkins divided Bourdieu’s capital into three different types: *social, cultural* and *symbolic.*  [[45]](#footnote-45) I am using Jenkins’ categorisation because Bourdieu did not define explicitly what he meant by the various types of capital in *Homo Academicus*. Furthermore, as Jenkins remarked, Bourdieu is “unnecessarily long winded, obscure, complex and intimidatory.” [[46]](#footnote-46) To add to the difficulties, Robert Moore notes that Bourdieu’s “extensive work is obviously open to multiple interpretations and he himself does change positions over time.”[[47]](#footnote-47) Because Jenkins stated that his aim in writing his book was to “translate Bourdieu into a language which is as clear and straightforward as possible” I have chosen to use Jenkins’ definitions.

Jenkins defined Bourdieu’s social capital as “a person’s valued relationships with others”.[[48]](#footnote-48) This factor enables academic patronage systems to operate. Someone who cannot form relationships with those in power would never progress up the academic ladder or indeed, make advances in any other social situation. The way social capital is used can vary with time and place. One example of an eighteenth-century method was the phenomenon of letters of introduction. They were usually from the man’s father or an influential friend and were addressed to any man with whom the writer was acquainted and who was likely to have influence in the university.[[49]](#footnote-49) This enabled the bearer of the letter to approach an individual who he was unlikely to encounter socially and who might be of assistance to him.[[50]](#footnote-50) Cullen, not only received such letters but offered them to his students who were leaving the Medical School.[[51]](#footnote-51)

Culturalcapitalis knowledge or expertise of some kind.[[52]](#footnote-52) This is the basic skill that any individual had to acquire before he was qualified to practise a profession or teach in a university. In Cullen’s case, it was his knowledge and expertise as a chemist which will be discussed in detail in the later chapters of this thesis. Bourdieu’s symboliccapitalwas prestige and official honours.[[53]](#footnote-53) In *Homo Academicus* this is described as academic capital.[[54]](#footnote-54) It depended on both the individual’s cultural and social capital and the distinction which came from possessing them.[[55]](#footnote-55) The accumulation of academic capital also presupposed that the person concerned has the necessary social skills to achieve success.[[56]](#footnote-56) In *Homo Academicus,* Bourdieu cited the publication of books, editorship of journals and honours such as the *Legion D’Honneur* as examples of this phenomenon. In eighteenth century one way of acquiring that type of capital was membership of one of the institutions described later in this chapter.

Bourdieu believed the acceptance of capital depended upon what he termed *habitus,* which is in turn, related to *doxa.* He defined *Habitus* as a “socially constructed system of cognitive, motivating structures.” [[57]](#footnote-57) They can give the impression to an uninvolved observer that individuals act according to rules dependent on antecedent conditions.[[58]](#footnote-58) Bourdieu however, argued that the people concerned perceived their own behaviour in a different way. They rationalised their actions on the basis of their underlying beliefs about the world. In all societies, there are individuals who are unaware of their *habitus.* They make assumptions about society which appear to themselves to be “self-evident and undisputed.” Bourdieu stated that in those cases *habitus* should be termed *doxa.[[59]](#footnote-59)*  Bourdieu also believed that when societies are functioning normally, the members of that society are unconscious of their assumptions. It is only when there is social upheaval that they question their attitudes.

In the mid to late eighteenth century, there seems to be little doubt that the basic ethos or *habitus* of many progressive Scots like Cullen, was a moderate, tolerant form of Calvinism. [[60]](#footnote-60) As Charles Camic put it, Calvinism in eighteenth-century Scotland was like belief in democracy in twentieth century America or economic *laissez-faire* in mid-nineteenth century England. [[61]](#footnote-61) In other words, this moderate form of religion was generally accepted by the middle and upper classes. All the evidence suggests that Cullen accepted the norms of his time and place, including the patronage system. He was neither anti-clerical nor a political radical. [[62]](#footnote-62)

Bourdieu maintained that the struggle to acquire the various forms of capital takes place in the *field.[[63]](#footnote-63)* In *Homo Academicus* Bourdieu stated that a university field was “the locus of a struggle to determine the conditions and criteria of legitimate hierarchy, that is, to determine which properties are pertinent, effective and liable to function as capital.” [[64]](#footnote-64) The examples he gave were the right to control entrance to universities through the examination system and the power to decide what university students were taught. This quest for domination produced two phenomena. One was the “struggle of each against all” and the other “by its own logic … the reproduction of the order.” [[65]](#footnote-65) In other words, in order to succeed, university teachers had to accept the opinions of their colleagues about academic standards, which implied that there had to be some sort of consensus as to what those standards were, and what should be taught in a university. The end results of the struggle depends upon one’s point of view. This situation can be interpreted to mean that either academic standards are maintained, or that they are resistant to reform.

An academic system tends to be self-perpetuating (the reproduction of the order) because it is to the advantage of both sides to maintain the *status quo*. No-one would profit by gaining an academic position if they were to find subsequently that the position was regarded as worthless. One of the factors which contributes to the perpetuation of the system is the sharing of the same *habitus* which, as result, it is not questioned. Bourdieu stated that the “real fee for acceptance to the group is what is known as team spirit”, which he went on to define as “the visceral form of recognition of everything that constitutes the existence of the group.”[[66]](#footnote-66)

Bourdieu argued that the system persisted in France because the professors from the dominant faculties chose the most academically gifted students to supervise for their dissertations. [[67]](#footnote-67) The students in turn tried to seek out the professor who, as supervisor, would be the most likely to enhance their career prospects. This was the “struggle of each against each other.” A heavy expenditure of time was required in order to undertake this struggle because the individual concerned had to supervise a large number of students. [[68]](#footnote-68) This certainly applied to Cullen. Thompson’s biography shows just how much time Cullen devoted to his students. Thompson quoted Doctor Aitken, an ex-pupil of Cullen’s, who stated that “he was cordially attentive to their interests: admitted them freely to his house; conversed with them on familiar terms; solved their doubts and difficulties; gave them the use of his library; and solved their doubts and treated them with the affection of a friend and the regard of a parent.”[[69]](#footnote-69)

**Patronage and Academic Capital**

Although Bourdieu did not use the term patronage, he discusses the topic under the heading of “accumulation of academic capital.” There, he gives a good description of how the patronage system worked in twentieth-century French universities. In *Homo Academicus* he is clearly referring to the phenomenon, even though he seems to disapprove of it. For example, when discussing an academic who speaks in favour of a colleague’s candidate at a selection panel, Bourdieu described how that person earns, not only the candidate’s gratitude, but the colleague’s too. According to Bourdieu, this “takes the form of a viciously circular mechanism of obligations which breed obligations” because both the colleague and his candidate then feel that they owe a favour to the academic concerned.[[70]](#footnote-70)

While Cullen would certainly have disagreed with the adjective “viciously”, he would have recognised the *scenario* being described. As we will see in Chapter 2, his successful career was based on utilising the principle of mutual obligation. Bourdieu pointed out the existence and continuance of the system depended upon the willingness of the participants to “play the competitive game” as he put it. [[71]](#footnote-71) All the evidence shows that Cullen was happy to do so, although there was an element of personal friendship in many of Cullen’s dealings with his colleagues, which seems to be absent from Bourdieu’s more cynical statement.

Bourdieu believed that some university faculties were more equal than others in academic life. *Homo Academicus* contains a chapter entitled “TheConflictoftheFaculties”in which he discusses the prestige attached to various university departments. He argued that Professors of Law and Medicine have a higher status than other professors. [[72]](#footnote-72) There is some evidence that such a “conflict of the faculties” existed in eighteenth-century Scotland although the combatants were different. Because Scottish universities had originally been set up to train clergy, unlike twentieth-century France, Divinity was the dominant faculty. While there was no overt censorship over the appointment of professors to chairs of what is now called science, no-one could ignore the Presbyterian ethos. [[73]](#footnote-73)

Often men of Bourdieu’s dominant faculties, namely Law and Medicine were helped by what he termed “professional heredity.” He explained that this term applied to those who came from upper class, academic families whose father was already an established academic. As a result of their father’s position, the children of such families acquired the knowledge and social skills needed to be successful early in life. Bourdieu also argued that because there were “great dynasties of jurists and doctors,” nepotism could not be the only explanation. [[74]](#footnote-74) There were numerous examples of such families in eighteenth-century Scotland, for example the Gregorys, Duncans and Monros. These families illustrate the importance of family connections in the search for academic patronage. How John Gregory both helped and hindered Cullen in his attempts to obtain a medical chair in Edinburgh will be discussed in Chapter 2.

Paradoxically, what Bourdieu termed professional heredity almost certainly survived during the early years of the Edinburgh Medical School because of the insistence by Lord Islay, 3rd Duke of Argyll that academics had to be well-qualified.[[75]](#footnote-75) The Town Council of Edinburgh were responsible for University appointments and it was generally accepted that Argyll effectively had the last word on any decision taken by them. As he valued his reputation as a good judge of academics, if the Town Council were to appoint someone who was incompetent, then it reflected badly on Argyll. Consequently, the first requirement of anyone seeking a university appointment was to have the necessary knowledge and skill. In other words, they needed cultural capital. If a man was appointed to a position in a university solely because of his family connections, it would bring the Medical School into disrepute.

**The Consecrated Heretic**

Bourdieu maintained that, although universities were run by elites, it was possible for an outsider to break into this relatively closed world. He stated that “Science and arts professors who have their origins in the lower or middle classes ... owe their entry into the upper classes entirely to their academic success.” [[76]](#footnote-76) In other words, they succeeded in academic roles without having been born into that social *milieu*. Because they owed their success to the institution which promoted them, they were very committed to the system. The individuals concerned were usually not members of well-established faculties. They formed a group which Bourdieu termed “consecrated heretics” who usually taught the newer disciplines. [[77]](#footnote-77) As a result they did not suffer from the same “social constraints” and had a degree of academic freedom denied to those teaching conventional courses like law or medicine. [[78]](#footnote-78) According to Bourdieu, consecrated heretics have little academic power but a considerable amount of academic prestige or symboliccapital.[[79]](#footnote-79) Their academic freedom meant that they were “free to choose their own lecture topics”. As a result, they can “explore new areas for the benefit of a small number of future specialists.”[[80]](#footnote-80)

Bourdieu’s concept of the consecrated heretic was a good description of Cullen. He was not one of the academic elite and he owed his position to the fact that he taught a subject, chemistry, which at that time was not mainstream. Because he was not constrained by the need to teach a set curriculum, he was able to teach what he felt was important. Until he began to lecture in Glasgow and Edinburgh, chemistry had been taught there as an adjunct to *materia medica*. Cullen pushed its boundaries to include what he described as “all of the Arts.” Cullen’s expansion of the topics included in his chemistry lectures made them of interest to all students with an interest in chemistry, even those who were not studying medicine. This, in turn, increased the numbers attending both Glasgow and Edinburgh Universities and Cullen gained social and cultural capital as a result.

Bourdieu argued that the usual way for new subjects to find their way into university curricula was through research. Although he gave the example of the introduction of the social sciences into French universities, Bourdieu could have been describing Cullen’s expansion of the chemistry courses of Glasgow and then Edinburgh Universities, when he wrote, “Research has at first, often been an escape route or a refuge for those excluded from traditional careers.” [[81]](#footnote-81) Cullen was forced to use the research route to obtain a university post because both his social position and his training initially excluded him from being appointed to one of the long-established chairs in a medical school.

Where eighteenth-century Scotland differed from twentieth-century France was that there were no organisations like the *Centre Nationale de la Recherche Scientifique* (*CNRS*). Bourdieu maintained that the *CNRS* gave both credit and credibility to French scientists who could not obtain university posts. Bourdieu included sociologists, like himself, among them. The organisation also pays its researchers. Cullen had to fund his own research and then use Institutional patronage from organisations like the Philosophical Society, which will be discussed later in the chapter, in order to advance his career. It was his membership of such societies that enabled Cullen to make his research available to the men who were striving to improve Scotland’s industrial base.

**The Control of Appointments to Eighteenth-Century Universities**

This section details the major difference between the universities of eighteenth-century Scotland and twentieth-century France. In eighteenth-century Scotland, the group who dominated what Bourdieu described as the “field,” were politicians. Roger Emerson estimated that between 1747 and 1761 Argyll controlled as many as three quarters of government posts in Scotland, including university appointments.[[82]](#footnote-82) Although he never held high political office in London, he was invaluable to English political figures like Prime Minister Robert Walpole (1676-1745) because effectively he ran Scotland for him by distributing appointments and pensions.[[83]](#footnote-83) At the time Cullen was trying to establish himself as a university teacher, the government relied on Argyll almost completely. If there was a vacant post, the merits of the various candidates were assessed by Argyll’s informants and the information was forwarded to Argyll’s cousin and agent, Andrew Fletcher, Lord Milton, (1692-1766).[[84]](#footnote-84) Milton, who was a lawyer and conversant with Scottish affairs, then compiled a short list and sent it to Argyll. Milton also worked closely with George Drummond, (1688-1766) an accountant, who was Provost of Edinburgh on several occasions and who controlled the town council of Edinburgh for many years.

Argyll’s principle opponents were the Whig faction, known as the Squadrone. They were out of favour with the government in London for many years and consequently they had none of Argyll’s influence. Their leaders included the Dukes of Montrose, who were chancellors of the University of Glasgow and distant relatives of Cullen. [[85]](#footnote-85) Argyll however, was such a powerful figure that after obtaining the chair of medicine in Glasgow, Cullen felt the need to seek his approval because he had been appointed through the Privy Council without applying to Argyll for his consent. [[86]](#footnote-86) The role played by Argyll and Walpole in the running of eighteenth-century universities might be seen as a form of oligarchy, if it were not for the fact, discussed later in the Chapter, that students were able, to some extent, to control what was taught in the universities.

Although Scottish universities in the eighteenth century often taught different subjects in different ways, the over-all functioning of universities since medieval times is so similar that Bourdieu’s concept of capital can be used to explain many of the features of the patronage practices used by all universities. The idea of clients gaining cultural capital and then using their social capital to attract patrons was the same in both eighteenth-century universities in Scotland and twentieth-century universities in France. Virtually the only difference between them was that in eighteenth-century Scotland, politicians had greater control over the appointment of professors.

Turning to the application of Bourdieu’s concept of capital to eighteenth-century Scottish society, in order to introduce some structure into a complex subject, I will divide patronage into four different types. They are aristocratic, familial, patronage among the middling sort, (which included students), and institutional patronage. They will be considered under separate sub-headings. It should be noted that in practice the various types of patronage were not entirely separate. For example aristocrats were just as anxious to obtain posts for their children as anyone else, so they used their family connections to secure jobs for their off-spring.

**Aristocratic****Patronage**

As the aristocracy were regarded as the highest social group, I will start with a discussion of aristocratic patronage. If a man was born into an aristocratic family, he would inherit symbolic capital in the same way he could inherit wealth. Aristocratic patrons were landowners and frequently related to each other. Their chief economic characteristic was that their income came from the rents and profits generated by their estates. Because estates passed to the eldest surviving son, the younger members of the family had to find other occupations. They were often to be found in senior military or legal positions. Once in a profession, the younger sons of aristocratic families exploited their symbolic capital to win promotion and honours.

In Scotland, the monarchy was the summit of the social pyramid. Just below the monarch were the senior politicians in Whitehall who held their offices because they were Royal favourites. Many books have been written on how British politics in the eighteenth century was controlled by the King, his ministers and the nobility.[[87]](#footnote-87) The system worked because those in power were able to dispense patronage by offering jobs and pensions to those they wished to influence. That behaviour was possible because the right to appoint men, to even lowly public office, was vested in the hands of only small numbers of people and such appointments were usually controlled by whatever political party was in power.[[88]](#footnote-88) This form of patronage was sought by ambitious men like Cullen because he needed the patronage of aristocrats who had influence in the universities.

After 1707, a Scottish aristocrat’s political interests meant he was based in London for much of the year but, in Scotland especially, the aristocracy had close links to their estates. [[89]](#footnote-89) This meant that their patronage often took the form of paternalism towards their tenants. [[90]](#footnote-90) During the late seventeenth and early eighteenth century, the attitude of the Scottish aristocracy towards their estates began to change. Where previously they had regarded their land holdings as sources of military power and authority, they began to see them as financial assets to be exploited.[[91]](#footnote-91) As a result of their interest in wealth creation, a “complex web of financial association” developed between the aristocracy and men with practical skills.[[92]](#footnote-92) Effectively, the aristocracy were being asked to finance what became known as the Industrial Revolution. To do so, they needed the skills of natural philosophers to assess the viability of the projects they were proposing to undertake. As will be described in Chapter 7, Cullen was able to exploit this situation to gain aristocratic patronage. [[93]](#footnote-93)

**Familial Patronage**

This was probably the commonest form patronage during the eighteenth century. It included not only the help members of the same family gave each other, but also assistance from their friends, together with their families. Although it was by definition social, because it was usually the way a man gained entry into a profession, it did lead to the acquisition of cultural capital. There was a definite hierarchy among patrons and their clients and very few men had access to the aristocracy, especially at the start of their careers. [[94]](#footnote-94) As a result, a man’s first experience of patronage was usually through his family and their connections and Cullen was no exception. The patronage Cullen received from various members of his family enabled him to acquire the cultural and symbolic capital he needed in order to make the acquaintance of aristocrats. For many men however, the patronage of family and friends was all they ever managed to achieve.

It was usually a man’s father who dictated his choice of career. [[95]](#footnote-95) Three of the medical dynasties, the Monros, Duncans and Gregorys, who dominated Edinburgh’s medical school have already been mentioned. While they were exceptionally successful, the pattern of a father determining his son’s future and then organising the appropriate apprenticeship and training was the norm for the “middling sort.” [[96]](#footnote-96) In doing so, a man would look for a suitable master to take on the training of his son. Research into apprentices has shown that recruits often came from relatives or associates of those already in the business. [[97]](#footnote-97) Jeremy Black in *Eighteenth-Century Britain* has argued that this situation was a consequence of the inheritance laws and the limited opportunities faced by most people.[[98]](#footnote-98) Once trained, it was up to the man concerned to establish his own circle of clients. How successful he became depended on how well he could manipulate the patronage system.

**Student Patronage**

One of the characteristics of eighteenth-century society was the development of what was termed the “middling sort.”[[99]](#footnote-99) This section of society can be classified as being below the level of the aristocracy socially, but above the level of the labouring classes. It included not only successful entrepreneurs but also members of the professions. Their main economic characteristic was that they had a standard of living which provided them and their families with a degree of domestic comfort. [[100]](#footnote-100) During the eighteenth century, not only did their numbers increase but their prosperity also. With the nascent industrial revolution and the general increase in disposable incomes they developed an appetite for luxury goods as well as the ability to pay the fees demanded by the various professionals. Their increasingly diverse ways of making money also presented the middling sort with more opportunities for upward social mobility which, along with their desire for knowledge, meant that they sought to provide their children with the best education they could afford.

To date, no-one has been able to define the precise characteristics, either socially or economically, of the middling sort.[[101]](#footnote-101) Because of this lack of a defining characteristic, I am going to concentrate my discussion on the group which most affected Cullen, namely, students. They were important to him because one feature which was common to the middling sort was that as adolescents, they had received formal training in the skills they needed to earn their livings. In the sixteenth and seventeenth centuries that training was through the apprenticeship system and was often arranged through familial patronage. [[102]](#footnote-102) This was the way Cullen started his career. As both urban and rural society changed during the eighteenth century, the way adolescents were trained began to change also.[[103]](#footnote-103) While the apprenticeship system did not disappear, it was increasingly combined with time spent studying at a university. Rosemary O’ Day, in her book, *The Professions in Early Modern England,* concluded that “by the eighteenth century, a period of apprenticeship for the practice of medicine, instead of forming a youth’s entire vocational training, became just a part of an educational and training package.”[[104]](#footnote-104) Cullen was one of the people who helped provide that package.

One important innovation in the teaching of medicine during the eighteenth century was the introduction of clinical teaching in the recently established voluntary hospitals and Cullen was one of its pioneers. [[105]](#footnote-105) For centuries, the middling sort (for want of a better term) had contributed to charities like orphanages, schools and alms houses and had served as magistrates as Cullen had done in Hamilton.[[106]](#footnote-106) During the eighteenth century, with the increasing urbanization of British society together with its lack of institutions to care for the sick poor, many began to see the establishment of hospitals as a necessity. Although they were motivated by the philosophy of Christian Humanism, which postulated that the powerful had a duty to help those less fortunate than themselves, from the beginnings of the movement, one of the arguments advanced in its favour was that collecting the sick together would provide excellent opportunities for teaching and research. [[107]](#footnote-107) Cullen was among the first to realise how important it was to supplement university lectures with teaching students about the diseases of individual patients. He was supported in this by the University authorities who, in 1785, insisted that candidates for an MD degree should have attended a course of clinical lectures at the Infirmary. [[108]](#footnote-108)

The increasing role of the university and its associated hospital in medical training meant that university students and apprentices were able to patronise both the Infirmary’s managers and the University’s lecturers. They were able to patronise the managers because in order to obtain access to the hospital, they had to pay for what was termed an “admission ticket.” By the 1780s, those fees constituted a considerable proportion of the Infirmary’s income. In 1785, the Hospital’s managers were becoming increasingly concerned about the disturbance to the routine care of the patients because of the “abuse and disorder” created by large numbers of students. Consequently, they sought to limit their access to the hospital.[[109]](#footnote-109) In response, large numbers of students, acting through the Royal Medical Society, got together and threatened to withdraw their support from the Infirmary.[[110]](#footnote-110) Eventually, what was described as a compromise was reached, but essentially what happened was that the managers of the Infirmary were forced to back down.

In addition to their contribution to the Infirmary, students were also able to patronise the University’s lecturers because, in eighteenth-century Edinburgh, what Bourdieu described as “the struggle of each against each other” had an impact not only on a professor’s reputation but also his income. The Town Council, who ran the University of Edinburgh, paid its Professors little or no salary, so professors were obliged to charge an attendance fee to the students who came to their lectures in the University or who attended their clinical lectures in the Infirmary.[[111]](#footnote-111) The students exercised their powers of patronage by their attendance (or otherwise) at the lectures on offer from the professoriate. In Glasgow, the situation was different because the university paid its lecturers and if the professors chose not to teach the students, the University’s Medical Faculty supported them.[[112]](#footnote-112)

This lack of a stipend in Edinburgh put the onus on the professor to attract an audience. If he could not do so, unless he had another source of income, he could not make a living. As a result, professors had to make sure that lectures were interesting and up-to-date. In other words, men like Cullen had to use their cultural capital to attract an audience for their lectures. This, in turn resulted in the University gaining symbolic capital for both itself and the lecturer. The Edinburgh Town Council, who were mostly wealthy merchants, were well aware that University’s reputation brought students into the city.[[113]](#footnote-113) If the students had been able to find a better education elsewhere, then the loss of revenue to the city might have been significant.

The system, when Cullen was a professor, seemed to justify itself. It was generally agreed that the standard of teaching in science and medicine at Edinburgh was a lot higher than that at both Oxford and Cambridge, where the professors were paid to lecture and often regarded their chairs as a sinecure. [[114]](#footnote-114) Although students had to prove they had attended certain courses if they were candidates for a degree, there was complete freedom for anyone to attend any course they could afford to pay for. Cullen had taken full advantage of this system when he extended his chemistry course to include topics of interest to “gentlemen connected with chemistry”. [[115]](#footnote-115)

While the students had more influence in Edinburgh than most universities, their power was limited and they knew it. When the Chair of the Practice of Medicine became vacant with the retirement of Doctor John Rutherford (1695-1779) in 1766, no fewer than 160 of them attempted to exercise their patronage by sending a letter to the City Council asking them to appoint Cullen to the post. One of the reasons they gave was the popularity of his chemistry courses. The students informed the Town Council that Cullen had “raised (chemistry) to the highest reputation” and that “there are now more students engaged in this collateral branch of Physic, than any other part of it, save Anatomy.”[[116]](#footnote-116) The tone they found it necessary to adopt however, was extremely deferential,

*The following address is presented with the sole view of promoting the good of the University and City of Edinburgh. When such is its intention there is no occasion to solicit from the guardians of both, a candid consideration of its contents, nor to entreat, that, what is meant only to declare the sentiments and wishes of those who are immediately interested in your determination of the point to be considered, should not be construed into a vain and ill-judged attempt to infringe your undoubted rights.* [[117]](#footnote-117)

While they were trying to exercise their patronage on Cullen’s behalf, they knew they could only express their wishes and hope City Council would respond favourably.

**Institutional****Patronage**

There were several important types of institutions in Scottish society during the eighteenth century and Cullen had links to most of them. Some institutions employed their members, others were essentially voluntary associations. Those institutions which provided employment were heavily dependent on their symbolic capital. This ensured that individuals would compete to join them. For the most part, they functioned by appointing men who had gained enough cultural capital to qualify them to fill the posts available. Examples include the Church, and Trading Societies like the East India Company and the South Sea Company. Any individual wishing to join such an institution also needed social capital for their application to be successful. Other institutions like the various learned clubs and societies, did not employ their members but those members needed both cultural and social capital in order to be asked to join by pre-existing members.

I will start with the Church which was closely linked to the universities. The Presbyterian Church was the most powerful institution in eighteenth-century Scotland and at the turn of the century it was one of the most democratic. Until they lost the power under the Patronage Act of 1712, the elders of each congregation had the right to choose their own ministers.[[118]](#footnote-118) Paradoxically, transferring rights of patronage from the church elders to the local landowners resulted in the appointment of a much more moderate body of clergymen. It was these men who dominated church organisations and, as a result, could ensure that like-minded individuals were appointed as ministers. Cullen had links to the Church through his friendships with various ministers. The Church also provided some degree of social mobility in a very stratified society. If a boy from a poor home was capable of getting a degree in divinity, joining the church gave him the potential to improve his status, provided he had the social capital needed to exploit the situation. [[119]](#footnote-119)

Domination of the education system by the clergy was another reason for the Church’s power. Many university professors were either clergymen themselves or closely related to clergymen. Cullen was no exception as his wife was the daughter of a Presbyterian clergyman. [[120]](#footnote-120)This resulted in what Richard Sher described as a “high degree of inbreeding and clannishness.” [[121]](#footnote-121) Those appointments were often under the control of the aristocracy and dominated by academic families. There was no doubt that the actions of these families made it very difficult for someone who did not have the requisite connections to obtain a university post. However, they did not have a complete monopoly, and once someone like Cullen had broken into the relatively closed world of the universities, he was able to use the patronage system to benefit his own family.[[122]](#footnote-122)

In addition to the official universities there were what could be described as academic institutions outside of the universities. They were termed “invisible colleges” by Robert Boyle. [[123]](#footnote-123) They exchanged ideas through the seventeenth and eighteenth-century culture of letter writing.[[124]](#footnote-124) Invisible Colleges were essentially, patronage networks and were a feature of early modern science. While there was often an element of friendship between the individuals involved e.g. the correspondence between William Cullen and William Hunter, they were another way that patronage operated. If a man was judged to be competent by a member of such a college, his letters (and the cultural capital they contained) would then be circulated to other members of the college. Although the most famous example of a correspondence network was the one established by Henry Oldenburg (1619-1677) at the Royal Society in London, there were many others, including a network based around Cullen.[[125]](#footnote-125) The letters that ex-students wrote to Cullen enabled them to get his opinion on their research, without their having to go to the trouble and expense of having it printed. [[126]](#footnote-126) Cullen benefited because such letters enabled him to keep in touch with other researchers. In his biography, Thompson quoted letters to Cullen from other natural philosophers like Du Hamel from the French Academy of Sciences.

There were also institutions which were independent of both Church and State and which played an important role in Scottish Society in the eighteenth century. Without some idea of how those institutions operated, it is impossible to appreciate one of the main features of intellectual life in eighteenth-century Scotland.[[127]](#footnote-127) The purpose of the “Learned Societies” was to enable their members to keep pace with the literary and scientific advances of their time.[[128]](#footnote-128) McElroy has argued convincingly that, in Scotland, the clubs reflected a general desire by the Scots for improvement.[[129]](#footnote-129) With the exception of the Royal Society in London, they seemed to have been formed there at an earlier date than in England.[[130]](#footnote-130) Cullen was a member of several of them – the Literary Society of Glasgow, Belles-Lettres Society of Edinburgh, the Select Society, and the Philosophical Society of Edinburgh.[[131]](#footnote-131) The Philosophical Society, of which Cullen became vice-president, was founded in 1737, from a pre-existing Medical Society.[[132]](#footnote-132) It went on to become the Royal Society in 1783. [[133]](#footnote-133)The societies were fashionable because they provided a “*milieu* for the intellectual activities of the local educated elite.” [[134]](#footnote-134) Although the membership of such societies was small, they were extremely influential. In the case of the Edinburgh Philosophical Society, the members were wealthy land owners, often with close family ties to the aristocracy, university professors, members of the Faculty of Advocates and prominent members of the medical community. [[135]](#footnote-135)

They were an important part of the patronage system because members had to be invited to join, which ensured they had symbolic capital before they were accepted. They also needed cultural capital in the form of expertise, as well as the social capital needed to gain *entrée* to such circles. As Albert Hume put it, the member’s “claims to the honour (of belonging to the society) were duly stated, they were duly investigated by men competent to judge, and he was duly elected.” [[136]](#footnote-136) In other words, without patrons it was impossible to become a member. A notable feature of such Scottish societies was the fact that most of the key players knew each other well. [[137]](#footnote-137)

The above institutions were relatively small, closed communities which in turn must have contributed to what has been termed the Scottish diaspora. Roger Emerson estimated that as many as 50% of Scottish doctors were forced to emigrate because they could not attract patronage at home.[[138]](#footnote-138) Many headed for England where there were “positions by the hundreds – in the royal household, the army, the navy, the diplomatic service and the colonies.” [[139]](#footnote-139) The large numbers of Scots who moved south of the Tweed tended to attract resentment from the established population. This resentment was expressed by figures like John Wilkes (1725-1797), the radical English journalist. He once remarked that “No Scot ever exerted himself but for a Scot.” [[140]](#footnote-140) While this is doubtless a gross exaggeration, there seems to be little doubt that once in exile, the Scots tended to stick together and help each other. They used the social capital which accrued to them as Scotsmen to help their fellow countrymen utilise their cultural capital.

Scots also found employment in one of the institutions of Britain’s recently acquired colonies.[[141]](#footnote-141) They had long been accustomed to selling their services as mercenary soldiers, so the idea of emigration was not new to them.[[142]](#footnote-142) The high incidence of disease in the colonies, together with the good standards of medical training in Scotland, gave physicians and surgeons plenty of opportunities for such gainful employment. [[143]](#footnote-143) Just as they did in England, they used their social capital with their fellow Scots to obtain positions in local institutions. The most famous (or possibly infamous) example was the East India Company.[[144]](#footnote-144) In Bengal, the richest province in India, 47% of senior government officials appointed between 1774 and 1785 were Scots. Even as early as 1731, John Drummond of Quarrel, who was employed by the East India Company, asked one of his relatives not to recommend any more surgeons to him. “All the East India Company’s ships have Scottish surgeons or surgeon’s mates and until some of them die, I can look for no more.” [[145]](#footnote-145) Cullen provided a good example of the way Scotsmen went out of their way to patronise their fellow Scots. He was employed as a ship’s surgeon by a relative, even though he had not completed his training.

**The Problems of the Patronage System**

Patronage, like all social systems, had a dark side. What follows is a short discussion of some of the problems associated with all four types of patronage. Members of the aristocracy, closely allied to the government, demonstrated the main disadvantage of the political patronage system. As one eighteenth-century writer put it, “You’ll find the greatest Superiorities have had the greatest Falls.”[[146]](#footnote-146) Furthermore, if a man’s patron fell from grace, he was likely to take his clients down with him. For example the fall of Robert Walpole in 1741 resulted in the Earl of Islay losing his position as the government’s patronage manager for Scotland for a few years. [[147]](#footnote-147) Although the aristocracy had more power than those further down the social scale, they sometimes played the game for higher stakes. Had the Duke of Argyll chosen the wrong side in the Jacobite Rebellion of 1745, it would have cost him his estates and possibly his life as well.

Although some patron/client relationships seemed to have included a measure of genuine friendship, especially between men of the same social background, this was not true of all such relationships. If one of the middling sort received patronage from a member of the aristocracy, that nobleman expected his wishes to be paramount. A good example was Argyll’s attitude to Cullen once he had obtained the Edinburgh Chair of Chemistry. The difficulties Argyll created for Cullen will be discussed in Chapter 2.

Another problem with the system was the possible reactions of those who believed that patronage had been used to deprive them of power, wealth or position. If that power was political, their resentment could give rise to rioting or even revolution. An in-depth-discussion of this aspect of the topic however, is well beyond the scope of this thesis. In a university setting, while the results could be unpleasant, as Cullen’s treatment by the followers of John Brown (1735-1788) showed, they were usually less violent. Brown and his disciples believed that Brown was being deprived of a medical chair because he disagreed with the teachings of Cullen and the rest of the Edinburgh medical establishment.[[148]](#footnote-148) Two hundred years later, Bourdieu argued that the revolt of French students against their academic institutions in 1968 was a protest against the French establishment and represented, “in an archetypical way”, all the forms of protest against cultural hierarchies.[[149]](#footnote-149) And Cullen and the Edinburgh professoriate were certainly part of the cultural hierarchy of eighteenth-century Scotland. Brown’s theories attracted students not only because they postulated a new and simpler concept of disease causation, but because those ideas were rejected by a cultural hierarchy which owed its position to patronage. [[150]](#footnote-150)

Sir James Mackintosh (1765-1832), was a medical student in Edinburgh in the 1780s. He eventually became a successful writer and political commentator and analysed the situation in this way,

*The Doctrine had great charms for the young; it allured the speculative by its simplicity and the indolent by its facility; it promised infallible success with little previous study. Both the generous and turbulent passions of youth were flattered by* ***an independence of established authority.*** *The pleasures of revolt were enhanced by their hatred of their masters as impostors, and even as tyrants with which all the power of Brown’s invective was employed to inspire them … [T]hey had opponents to detest, as well as a leader to admire, without which no sect or faction will much flourish. Add to all this that Brown led the way in Bacchanalian orgies as well as plausible theories.[[151]](#footnote-151)*

Brown’s conduct too, was different from the generally accepted norms of the group who were in power in the universities. They did not indulge in the “Bacchanalian orgies” which made Brown so attractive to his student followers. And, as Bourdieu pointed out, manners and behaviour could determine who was accepted and who was rejected as being unsuitable for university appointments. [[152]](#footnote-152)

From a twenty-first century perspective however, probably the greatest defect of the patronage system was a direct consequence of the fact that it was almost completely dependent on personal relationships. *Who* a man knew could be far more important than *what* he knew. Because the government operated through a patronage system, it was relatively easy for anyone with the right political connections to exploit the system for the benefit of his family, friends and their connections. As a result, men could be given posts for which they were completely unqualified.[[153]](#footnote-153) The army in particular was spectacularly corrupt. [[154]](#footnote-154) Edinburgh University seems to have escaped this fate until the end of the eighteenth century. Alexander Grant, writing in 1884, commented that the reason why Edinburgh University flourished during the eighteenth century was because Drummond and Argyll had the enlightened scheme of filling posts there with the ablest candidates. [[155]](#footnote-155) Argyll’s death in 1761 ended that policy. The men Argyll and Milton had appointed on merit, were eventually replaced by men whose appointments were more political in nature. [[156]](#footnote-156)

Patronage in the eighteenth century was a ubiquitous phenomenon. While it would be possible to write whole volumes on the way it operated, the above paragraphs provide a brief description of its nature. Without this, it would be impossible make sense of Cullen’s career. While patronage was ultimately responsible for Cullen being able to obtain a university appointment, it also resulted in him having many difficult years when he was struggling to find suitable patrons. To succeed, he needed not only social capital but also cultural capital in the form of knowledge and expertise. It was the latter form of capital which impressed his patrons. Even when a man became successful, that success was not without its tribulations. As the story of John Brown demonstrated, some of those did not manage to find patrons caused problems for those who did.

**Conclusion**

Ludmilla Jordanova has commented that, “if medicine is restricted to systematic theories and orthodox practice, too much is excluded.”[[157]](#footnote-157) This chapter has demonstrated the truth of that observation. It did so by investigating not only eighteenth-century universities,where the systematic theories and orthodox practice were taught, but also the society in which they operated. One thing that is usually missing from orthodox medical histories is the fact that, in the eighteenth century, even well qualified individuals like Cullen needed patronage to get a post in a university. Such appointments were completely out of reach for someone without some personal or family connection to the institution. While Cullen did appear to have a family connection to Glasgow University, his progress in the academic world was almost entirely due to his use of his cultural capital in the form of his chemical expertise to exploit the patronage system.

Bourdieu termed men like Cullen “consecrated heretics.” They managed to obtain a university appointment despite the fact they started their careers lacking the right patrons and, as a result, were heavily reliant on their cultural capital. The observations Bourdieu made on consecrated heretics are a good description of Cullen. Although Bourdieu was writing about French universities in the twentieth century, his research has much wider applications. Extending Bourdieu’s concept of capital to eighteenth-century Scottish society as a whole enables me to interpret the part played by patronage in the way that society functioned. Without aristocratic, student, institutional and familial patronage, Cullen’s career would have been very different. This thesis will show that without his ability to exploit the patronage system both inside and outside of a university setting, Cullen would never have been able to obtain the senior chair in what was then Europe’s leading medical school.

CHAPTER 2 HOW DID CULLEN ACQUIRE HIS CAPITAL? : AN ACCOUNT OF HIS LIFE.

**Introduction**

This chapter will use Bourdieu’s concept of capital to explore how Cullen acquired the various forms of patronage he needed to become a successful physician. The first half of the chapter shows how Cullen’s early years were difficult because he lacked what Bourdieu described as professional heredity. I demonstrate how those years were very important for Cullen, because it was during them that he acquired an interest in chemistry and earned the money to train as a physician. Yet that part of his life has never been fully investigated. Most historians begin their biographies of Cullen when he moved to Glasgow, even though by then Cullen had been practising medicine for over ten years.

By investigating Cullen’s family and his early life I demonstrate that Cullen was typical of the middling sort in that his first patrons were members of his family together with their relatives and friends. They provided him with paid employment and the means to study for the qualifications he required. In discussing them, I have included brief accounts of life in both eighteenth-century Scotland and the Caribbean, because without such information it would be impossible to appreciate why Cullen needed patronage. This enables me to highlight the problems he had and the predicaments that his patrons created for him.

The latter part of the chapter discusses how Cullen used his cultural capital. Once trained, Cullen exploited his family and social capital to establish himself in surgical practice in Hamilton, from where he moved to the University of Glasgow. How Cullen achieved this will be discussed in detail. I also discuss how, when Cullen was appointed Professor of Chemistry in Edinburgh’s Medical School, his promotion created financial problems for him. Those problems were due to the way the patronage system functioned. Once established in Edinburgh, it is clear that Cullen was not satisfied to remain a chemist. Not only did he teach medicine, he also went to considerable lengths to acquire the Chair of the Practice of Medicine. His difficulties in doing so illustrate the problems of anyone needing political patronage.

**Cullen’s Family Background**

Cullen came from a legal family so finding a medical patron may have been difficult for that reason alone. But the evidence given in the following paragraphs suggests that the circumstances connected to his father’s death added to his problems. Cullen’s family was a part of what Christopher Brooks termed “the Middling Sort.” [[158]](#footnote-158) The main characteristic of the middling sort (discussed in Chapter 1) was the fact that they had been educated and that their income was dependent, either directly or indirectly, upon their ability to attract fee-paying clients. While it was possible to be a member of the middling sort and relatively wealthy, Cullen’s parents seem to have been the sort of land-owning family described by Emma Rothschild as the “unprosperous professional classes of lowland Scotland”.[[159]](#footnote-159)

I will start with a discussion of the background of William Cullen’s parents. Cullen’s father was also called William Cullen but there is very little known about his side of the family. A document in the National Records of Scotland (NRS) refers to the Cullen family’s lands in Sauchies which was probably his birth place but his baptismal record has not survived.[[160]](#footnote-160) John Thompson gave Cullen’s father’s profession as either an advocate or a writer to the signet (a solicitor in modern terminology). However, his name does not appear on the 1890 list of Writers to the Signet which gives the names of writers to the signet from the fifteenth century.[[161]](#footnote-161) Thompson described Cullen senior as the factor for the Duke of Hamilton.[[162]](#footnote-162) Although writers to the Signet were generally from lower down the social scale than advocates, paradoxically they often had a better income, especially if they were factors for the estate of a great landowner, like the Duke of Hamilton.[[163]](#footnote-163)

The NRS contain a baptismal record from the parish of Hamilton for Cullen’s mother, Elizabeth Robertoun for December 25th 1688. It states that her father was John Robertoun and her mother Margaret Hume. [[164]](#footnote-164) Cullen’s mother came from a well-known and influential legal family. The Roberton family could trace their ancestry back for many centuries. In the eighteenth century they were a legal dynasty, descendants of James Roberton, 9th Laird of Earnock (1550-1664). He was an advocate, then a judge who became rector of Glasgow University on April 3rd 1646.[[165]](#footnote-165) The list of Writers to the Signet included James Roberton’s grandson, also named James, admitted in 1690 and William Roberton, admitted on 23rd December 1698.[[166]](#footnote-166) The latter entry contains the information that William Roberton was the youngest son of Archibald, eldest son of Laird of Enoch. This may be Elizabeth Roberton’s uncle or cousin. There is no doubt that William Cullen, physician, had an impressive legal pedigree, but there were no well-known medical practitioners in either the Cullen or Roberton families.

William Cullen himself was described by John Thompson as the second of a family of nine, although the NRS has baptismal records for only six children. There is a baptismal record for a William Cullen dated May 2nd 1710. It gives his mother’s name as Elizabeth Roberton and his father’s name as William Cullen and Thompson seems to have assumed it was *the* William Cullen. [[167]](#footnote-167) This assumption was disputed by Cullen’s daughter who claimed that her father was born on December 23rd 1713. [[168]](#footnote-168) The baptismal records show that Cullen definitely had at least one elder surviving brother, Charles, who was baptised on 18th November 1711, and four younger siblings born between 1718 and 1725. We also know that he had two sisters and another brother Robert, whose baptismal records have not survived. Judging from his mother’s obstetric record those siblings were probably born between 1714 and 1718.[[169]](#footnote-169) Cullen was born in Whistleberry, the home of the Roberton family.[[170]](#footnote-170) It is evident that Cullen spent at least part of his childhood there as he refers to his happy memories of Whistleberry in a letter to his brother Robert. [[171]](#footnote-171) John Thompson stated that Cullen’s father died “shortly after” the birth of his youngest child in 1725. The phrase “shortly after” is vague and could mean anything from a few weeks to a few years. There is no doubt however, that Cullen lost his father when he was in his early to mid-teens.

Thompson stated that after Cullen’s father died his family’s financial affairs were “found to be in an embarrassed state.” As a result of this, the Cullen family’s ancestral property, Saughs had to be sold to pay his debts along with a small farm near Shotts which was owned by Cullen’s father.[[172]](#footnote-172) Documents in the NRS make it clear that Cullen’s father died in debt and that it might be more accurate to describe his financial affairs as “embarrass*ing*” for his surviving family. There are two records showing that Cullen senior managed to borrow money by persuading two individuals to stand guarantor for him.[[173]](#footnote-173) In one of the documents, dated 1712, he was described as having “wrongously (sic) suspended” payment. There is also a letter written in 1718 by William Cullen senior to Mr Daniel Fyfe, a writer to the signet. In the letter, Cullen asked Fyfe for legal assistance because a decree had been taken out against himself and several others by the Laird of Raploch.[[174]](#footnote-174) The Laird had not told the men concerned what was in the decree but they all assumed it was a demand for payment.

Further doubts about Cullen’s father’s standards of integrity are suggested by a petition written to a judge by James Naismyth of Ravenscraig in 1710.[[175]](#footnote-175) The petition was an attempt to revoke a judgement appointing Cullen senior as factor for the Cleland estate. Cullen senior had apparently claimed a “sallary (sic) of two hundred marks.” Naismyth asked that someone “be authorised and appointed” to investigate his accounting with regard to his salary. There is no indication in the document of how James Naismyth came to be involved in the affair, but another document in the NRS confirms that William Cullen senior had been appointed factor for the estate in question. [[176]](#footnote-176) His appointment was supposed to ensure that Cleland’s creditors (who included widows and the hospital for the poor in Hamilton) were paid. [[177]](#footnote-177)

The revelations about Cullen’s father’s financial problems had two important repercussions for Cullen himself. First of all, it deprived him of the money he needed to finish his education. Second, it created problems when it came to attracting patrons. Although Cullen, thanks to his family’s connections, undoubtedly had an impressive legal pedigree, but in order to establish a medical practice he would need help from patrons connected to the medical profession, which could only have come from outside of his family. Almost certainly potential patrons would have been deterred by the revelations of his father’s financial affairs.

Even when he was established in HamiIton, there is some evidence to suggest that Cullen still had family problems to cope with. In a letter to Thompson, Cullen’s daughter hinted that her father had had more troubles there then she was prepared to disclose.[[178]](#footnote-178) It would be easy to dismiss the hint as a bit of exaggeration but there are other documents which support her claim. It may not be too far-fetched to postulate that his family’s problems gave Cullen another incentive to leave Hamilton. The trouble seems to have resulted from the fact that after Cullen’s father’s death his mother re-married.[[179]](#footnote-179) In his *Life,* Thompson named the man as “Mr Naismith, a writer to the signet”. A letter to Thompson added the information that his “mother’s imprudent second marriage reduced the family to such difficulties that notwithstanding his every exertion for them ... most of them were forced into very adverse situations.” The lack of any detailed information makes this the most tantalising document in Thompson’s papers. [[180]](#footnote-180) Why the marriage was imprudent is unclear from this evidence but two documents give some indication of a dysfunctional element in the Naismith family and of William Cullen’s involvement with his mother’s problems.

The first is the probate record of James Naismith.[[181]](#footnote-181) He was described as surgeon and post master in Hamilton. Probate was applied for by his brother, Arthur Naismith, writer, and William Cullen, surgeon, among others. They had applied for probate in order to recover money owed to them by James Naismith. Other creditors included the Duke of Hamilton and the Postmaster General, plus a large number of tradesmen, including an Edinburgh wine merchant. In Cullen’s case he was owed £20 sterling, the rent for a house he owned in Hamilton. In 1736 he had taken James Naismith to court in an attempt to recover the money. While we will probably never know the story behind the episode, it cannot have been a happy situation for Cullen. This would have been especially true because the very influential Duke of Hamilton was involved.

The second document is a letter to Cullen from William Smellie (1697-1763), who became famous as an obstetrician. Thompson mentions the letter in his *Life* but not the fact that there was a postscript to it.[[182]](#footnote-182) The letter itself is about a book that Smellie borrowed from Cullen but it is the postscript which is of interest. In it, Smellie mentions a dispute he was having with James Naismith over the Glasgow post bags. It appears that although Smellie had paid for whatever was in the bags, Naismith had kept the goods. Smellie had written to Mrs Naismith to ask for her help. The letter to Cullen continues, “Pleas(sic) ax(sic) Mrs Naismith about it for having had no ansure(sic) I am afrayd(sic) he hath kept the letter.” Smellie evidently did not feel the need to explain why he was so sure that James had kept the goods and the letter. Nor did he explain why he chose to write to Cullen’s mother rather than his step-father. Whatever the Cullen’s family problems were, they must surely explain the post-script to the letter and James Naismith’s probate record.

Thompson named Cullen’s stepfather as “Mr Naismith, a writer in Hamilton.” [[183]](#footnote-183) As James Naismith’s probate record gave his first name as Arthur it is possible, using documents held by NRS, to construct a family tree.[[184]](#footnote-184) Arthur Naismith’s parents, according to a marriage contract dated 1673, were Elizabeth Roberton and Arthur Naismith, son of James Naismith of Ravenscraig (the man who had complained about the excessive fees charged by William Cullen senior). Elizabeth Roberton’s father, John, was described as a merchant in Hamilton.[[185]](#footnote-185) Another document dated 1695 records the transfer of some of Arthur Naismith’s property to his second son, Arthur.[[186]](#footnote-186) Arthur Naismith (Cullen’s stepfather) seems to have been well respected in Hamilton because he was described as a bailie.[[187]](#footnote-187) He also owned property, including a share of the local brewery. [[188]](#footnote-188) As his mother was a Roberton it seems likely that he and Cullen’s mother were related. Both were born and lived in Hamilton so they must have known each other all their lives.

What the forgoing history of Cullen’s relatives shows is that he came from a legal family who could not have provided him with the medical patronage he needed to establish himself at the beginning of his career. His family history seems to have followed the normal pattern with Cullen’s eldest brother studying law at university before inheriting his father’s land. William junior, as was customary with younger sons, was being trained in a profession when his father died. After his father’s early death, Cullen had to cope, not only with that emotional trauma and its resulting poverty, but also with the revelations concerning Cullen senior’s financial affairs. By falling short of the ideals of “honesty and honest behaviour” promoted among the middling sort, Cullen’s father’s behaviour almost certainly reflected on his son. [[189]](#footnote-189) His mother’s ill-advised second marriage added to his troubles. Just how widely known the family’s problems were, it is now no longer possible to judge. But in a society where moral probity was important, any hint of a scandal would have deterred potential patrons.

**How Cullen started to earn his Cultural Capital: His Early Education**

In the eighteenth century, to be recognised as a physician a man had to have a medical degree. But other than that, there were no legally defined training requirements before an individual could claim to be a medical practitioner. Cullen was not unusual in starting his career as an apprentice and then gaining a degree. What follows is what is known of his early formal training, or how he began to acquire cultural capital.

Thompson does not give a reason for what, in retrospect, was the most important decision of Cullen’s life, namely to enter the medical profession. When Thompson was compiling material for Cullen’s life, an unidentified writer wrote to him to say that although Cullen had wanted to be a physician, his father could not afford to educate all his sons to university level. As a result, his elder brother was sent to university to study law.[[190]](#footnote-190) Cullen, as a younger sibling had an apprenticeship arranged for him. [[191]](#footnote-191) This situation was not unusual. Rosemary O’ Day in her book *The Professions in Early Modern England* gives several examples of fathers who sent their eldest sons to a universities while the younger ones had to settle for the less prestigious training associated with apprenticeship.

Judging by Thompson’s account of Cullen’s early education, it was conventional. From the local Grammar School in Hamilton, Cullen went to Glasgow University where there is no record of him having matriculated.[[192]](#footnote-192) Again, this was not unusual as the consensus was that boys were sent to University to get an education, not a degree. [[193]](#footnote-193) There is a record of him attending the mathematics course at Glasgow University in 1727.[[194]](#footnote-194) According to John Kerr, mathematics was normally studied in 2nd year, which puts Cullen’s university entrance at 1726. [[195]](#footnote-195) If Cullen was born in 1713, he would have been thirteen when he went to University, but that too, was common practice.[[196]](#footnote-196)

After attending Glasgow University, Cullen began a surgical apprenticeship with John Paisley in Glasgow. Paisley was well known and respected and had a large library which he was happy to make available to his apprentices. [[197]](#footnote-197) This was an ideal situation for any apprentice. Normally apprentices stayed with their first master for three years. [[198]](#footnote-198) In 1730, the year after Cullen left Glasgow, Paisley was appointed to teach anatomy in the University. If Cullen was in Glasgow University in 1727 and as Thompson states, in London in late 1729, then he almost certainly left Glasgow before he had served a three-year apprenticeship. [[199]](#footnote-199) This was probably the result of the family’s financial problems resulting from his father’s death. We do not know how much a prominent figure like Paisley would have charged for an apprenticeship, but there were complaints at the time that “the studies to qualify for a surgeon-apothecary are numerous and costly.” [[200]](#footnote-200) One pamphlet on the subject cited amounts of between £50 and £60, as the norm. [[201]](#footnote-201) This sum would have been far greater than anything an impoverished widow, with young children to support, could have afforded. It is reasonable to conclude that because of his late father’s debts, Cullen had been forced to abandon his apprenticeship and start earning to help support his family.[[202]](#footnote-202)

In conclusion, there was nothing unusual about Cullen’s early education and training until it was cut short by his father’s death. Even if his father had survived, his family’s relative poverty meant that he was deprived of the cultural and symbolic capital that came from having a degree and attending a European university. If he did not manage to finish his apprenticeship that would have increased his problems significantly because he would have been competing with large numbers of other surgeons who had completed their training. This, along with the revelations about his father’s financial affairs meant that it would have been almost impossible to find a patron to employ him in Scotland. He probably had little choice but to leave, which explains why he set off for London around 1729.

**Cullen’s Time in London and Voyage to the Spanish West Indies.**

By travelling to London to look for employment, Cullen was following in the footsteps of many of his compatriots. [[203]](#footnote-203) Once in London, young Scotsmen had to look for a patron who could introduce them to the contacts they needed to find work. This practice applied even to children of the well connected.[[204]](#footnote-204) Cullen’s first patron was – typically – a member of his family, William Cleland (1673/4-1741). [[205]](#footnote-205) Thompson implies that Cullen was lucky in being able to find a patron so easily. As well as being a relative of his mother’s, Cleland was a friend and associate of the poet, Alexander Pope (1688-1744).[[206]](#footnote-206) Cleland arranged for Cullen to sail with Captain Cleland of Auchinlee (another relative) as surgeon on his ship, which was bound for the Spanish West Indies. The Caribbean was another well-recognised destination for Scotsmen seeking fame and fortune.[[207]](#footnote-207) Cullen’s younger brother, Robert and his step-brother subsequently travelled there. However, because it took a year before the ship was ready to leave London, Cullen had to find alternative employment in order to support himself. [[208]](#footnote-208)

Although, at the time, this must have created problems for Cullen, in fact it was to play a vital role in his future career because the work he found was in an apothecary’s shop belonging to Mr Murray of Henrietta Street.[[209]](#footnote-209) Unlike Scotland, there was a much greater separation between the work of physicians, surgeons and apothecaries in London and the preparation of chemical remedies was a significant part of the work of the latter group.[[210]](#footnote-210) Working for Murray meant that Cullen was trained in this form of chemistry as well as the usual methods of manufacturing drugs from plant extracts. Cullen’s time in London provided him not only with an interest in chemistry, but also with at least some of the chemical expertise that he was later to exploit so successfully when he was trying to establish himself in a university.

In his *Life,* John Thompson stated that Cullen worked for Murray after his return from the Caribbean then returned to Scotland when his eldest brother, Charles, died. An investigation of the State Papers concerning Cullen’s voyage to the Spanish West Indies suggests that Thompson, who was writing long after the events, had confused two episodes. The ship on which Cullen was due to sail to the Spanish West Indies did not leave London until early in 1731.[[211]](#footnote-211) As Cullen arrived in London at the end of 1729, it appears that he worked for Murray in 1730 while waiting for the ship to sail and that he returned home to Scotland as soon as he heard the news about his brother.

The Guild Hall in London has records of many eighteenth-century apothecaries and their apprentices but there is no record of either Murray or Cullen in Henrietta Street. Wallis‘s book, *Eighteenth-Century Medics,* does contain a reference to two Murrays whose address is listed as Covent Garden.[[212]](#footnote-212) As Henrietta Street forms one of the boundaries of the Covent Garden Piazza, one of them is almost certainly the individual mentioned by Thompson. The slight discrepancy in the addresses can be explained by the determination of Thompson and Cullen’s surviving family to protect Cullen’s social capital in the form of his professional reputation. At the time of his death, Cullen was widely revered and respected as a physician; Covent Garden, on the other hand, was a notorious red light district.[[213]](#footnote-213) This highlights Cullen’s problem. His circumstances were such that he was forced to take whatever patronage and employment he could get.

Cullen probably left London for the Caribbean in January 1731 and worked there for six months. While there, he lived in Portobello, a town in the Spanish colony of Panama. [[214]](#footnote-214) Because of the shortage of qualified physicians in the Caribbean, it was possible for a practitioner to make a lot of money once he had established himself in practice in that part of the world.[[215]](#footnote-215) But, whatever hopes Cullen may have entertained, without patronage, he had no hope of establishing himself there. [[216]](#footnote-216) Charles Leslie noted that “physicians of any note generally had fine estates but the island (Jamaica) and the rest of the Caribbean was crowded with raw and inexperienced Youths”[[217]](#footnote-217) Such unqualified and inexperienced youngsters (and that description would have fitted Cullen in 1731) were forced to take the most menial work which was considered to be the care of slaves.

John Thompson, when referring to Cullen’s voyage to the Spanish West Indies, said that Cullen always spoke of it “with diffidence and distrust.” [[218]](#footnote-218)According to Thompson, that was because Cullen was aware of his inexperience at the time. However, it seems possible that his diffidence resulted from the fact that his voyage was linked to the slave trade. T.M. Devine has pointed out that while Scots like Adam Smith did much to help the cause of abolition, those who were actually involved in the trade usually did what they could to conceal the fact from their fellow Scots. [[219]](#footnote-219) Cullen’s later medical practice depended upon professional patronage from his patients. If they had known about Captain Cleland and his activities (described below), it may have had a detrimental effect on Cullen’s reputation. The circumstances are discussed in some detail because without the historical background, it would be impossible to appreciate Cullen’s difficulties.

When he sailed for Portobello in the Spanish West Indies Cullen’s employer, Captain Cleland, was an employee of the South Sea Company. The Company had been established to take advantage of what was known as the *Assiento* granted to Britain in 1717.[[220]](#footnote-220) The *Assiento* gave the Company the sole right to ship slaves, brought from Africa, to Panama. The English Factors operating the *Assiento* in Portobello arranged for slaves, brought via Jamaica, to be transported across Panama and then down the West Coast of South America to Peru and New Spain. This resulted in a massive increase in the price they would have fetched in the British West-Indies.[[221]](#footnote-221) Although the company is usually associated with the South Sea Bubble which burst in 1721, it survived until 1750.[[222]](#footnote-222) It would be possible to write an entire book on the various frauds perpetrated or condoned by the Company but suffice to say, it was notoriously corrupt and the Spanish were aware of the fact. [[223]](#footnote-223)

The Company was allowed to send out one ship every year in order to re-supply the residents of the *Assiento* ports, which included Portobello.[[224]](#footnote-224) Apart from these “annual ships”, the Spanish claimed the sole right to ship merchandise to and from their colonies to Europe, but could not enforce that monopoly because of the intense hostility and competition between the English and their own nationals in the area.[[225]](#footnote-225) Laws in the Caribbean were regularly flouted by ships’ captains and both British and Spanish colonial authorities. [[226]](#footnote-226) Eventually, the Spanish Government became so incensed that in 1726 they seized all the foreign ships in their West Indian ports, stopping trade completely.[[227]](#footnote-227) The action concentrated minds and the *Assiento* was re-negotiated. The Spanish agreed to a resumption of trade and the Treaty of Soissons was signed in 1729.[[228]](#footnote-228) The first ship to sail to Cartagena and Portobello after the Treaty was signed was Captain Cleland’s ship, the *Prince William*. [[229]](#footnote-229) Her departure was delayed because Spanish regulations stipulated that the ship be less than 650 tons and the Spaniards queried the size of the *Prince William.*[[230]](#footnote-230) Then, just as she was due to leave, she lost her main mast and was taken to Deptford Naval Dockyard for repairs.[[231]](#footnote-231) A letter in the Archives in Kew stated that the ship had arrived safely in Portobello on May 15th 1731. [[232]](#footnote-232) There is evidence that she did not sail directly to Cartagena and Portobello.

Among the numerous pamphlets complaining about the South Sea Company, one details illicit trading by Captain Cleland in the Caribbean and another, anonymous pamphlet, refers to the time Cullen was most likely to have been on board the *Prince William*.[[233]](#footnote-233) In the latter pamphlet are two *affidavits* relating what occurred on the voyage.[[234]](#footnote-234) Both stated that the ship first sailed to the Island of Saint Christopher in the British West Indies where they met with another of the South Sea Company ships, the *Saint Phillip.* Her captain was John Cleland, a relative of William Cleland and presumably Cullen as well. Once at Saint Christopher, the *Prince William’s* guns were transferred to the *Saint Phillip* to lighten the ship, which was then loaded up with trade goods ferried across from another vessel, the *James Galley.* They were intended for private sale by William Cleland. Both *affidavits* make it clear that, as a consequence of Cleland’s actions, the *Prince William* was not only dangerously overloaded but also undefended – and in an area plagued by pirates. What was described as “hush money” was distributed to the crew who were promised that if they kept quiet “they should all be taken care of.” [[235]](#footnote-235) The South Sea Company eventually took Captain Cleland to court, charging him with fraud. [[236]](#footnote-236)

These short episodes were to prove of vital importance to Cullen in the long term. His stay in London gave him an interest in, and some knowledge of, the chemistry which was to make his name. [[237]](#footnote-237) The patronage of the Cleland family provided him with employment when he was in dire need of it. This is of course, a retrospective judgement and it is unlikely that Cullen realised the significance of the events at the time. For him, a penniless and untrained surgeon, taking a job in an apothecary’s shop while waiting for a ship to sail probably was a matter of necessity and of no long-term significance. However, there is no doubt that being associated with the wrong patron could result in major difficulties for a man like Cullen and he eventually severed his links with the Cleland family.[[238]](#footnote-238) Whether this was because the South Sea Company charged Cleland with fraud or because it became unacceptable in Cullen’s social circle to be associated with the slave trade must remain a moot point.

**Cullen’s Return to Scotland**

Whenhe returned to Scotland Cullen was still reliant on his family’s patronage and Captain Cleland supported Cullen by employing him to look after his son. The boy was suffering from what Thompson described as “a lingering illness.”[[239]](#footnote-239) As the family lived in Auchinlee, near Hamilton, this enabled Cullen to start building up a medical practice near his home. After two years there, he had acquired the funds to return to full-time education. There is some uncertainty over the origin of the money. Thompson maintained that it was a small legacy. Cullen’s daughter, on the other hand, denied he had ever received a legacy and suggested that Thompson had confused this with the fact that Cullen had inherited property from his brother. [[240]](#footnote-240) The writer of another letter in the Thompson papers agreed with Cullen’s daughter. [[241]](#footnote-241)

However he acquired the money, it seems certain that between 1734 and 1736, Cullen lived with a dissident minister in Rothbury in Northumberland during the summer and attended medical classes in Edinburgh throughout the winter. [[242]](#footnote-242) Thompson did not say which classes Cullen attended at the Medical School in Edinburgh. They were likely to have covered a wide range of medical topics because, according to John Fothergill, the School was established by “several gentlemen who had studied under Boerhaave … qualifying themselves for the purpose of giving courses of public lectures on every branch of their profession.”[[243]](#footnote-243) By the time Cullen was a student there, the Medical School had been operating for ten years and was beginning to establish a good reputation for the teaching of medicine. Its prestige was enhanced when in 1735, some medical students, including Cullen, founded the Royal Medical Society in order to provide themselves with a forum where they could discuss their studies in depth.[[244]](#footnote-244)

The “private” study in Rothbury, Thompson described as “mainly general literature and philosophy.” It was needed because if Cullen was to build up a successful medical practice he needed to impress potential patrons with his knowledge of the humanities. The reason for this was stated in a pamphlet written by Thomas Withers (1750-1809).[[245]](#footnote-245) He argued that “as few gentlemen are judges of medical attainments, recourse therefore is often had to the more general topics of polite literature in order to convince the world of his (the physician’s) sense and ability.”[[246]](#footnote-246) In other words, if Cullen was going to impress upper-class patients, he needed not only a medical degree but an in-depth knowledge of the humanities as well. Withers recommended that all physicians should study History, Logic, Belles-Lettres, Natural History, Moral Philosophy, Latin and Greek as well as medicine.[[247]](#footnote-247) This would indicate to potential patrons that the physician concerned had a much better education than a surgeon trained through the apprenticeship system. John Gregory (1724-1773), Professor of the Practice of Medicine in Edinburgh, endorsed these sentiments when he stated that physicians should have a knowledge of the sciences which “applied to their own profession” as well as Latin, Greek, French and English composition.[[248]](#footnote-248)

According to John Thompson Cullen, settled in Hamilton in the spring of 1736. It was there that he began to consolidate his reputation as a practitioner of medicine.[[249]](#footnote-249) While there, he “was employed not only by the Duke and Duchess of Hamilton as their ordinary medical attendant but by almost all the families of any consideration in the neighbourhood.” Effectively, Thompson was telling his readers that Cullen’s search for patronage had been very successful and that even the aristocracy were endorsing Cullen’s cultural capital in the form of his medical expertise. This was not just an idle remark. In the eighteenth century, success in a medical career was judged by the individual’s closeness to members of the gentry, so when Thompson told his readers that Cullen had been accepted as the ordinary medical attendant of the Duke and Duchess of Hamilton, he knew that they would infer that Cullen’s practice was a very successful one.[[250]](#footnote-250) This does not mean that Cullen had been recognised as a physician. Being employed as a medical attendant was the usual practice for eighteenth-century surgeons.[[251]](#footnote-251) Adam Smith described them as “physicians to the poor in all cases and to the rich when the distress and danger is not too great.”[[252]](#footnote-252) It was during this time that he started his life-long friendship with William Hunter.[[253]](#footnote-253)

The type of practice that Cullen pursued has been investigated by N.D. Jewson who argues that it was dependent upon the patronage relationships which characterised the eighteenth century medical ethos. [[254]](#footnote-254) According to Jewson, for a practitioner to enhance his reputation and for his practice to be regarded as a success, he had to acquire upper class patients. And because “deference to superiors was part of the unquestioned fabric of social life,” an upper-class patient had considerable power over a physician, in that the patient could dictate to the physician the significance of his or her symptoms.” It is not necessary to accept Jewson’s theory that this relationship between doctor and patient held up the development of medical knowledge to believe that the picture he paints of eighteenth-century medical consultation with *upper*-*class* patients contains at least an element of truth. Jewson’s understanding of medical patronage is incomplete in that it assumed that only the upper classes could afford medical fees and it overlooks the sick poor in the voluntary hospitals.[[255]](#footnote-255) As Jewson pointed out, the ultimate success of any medical consultation (then as now) depended upon the patient’s personal assessment of the treatment he had received. Cullen, like other medical practitioners, needed both his cultural and his social capital to impress his patients. Cullen’s surviving consultation letters show the way he exhibited his cultural capital both in his medical knowledge and his social skills when handling his patients. In other words, Cullen treated them with deference and agreed with them whenever he could.

Although his ultimate ambition was to become a physician, Cullen applied to take the surgical examination of the Faculty of Physicians and Surgeons in Glasgow on March 1st 1737. [[256]](#footnote-256) Passing the examination would have qualified him to take on apprentices. There is no record of him ever taking the examination, but the record books for that period have been lost.[[257]](#footnote-257) The fact that William Hunter became his apprentice in Hamilton suggests that he passed the examination.[[258]](#footnote-258) There is no doubt that Cullen gained an MD in 1740 and was then recognised as a physician. [[259]](#footnote-259) His degree certificate still exists and records the fact that he already had an MA from Glasgow, although it did not record the date.[[260]](#footnote-260) As an MA degree was usually obtained before a medical qualification, it seems probable that he studied for his MA while living in Rothbury.[[261]](#footnote-261)

By 1742 Cullen had not only established himself in practice in Hamilton but had also acquired the skills and at least some of the knowledge needed to teach in a university. When the Professor of Anatomy, Dr Brisbane, died that year, according to Thompson Cullen was invited by his friends there to move to Glasgow.[[262]](#footnote-262) This would have enabled him to take over Brisbane’s extensive medical practice and start teaching in the university there.[[263]](#footnote-263) Had he succeeded in going there, it would have been an important advance in his career. Several letters to Thompson detailed how Cullen was on his way to Glasgow when the Duke of Hamilton caught up with him and promised him a generous salary and a chemical laboratory if he remained in Hamilton. [[264]](#footnote-264) This would have given him better facilities than were available in Glasgow. [[265]](#footnote-265)

Cullen went back to Hamilton where he stayed for a further two years. The laboratory never materialised and he was never paid for his services to the Duke.[[266]](#footnote-266) Worse still, the Duke monopolised his time and as a result he had to neglect the rest of his practice.[[267]](#footnote-267) This was another example of the difficulties aristocrats could make for those lower down the social scale. As the Duke was not only a powerful landowner but also had connections to Glasgow University, Cullen could not afford to slight him. Cullen’s daughter Margaret, quoting her parents, maintained that his association with the Duke was “one of the most unfortunate occurrences of my father’s life” because it “retarded his medical reputation and injured his worldly interests”[[268]](#footnote-268) When the Duke died in 1744, Cullen felt free of his ties to Hamilton and was able to move to Glasgow where he began to lecture on medicine and chemistry.

**Cullen’s Move to Glasgow**

As mentioned above, Cullen moved to Glasgow “because he had many connections and friends there.” [[269]](#footnote-269) In other words, he was relying on a network of patrons he had built up over the years. Where and how Cullen acquired this social capital, Thompson did not say. The following paragraphs are an attempt to supply the information missing from Thompson’s account. To do so, I discuss people named by Thompson and also letters sent to him when he was writing his biography of Cullen. Isupplement these sources with other, more modern, ones*.* It was an open secret when Cullen moved to Glasgow that he intended to establish himself as a lecturer, thus gaining symbolic capital.[[270]](#footnote-270)

Cullen’s earliest experience of Glasgow was the time he spent there as a pupil in the university in his early to mid-teens. One of Thompson’s correspondents said that when Cullen was attending the university, he lived with Mr Graham of Dougalston.[[271]](#footnote-271) The same family was mentioned by Cullen’s daughter, Margaret, in a letter she wrote to Thompson after he showed the family his first draft of his biography. In that early draft Thompson claimed that Cullen had benefitted from his relationship with the Duke of Hamilton.[[272]](#footnote-272) Margaret denied this and stated that her father had more help from his mother’s relations, the Robartons and the Grahams. [[273]](#footnote-273) Ronald Sunter in his book, *Patronage and Politics in Scotland, 1707-1832* quoted sources which showed that the Grahams of Dougalston were important political players in the Glasgow area in the eighteenth century.[[274]](#footnote-274) John Graham of Dougalston was chosen as the Rector of Glasgow University in 1740. [[275]](#footnote-275) The Dukes of Montrose were Grahams and not only the titular heads of the family, but also Chancellors of the same University.[[276]](#footnote-276)

Although successive Dukes of Montrose were Chancellors of the University of Glasgow from 1714 to 1874, as members of the Squadrone faction they did not have the extensive political powers of the Dukes of Argyll. Worse still, there was no love lost between the houses of Montrose and Argyll.[[277]](#footnote-277) The 2nd Duke of Montrose only managed to secure his appointment as Chancellor in 1743 because the Duke of Argyll was out of favour with Walpole and the government of the day. As a result, Argyll’s powers were limited and he could not prevent his rival from being elected to the post.[[278]](#footnote-278) This presented Cullen with a difficult situation to negotiate. If the two letters in the Thompson papers are correct, and there is no reason to doubt them, then Cullen’s family had a connection to the university which he was able to exploit. It seems likely that Cullen’s relatives, the Grahams supplied him with the patronage he needed to establish himself as a university lecturer. Without their help it is highly improbable that Cullen would have gained *entrée* into Glasgow University, no matter how much cultural capital he possessed. Yet the men who supplied him with the patronage he needed to establish himself in Glasgow were enemies of the Duke of Argyll, then the most powerful man in Scotland.

Thompson suggested that Cullen was asked to move to Glasgow to take over Brisbane’s medical practice by “several respectable families in Glasgow and its neighbourhood.”[[279]](#footnote-279) This was another reference to the way the patronage system worked. How Cullen was connected to the families we do not know, because Thompson did not name them. Brisbane’s practice seems to have been a lucrative one because the minutes of a meeting of the Faculty of Glasgow University, held on 9th June 1741, record that the Faculty had issued a bond to Doctor Brisbane for the money they had borrowed from him. [[280]](#footnote-280) Thompson did not say anything further about Thomas Brisbane but in fact he was the first professor of Anatomy in Glasgow, appointed in 1720.[[281]](#footnote-281) He seems to have possessed what Bourdieu termed “professional heredity” because his father, Matthew had been Rector there from 1679 to 1681.[[282]](#footnote-282) Brisbane had also agreed to teach botany. As a professor of Anatomy he was something of a liability because he found it physically impossible to dissect and refused to teach the subject.

Despite the pleas of the students that they were being deprived of their education, the Principal and the university faculty supported Brisbane. Eventually, after 1730, surgeons were employed to teach anatomy. The first of them was John Paisley. He was the master to whom Cullen had been apprenticed in the late 1720s and he taught anatomy at Glasgow University until his death in 1740. [[283]](#footnote-283) When Cullen began to lecture there some five or six years later, the teaching of anatomy had been taken over by John Crawford, who also taught chemistry.[[284]](#footnote-284) Originally Cullen and Crawford were to share the teaching of chemistry but Crawford’s illness and death meant that Cullen had to teach the whole chemistry course himself.

Another person mentioned by Thompson was Mr Thom (1710-1790) “who was at that time, tutor to the family of Mr Hamilton of Wishaw”.[[285]](#footnote-285) William Thom’s letter to Cullen makes it clear that he and Thom were old acquaintances and that Cullen had confided his intention of teaching at the university to him. It appears that, initially, Cullen had tried to keep his plans secret. Thom’s letter informed Cullen his intentions were no longer a secret as he (Thom) had heard them “talked of in several assemblies.” Thom went on to remark that the number of students applying to study anatomy at the university had increased, (presumably as a result of the teaching provided). Thom thought the situation in Glasgow was ideal for Cullen. His rationale appears to have been that if someone was prepared to teach students, then they would enrol at the university.

How Cullen became acquainted with Thom is unclear, but Thom obtained an MA from Glasgow in 1732 and was licenced as a clergyman by the Presbytery of Hamilton in 1738. [[286]](#footnote-286) Thom too, must have had connections, not only to Hamilton, but also to the University, because in 1746, the University of Glasgow, who held the patronage for the parish of Govan, appointed him minister there. [[287]](#footnote-287) Both Cullen and Thom evidently shared similar views of Glasgow University. Thom expressed his ideas in a pamphlet entitled, *Defects of a University Education and its unsuitableness for a Commercial People. [[288]](#footnote-288)* In it, he complained that the University of Glasgow was “founded and designed purely … for the sake of the theology which was in vogue three hundred years ago … (and) calculated for the disputes and wranglings of the divines and of little use to the lawyer or physician and still less to the merchant and gentleman.” [[289]](#footnote-289) It was this situation that Cullen hoped to remedy.

**The Situation in Glasgow University in the 1740s**

As discussed in Chapter 1, probably the most powerful organisation in eighteenth-century Scotland was the Presbyterian Church. It, like everyone else, operated though the patronage system and one of its sources of power was its connection to the universities. This was because Scottish universities had originally been established to train ministers for the Kirk. By the beginning of the eighteenth century however, the universities were having to accept that they needed to offer courses in subjects like medicine and natural philosophy. This was because the professional middle classes realised that the type of education currently on offer by the universities was of little or no use to their children. Middle-class children needed to be taught the more practical subjects which were relevant to commerce or the practice of a profession.

When Cullen eventually introduced the upgraded chemistry syllabus to Glasgow in 1745-46, the subject was already being offered at both English and Scottish dissenting academies. They too, were originally set up to train clergy, but by the early eighteenth century were teaching a wide range of practical subjects to anyone who could afford their fees. The subjects included advanced mathematics, book-keeping, and chemistry.[[290]](#footnote-290) Peter Jones has argued that because of that situation, the more enlightened university teachers realised that in order to compete with academies, they had to introduce these, more practical topics into universities. [[291]](#footnote-291) This presented an ideal opportunity for someone as able and energetic as Cullen who, as a consecrated heretic, was able to supply students with the cultural capital they needed.

One sign that things were changing in the University of Glasgow was the introduction of lectures in English between 1730 and 1750. Since their establishment in medieval times, university teachers had delivered their lectures in Latin. Teaching in the vernacular made lectures much easier to understand and they became comprehensible, even to those who had not had a good secondary education. As it became possible to acquire a university education in Scotland without an in-depth study of the Classics, students began to patronise her universities in larger numbers. The disadvantage of dropping Latin was that Scottish Universities became more parochial as they lost their close connection to their European counterparts, like Leiden.[[292]](#footnote-292) As Cullen was one of the first to lecture in English in Glasgow, he was must have been aware of the way teaching methods were changing and was set upon implementing those changes.

J.D. Mackie, in his *History* *of* *the* *University* *of* *Glasgow*, agreed with Thom that there were some problems with the University during the eighteenth century. Although Mackie does not discuss patronage *per se,* he was clearly aware of the institutional patronage exercised by the Presbyterian Church and the various ways in which the Church exercised control over the universities. One result of the situation noted by Mackie, was that Glasgow’s academic staff were recruited form “the ranks of a small society closely connected to the Church in Scotland.” [[293]](#footnote-293) Another indication of the Church’s power was the arrangements which were put in place in Glasgow University in 1727 when the system of regenting ended. When the new system was introduced it was decided that the Principle of the University had to be a member of the Presbytery and next in seniority was the Professor of Divinity. [[294]](#footnote-294) As the *habitus* of eighteenth-century Scotland was essentially Presbyterian, this is not entirely surprising and there appeared to be few who objected to the Church’s influence.

At first sight, the domination of the University by the Presbyterian Church might have been expected to lower academic standards by restricting the scope of the lecturers. In practice, the opposite situation occurred. Both Mackie and James Coutts argued that, thanks to men like Adam Smith and Francis Hutcheson, the University flourished during that time.[[295]](#footnote-295) Andrew Kent, while agreeing that the arts subjects were doing well in the early eighteenth century, pointed out that the “Faculty of Medicine was stagnant.”[[296]](#footnote-296) Although Cullen did much to improve the situation that stagnation was not completely overcome until Glasgow acquired its own teaching hospital in 1794.

Mackie also noted that because many professors were appointed for life, “there followed consequences which appear astonishing to observers today.” [[297]](#footnote-297) He made an acidic comment about how the Professoriate seemed to be more concerned about their salaries, their rights and their houses, (which were provided by the University). That situation however, provided Cullen with an opportunity to teach medicine because, according to Mackie, John Johnson, the Professor of Medicine, did not regard it as part of his duties to offer lectures to students.[[298]](#footnote-298) Glasgow’s Chair of Medicine had been established in 1712 as a result of a request from a Mr Benion who, having learned medicine elsewhere, applied for a medical degree from Glasgow. [[299]](#footnote-299) He obtained the degree only after assessors were appointed by the University to conduct an examination. When a second man made the same request, the need to appoint a Professor of Medicine was accepted and Johnson (who had acted as an assessor) was given the Chair in 1714. He seems to have seen his university duties as confined to conducting examinations. This created an opening for someone like Cullen who was willing and able to provide medical teaching. Nevertheless, Johnson took an active interest in the running of the university and was present at most of the Faculty meetings.[[300]](#footnote-300)

Another result of Mackie’s “astonishing consequences” was that Cullen was able to acquire the Chair of Medicine from Johnson. Thompson mentions that there was some form of negotiation between them but what he failed to say is that Cullen appears to have bought the position.[[301]](#footnote-301) In a letter, dated 1749 and addressed to the Faculty of Medicine, Johnson stated that Cullen “had proposed terms to him for his obtaining it as a gift from the Crown”.[[302]](#footnote-302) In the same letter he stated that “we find it can be bought.” The Public Record Office in Kew has a resignation letter from Johnson. It was dated November 10th 1749 and was addressed to the King and the Privy Council.[[303]](#footnote-303) The letter to the Privy Council does not mention any agreement with Cullen but in his letter to the Faculty in Glasgow he asks them to sanction his choice of a successor. One of the terms he was anxious for them to approve was that he could retain the university house reserved for the Professor of Medicine.

The above paragraphs have demonstrated, not only the Institutional Patronage exercised by the Presbyterian Church and how ubiquitous it was, but also how the members of the university staff could treat their posts as sinecures if they so wished. This was a situation that the Duke of Argyll was trying to change. Given Argyll’s power and his (Cullen’s) connections to the Graham family, Cullen felt that he had to obtain his approval for his obtaining the post of Professor of Medicine in the way that he did. Had he failed to do so the Duke could have seriously damaged Cullen’s career prospects. In a letter to Cullen dated 3rd August 1754, William Hunter reassured Cullen that the Duke, who was well informed about the situation in Glasgow University, had sanctioned Cullen’s purchase of a Professorial Chair. Writing to Cullen, Hunter stated that “the Duke expressed great regard for you … that he should always be against any body’s having leave to sell a professorship, but that in your particular case, that indulgence should be granted.”[[304]](#footnote-304) The way the letter is worded indicates just how powerful Argyll was and why Cullen was so anxious to avoid offending him.

When Cullen went to Glasgow he entered an institution that, although it was thriving in some ways, did not offer much in the way of medical teaching. Cullen had obtained his formal medical training in Edinburgh which had given him the experience of attending a University which actually taught its students. As a result, he saw Glasgow as an opportunity for someone with connections to the University who was willing to teach chemistry, medicine and its related disciplines. His acquisition of the Chair of Medicine also indicates the direction of Cullen’s ambitions. Had he been content to remain a chemist, he would not have gone to considerable lengths to obtain the Chair of Medicine.

**Cullen in Edinburgh**

Once established in Edinburgh, Cullen no longer needed the Family Patronage mentioned in Chapter 1. Instead he became much more dependent upon the patronage he received from students and professional colleagues as well as patronage from aristocrats. The relationship between Argyll and Cullen typified what an aristocrat expected from a client on whom he bestowed patronage. What follows is a short account of the problems Cullen experienced in Edinburgh because of the patronage system.

Cullen’s years in Glasgow demonstrated that he was not only a capable teacher of medicine but uniquely qualified to teach chemistry. There is no doubt that this latter facet of his cultural capital was responsible for his appointment to the Chair of Chemistry in Edinburgh Medical School. And there is equally little doubt that he was appointed because of the Aristocratic patronage of the Duke of Argyll. The details of how Cullen used his chemical expertise to get patronage from the Duke will be discussed in Chapter 7. Cullen’s appointment to the Chair of Chemistry in Edinburgh was an important step in his climb up the academic ladder but placed him in a difficult financial position.[[305]](#footnote-305) His medical practice was in and around Glasgow, and Glasgow University, unlike Edinburgh, paid its lecturers a salary. Moving to Edinburgh meant that Cullen lost not only his salary from the university, but also his income from his medical practice because he could not attend to his patients. Cullen tried to resolve these problems by working in both Glasgow and Edinburgh. When the Duke of Argyll discovered what Cullen was doing he was “exceedingly angry that Doctor Cullen had not resigned” from his Glasgow post because he had “told the Duke of Newcastle there was a vacancy”.[[306]](#footnote-306) This information was sent to Glasgow University in a letter written by William Ruart, Professor of Oriental Languages there. Ruart continued “we must not allow his Grace to be made a Lyer (sic)”.[[307]](#footnote-307) Cullen resigned his Glasgow chairs immediately.

Even when Cullen was well-established as Professor of Chemistry and Medicine in Edinburgh, he still needed the patronage of politicians. The Duke of Argyll died in 1761 and, in 1766, Cullen sought to be appointed Professor of the Practice of Physic when the incumbent, John Rutherford (1695-1779), decided to retire on health grounds. This was generally regarded as the senior chair in Edinburgh Medical School. Rutherford however, did not want Cullen as his successor and refused to resign if there was any possibility of Cullen getting the chair.[[308]](#footnote-308) The cause of his antipathy is not clear but Thompson’s, admittedly partial verdict, was that the “keen opposition” was due to “the dread of innovation and the fear of being excelled in professional reputation.”[[309]](#footnote-309)

Rutherford, after finishing his apprenticeship, had spent time studying with Boerhaave in Leiden and was responsible for introducing Boerhaave’s teachings to the Edinburgh Infirmary.[[310]](#footnote-310) Cullen, on the other hand, regarded Boerhaave as outdated and introduced his own system which argued that diseases were the results of disturbances of the nervous system and not related to humoral pathology.[[311]](#footnote-311) We know this caused controversy because in a lecture of 1783-84 Cullen told his students,

*I ventured to give my own opinion of the nature and cure of diseases, different in several ways from that of the Boerhaavians. In a public college, as I happened to be a Professor of Chemistry, I was called a Paracelsus, a Van Helmont, a whimsical innovator; and great pains were taken in private to disparage myself and my doctrines. This went so far, that my friend and patron, the late George Drummond … came to me, requesting seriously that I would avoid differing from Dr Boerhaave, as he found my conduct in that respect was likely to hurt myself and the University also.*[[312]](#footnote-312)

This would suggest that Rutherford’s dislike of Cullen was based on their differing views on medical science. It is an indication that whether an individual obtained patronage depended not only upon his colleagues, but also his natural philosophy.

Edinburgh Town Council were responsible for appointments to professorial chairs.[[313]](#footnote-313) They, in turn were controlled by a small number of men, who have been described by Roger Mason and Alexander Murdoch as “a self-perpetuating oligarchy of prominent merchants who were able to shuffle the various council offices among themselves.” This situation made it easy for one man to control the council by the distribution of political favours. Until his death in 1761, that man had been the Duke of Argyll, who managed the council through his agent, Lord Milton.

After Argyll’s death, his next-of-kin lost control of the Council. From 1767 to 1781, Edinburgh Council was heavily influenced by the fabulously wealthy army contractor, Sir Lawrence Dundas, (1712-1781). [[314]](#footnote-314) There had been intense enmity between Argyll and Dundas after Dundas had managed to get himself elected MP for Linlithgow in 1747. [[315]](#footnote-315) He had done so, according to the Duke, by paying “the greatest sum to purchase an election than was ever known in this country.” Worse still, he had sought election without consulting Argyll who was the government’s manager for Scotland. Argyll subsequently took Dundas to court, alleging that the seat had been obtained by bribery. Argyll won the case and Dundas lost his seat. Given the nature of the patronage system this meant Dundas would oppose the appointment of Argyll’s clients to any position they sought. As the Town Council had not wanted to appoint Cullen to the chair of Chemistry in the first place, they probably did not need much persuading to deny him the Chair of the Practice of Physic, even though Cullen was thought by his students and a group Thompson termed “Patrons of the University” to be the obvious choice. [[316]](#footnote-316)

Rutherford’s choice of a successor was Doctor John Gregory, who had been appointed as Professor of Medicine in Aberdeen but had not taken up the post. Gregory, who had studied in Leiden, was the son of the previous Professor of Medicine in Aberdeen and a cousin of the philosopher, Thomas Reid (1710-1796).[[317]](#footnote-317) Those connections gave him a large amount of social and symbolic capital. He was, by eighteenth-century standards, an ideal candidate for the chair, even though he had never actually given a lecture.[[318]](#footnote-318) In order to placate Rutherford, Gregory was asked to take the Edinburgh Chair with the caveat that once appointed, he would stand aside in favour of Cullen.

Gregory, it was alleged, had agreed to humour Rutherford and was appointed by the Edinburgh Town Council. He then failed to resign so that Cullen could take the Chair.[[319]](#footnote-319) Cullen was, according to Thompson, so disgusted that he contemplated refusing the Chair of the Theory of Physic when it was offered to him after the death of the holder, Professor Robert Whytt (1714-1766). Thompson maintained that he was persuaded to accept this less prestigious chair in order to vacate the Chair of Chemistry for his star pupil, Joseph Black. [[320]](#footnote-320) Gregory was eventually “induced to comply with those interested in the prosperity of the University” and Cullen was allowed to lecture on the practice of medicine every alternate academic year, until Gregory’s death. Cullen was then appointed Professor of the Practice of Physic.[[321]](#footnote-321)

Thompson’s account asks more questions than it answers because he made no attempt to explain why John Gregory, author of a book on medical ethics, would agree to trick Rutherford.[[322]](#footnote-322) A letter from Lord Kames to Cullen sympathising with his plight makes it clear that the town council favoured Gregory. Kames seems to have thought that it was wrong for Gregory to continue in his post. [[323]](#footnote-323) William Hunter also knew of the situation and wrote to Cullen from London telling him of his efforts to use his influence on his (Cullen’s) behalf. Unfortunately, most of the names he cited were given as initials so it is impossible to be sure to whom he was referring. He finished by commenting that “in this country, never expect anything from them (politicians). Their views are, and I’m afraid always will be directed by their political interests.” [[324]](#footnote-324) This was a clear acknowledgement of the way patronage operated. Politicians effectively used jobs and pensions to gain the support of those who had the right to vote. As Edinburgh Town Council had far more political influence than Cullen, then no politician had anything to gain by taking up his cause.

The situation changed when John Gregory died in 1773. It appears that one of “the Patrons of the University” referred to by Thompson, was Gilbert Laurie (1718-1787). He was a surgeon-apothecary, Burgess of Edinburgh, manager of the Royal Infirmary and at the time in question, Lord Provost of Edinburgh.[[325]](#footnote-325) On the day of Gregory’s sudden death on 9th February, Laurie wrote to the Master General of the Ordinance, George Townshend (1724-1807), a member of the Lord North’s government, telling him what had happened.[[326]](#footnote-326) Gregory had been Scotland’s Royal Physician and Laurie suggested that Cullen be appointed as his successor.[[327]](#footnote-327) A warrant from the Lord Privy Seal to that effect was issued on March 18th.[[328]](#footnote-328) The logic behind the manoeuvre appears to have been that once Cullen became Scotland’s senior physician, it would be impossible for the Town Council to deny him the senior chair in the medical school.

The connection between Cullen and Laurie is clear enough but how Laurie was able to influence Townshend is not. Townshend was an army officer who had fought at Culloden with the victorious Duke of Cumberland but later quarrelled with him.[[329]](#footnote-329) He was a member of Frederick, Lord North’s (1732-1792) cabinet of 1770-1782 and a friend of Lord Bute (1713-1792). As Lord Bute was a nephew of the Duke of Argyll, this seems to be the most likely link between them. The episode illustrates the complex nature of the patronage system. Laurie and Cullen must have known and presumably liked each other. As a result, Laurie used his social capital with Townshend to help Cullen. Whatever the relationship was, there is no doubt that patronage played a significant role in Cullen’s appointment.

The conclusion is inescapable. Not only did any man wanting a university career need to impress patrons, he also had to impress the right patron and if the patron was an aristocrat, he expected to be obeyed. If the patron lost control of a group of individuals like a town council, his clients would suffer. Although patronage was a vitally important part of obtaining any academic appointment, it seems to have been largely overlooked by historians who have written about Cullen and the eighteenth-century world of academic medicine.

**Conclusion**

Cullen’s daughter was adamant that her father had many difficult early years, struggling to make a success of his life.[[330]](#footnote-330) Although she was obviously determined to present her father as the late, great Doctor, I have shown there was truth in her claim. Although Thompson’s influential biography glosses over Cullen’s early career, as a weaver’s son himself, he must have had a great deal of insight into Cullen’s early struggles.[[331]](#footnote-331) Unfortunately, Thompson was influenced by the early nineteenth-century ethos which presented natural philosophers as disinterested seekers after truth. This meant that Cullen’s search for patronage is not spelt out. Thompson probably felt that it was unnecessary to spell out the details as his readers would be well-aware of the situation. Furthermore, he also attempted to play down the significance of anything that was not socially acceptable in Whig circles during the early nineteenth century, like Cullen’s association with the slave trade. As a result, he does not fill in the background to Cullen’s early years.

This chapter has also shown, that although Cullen eventually achieved his ambition to become a Professor of Medicine, he was forced to confront and overcome more handicaps than Thompson’s biography disclosed. Most professors of medicine at the time, even if their initial training had been through the apprenticeship system, had spent time, not only at a university, but also a prestigious foreign university like Leiden or Paris. This was something that Cullen would never achieve because of his family’s circumstances. With his educational background, effectively Cullen’s only chance of becoming a successful physician was to gain entrance to the university system as a consecrated heretic. There is no doubt that Cullen was a man driven by ambition to succeed. He was evidently highly intelligent and must have had a very attractive personality in order to secure the patronage needed to advance his career. Exactly what drove him we will never know for sure but his life illustrates how the patronage system could work both to the advantage and the disadvantage of those involved.

CHAPTER 3: WHO WERE CULLEN’S STUDENTS AND HOW DID HE USE NATURAL PHILOSOPHY TO JUSTIFY THE STUDY OF CHEMISTRY TO THEM?

A major problem for eighteenth-century academic chemistry was that the men with the expertise to actually *do* chemistry were artisans and the social attitudes of the time meant that it was deemed improper for the gentry to learn a skill from them. Things began to change as the philosophy of Francis Bacon re-emerged. He had introduced the idea that “useful arts” such as chemistry needed to be studied because they were capable of providing benefits for the whole of society. [[332]](#footnote-332) But that still did not mean gentlemen were prepared to learn a trade by becoming apprentices. As Jan Golinski put it, “the development of specialist skills, threatened the idea of gentility and politeness.” [[333]](#footnote-333)

One of Cullen’s major insights was to see that the answer to this problem was to teach the subject in the universities. Doing so meant that chemistry could be taught to the middle and upper classes in a setting which they believed to be socially acceptable. In order to ensure that chemistry was accepted as an academic subject, it was not enough to just teach a student how to conduct chemical experiments. Cullen had to demonstrate that it could be explained in terms of up-to-date natural philosophy. This meant that his lectures were, as J.R.R. Christie put it, “decidedly speculative in tone.” [[334]](#footnote-334) It was his speculative philosophy which made Cullen “a daring and innovative teacher.”[[335]](#footnote-335) By using his cultural capital to show how chemistry was based on natural philosophy Cullen took the subject “out of the hands of artists, metallurgists and pharmacists and made it, as a liberal science, the study of a Gentleman.”[[336]](#footnote-336) And it was gentlemen who could afford to patronise him by paying university fees.

Even at the start of his career, Cullen realised that by extending his courses to include topics that were not directly relevant to *materia medica* would make them more popular*.* The fact that he instituted the practice of teaching in English made his teaching much easier for the students to understand. [[337]](#footnote-337) The students’ appreciation of Cullen’s efforts to teach them chemistry was recorded in a letter, from Robert Wallace and addressed to Thompson, when he was compiling material for Cullen’s biography. It stated that when he was lecturing in Glasgow, Cullen’s chemistry lectures were a lot more popular than his lectures on *Materia Medica.*  Wallace suggested that the reason was because the lectures were “calculated not only for medical students but for the general students of the University and for Gentlemen in any business connected with Chemistry.”[[338]](#footnote-338)

In what follows I start by discussing who those students were and what they were hoping to gain by patronising Cullen’s chemistry courses. Then I give an account of Cullen’s natural philosophy and how he made it relevant to the more general form of chemistry he was teaching. My account of Cullen’s natural philosophy begins with a synopsis of Cullen’s history of the subject and continues by discussing the Baconian and Newtonian philosophies from which Cullen derived his own ideas. I conclude with a discussion of Cullen’s own philosophy of the structure of matter and show how, in addition to his Baconianism and Newtonianism, many of his ideas were based on concepts developed by Georg Stahl, (1659-1734). By using his cultural capital in this way, Cullen enhanced his own and the University’s reputation, increasing both his own and the university’s symbolic capital.

**The Students who Attended Cullen’s Chemistry Courses**

This need for a comprehensive course in chemistry in the United Kingdom was flagged up by William Lewis (1708-1781). Lewis was an English physician and experimental chemist, a FRS who had published several well-regarded books on chemistry and *materia medica.[[339]](#footnote-339)* He was one of the few chemists Cullen recommended to his students.[[340]](#footnote-340) Lewis also pointed out that even if students were prepared to learn from workmen, such chemistry had its own problems. He wrote

*[t]he discoveries and improvements made in one art and even its common processes are generally little known to those employed in another, so that the workman can seldom avail himself of the advantages which he might receive from the correlative arts and an effect wanting to perfection in his own art may be actually produced in another.* [[341]](#footnote-341)

One reason why Cullen’s courses were so successful was that he made great strides in overcoming the problems which Lewis had highlighted.

Cullen stated

*Chemistry is an art that has furnished the world with a great number of useful facts … but these facts lie scattered in many different books, involved in obscure terms mixed with many falsehoods and joined to a great deal of false philosophy …. Since it has been taught in universities, the difficulties of this study should have been in some measure removed … and a system of it attempted – the scattered facts collected and arranged in proper order. [[342]](#footnote-342)*

Cullen collected the “scattered facts” discovered by artisans, stripped them of what he described as their “false philosophy” and organised them into a system. By organising facts into a single unified system Cullen ensured that information about chemical compounds was easy to find when the student needed it. If students had been obliged to research such things for themselves it would have taken them years to acquire Cullen’s level of knowledge. Until Joseph Black (1728-1799) took over Cullen’s course in Glasgow, he was the only person in the United Kingdom who offered such a course.

Chemistry had been introduced into European medical schools in order to teach students how to make drugs. [[343]](#footnote-343) Before that, courses in chemistry had been given by apothecaries in towns with medical schools. They offered extra-mural classes on drug manufacture. Even when chemistry got onto university syllabi, until Boerhaave introduced philosophical chemistry, what was taught was basically practical pharmacology. This was true of Andrew Plummer’s chemistry course in the University of Edinburgh until Cullen took over the chair.[[344]](#footnote-344) The subject was also important to medical students because it helped them to understand how the human body worked. One of Cullen’s students, James Lind was to write later in the century,

*Chemistry is a necessary part of a medical education as without a knowledge of it we must ever be ignorant of the various chemical Processes that are constantly going on in the Animal Oeconony upon whom depends health or disease and from a true knowledge of which we are greatly instructed how to preserve the first and cure the latter also.* [[345]](#footnote-345)

Some writers went so far as to claim that a chemistry course was of more value to a student then a course in *materia medica.* [[346]](#footnote-346)

While Cullen did widen the chemical curriculum considerably, in Edinburgh he was employed by the Medical School, so his primary commitment was to medical students. [[347]](#footnote-347) This meant that much of Cullen’s teaching was orientated towards what they needed to know, which was how to manufacture drugs. It was also Cullen’s main area of expertise. As an ex-provincial surgeon and a practising physician he was constantly using this form of chemistry. Because of his vast practical experience of pharmacology, any student who patronised Cullen’s course was bound to increase his cultural capital by learning the theory of drug production.

The lists of the students who attended Cullen’s courses in Edinburgh still exists and in the majority of cases Cullen noted where the man normally lived. Using those lists and the records of men who went on to obtain Edinburgh degrees it is possible, in many instances, to make an educated guess about why certain groups of students chose to attend Edinburgh University and what they might hope to gain by patronising Cullen. [[348]](#footnote-348) (See Appendix 2 for an alphabetical list of students and their countries of origin). It is interesting to note that in every year-group there were crosses next to several of the names on the list. Those names included Cullen’s son, James and John Brown. As John Brown’s professors allowed him to attend their classes free of charge and as Cullen would not expect payment from his own son, the marks appear to indicate that he was offering free tuition to several students every year. [[349]](#footnote-349) How Cullen decided to admit a man without payment is not known, but it provides another example of social patronage. The students concerned were almost certainly recommended to Cullen by his acquaintances. As Edmund Burke remarked, “Patronage … is the tribute which opulence owes to genius.”[[350]](#footnote-350)

Cullen often noted if a man had attended his courses more than once. If they had done so, he invited the student concerned to his house for extra tuition. Given the number of pupils who did his chemistry course at least twice, this must have involved a lot of extra teaching. During those classes, he was, wrote Samuel Bard, “like Socrates … surrounded by his admiring pupils.”[[351]](#footnote-351) After the lecture, time was spent in a relaxed discussion of the topic. His hospitality was legendary. Alexander Coventry described him as “having the liberality of a prince and was never so happy as when entertaining his friends or befriending young men.”[[352]](#footnote-352) If Bard’s and Coventry’s assessments of the situation are correct then Cullen’s search for student patronage must have been very rewarding for him personally and was not simply an attempt to acquire economic capital. He seems to have thoroughly enjoyed teaching.

The lists show that the majority of students came from Scotland, which was to be expected. Of the 302 individuals identified as being Scottish, only 5% of them went on to take degrees. This suggests that many of them were surgical apprentices who attended university for a limited time and had no intention of taking a degree.[[353]](#footnote-353) In other words, they were attending Cullen’s course as part of the “training and education package” described by Rosemary O’ Day. In his obituary on Cullen, James Anderson noted that students would have needed to attend Cullen’s course twice in order to hear him discuss all aspects of chemistry. [[354]](#footnote-354) (See Introduction) Approximately 21% of Cullen’s Scottish students did so and 7% of them went on to do the course three times or more. Attending the course multiple times was a more frequent occurrence among Scottish students than those from England, Ireland or the colonies. (There were no students from Wales.) One possible reason for Scottish students to show such an interest in chemistry was that, unlike the rest of Britain, there was no major distinction in Scotland between the professions of apothecary and surgeon and surgeons compounded their own medicines*.[[355]](#footnote-355)* As a result, surgical apprentices had a greater interest in the topic*.*

The second most numerous group were the 144 students from all parts of England. Almost 10% of them obtained an Edinburgh degree but only 17 (12%) of them repeated Cullen’s chemistry course. Because Edinburgh is closer to the North of England than Oxford or Cambridge, it is likely that some of the men from the Northern counties of England attended medical school in Edinburgh because it was more convenient for them. But proximity to the University could not explain the presence of all of them because there were also large numbers of men from the South of England. This suggests that they had other reasons to go to Edinburgh and those reasons are not hard to find.

During the eighteenth century, the standard of teaching at the two English universities, Oxford and Cambridge was at an all-time low. Edward Gibbon, who was admitted to Magdalen College Oxford in 1752, commented that the Oxbridge professors had “from the toil of thinking or writing … completely absolved their consciences.” [[356]](#footnote-356) It appears that the cultural capital, in the form of chemical expertise, which students acquired in Edinburgh was far greater than anything available to them in England. This supposition is supported by the lists of men attending Cullen’s courses which include the names of men who had already studied at Oxford and Cambridge. Presumably if it had been possible to acquire such chemical expertise there, they would have had no reason to undertake the long journey to Edinburgh.

The second reason for some Englishmen to go to a Scottish university was that they were religious dissenters and the Test and Corporation Acts did not apply in Scotland. These acts were introduced in 1661 and 1673 and required university students to subscribe to the thirty-nine articles of the Anglican Church. This reduced religious dissenters to the status of second class citizens as they could neither obtain a university education in England nor “discharge the meanest of duties in society.” [[357]](#footnote-357) It is obvious that the decision to patronise Cullen was, for religious dissenters, a matter of necessity if they wanted a university education without having to travel to Europe.

The third largest group were the 103 Irish, of whom eight went on to obtain Edinburgh degrees but only five of them did the chemistry course twice. It seems likely that many of them came to Scotland because they suffered the same problems as English dissenters when it came to accessing university education. Ireland’s only university was Trinity College in Dublin and it was dominated by the Church of Ireland (the Irish branch of the Anglican Church) which also enjoyed “an automatic monopoly.” [[358]](#footnote-358) Trinity had established a medical school in 1715, when Thomas Molyneux (1661-1733), President of the Royal College of Physicians of Dublin was appointed Professor of Medicine. Anyone wishing to be educated at Trinity however, had to subscribe to the doctrines of the Anglican Church. This excluded Presbyterians who were the largest religious group in Ulster and who were, for the most part, descendants of Scots migrants.[[359]](#footnote-359) Traditionally, Presbyterian clergy had been trained at Glasgow University and the most likely explanation for the relatively large number of Irish attending Cullen’s classes was that they too were religious dissenters from Ulster, attracted to Edinburgh by its reputation for good medical training.[[360]](#footnote-360)

In addition to the students from the British Isles there were 28 students from the Caribbean and 42 from what was later to become the USA. Before 1765, when America’s first Medical School was opened in Philadelphia, American students had no choice but to cross the Atlantic to patronise one of the European universities if they wanted a degree in medicine.[[361]](#footnote-361) Three of the four founding fathers of Philadelphia’s Medical School attended Cullen’s chemistry courses. They were William Shippen (1736-1808), in 1760, John Morgan (1735-1789), in 1761 and later Adam Kuhn (1741-1817), who studied chemistry with Cullen in 1765. Although the fourth and most famous member of this group was Benjamin Rush (1745-1813), he was younger than the other three and by the time he arrived in Edinburgh, Cullen was no longer teaching chemistry. The students from the colonies seem to have had more interest in gaining a medical degree than men from the British Isles. Of the men from the USA, 21% obtained Edinburgh degrees and the figure for men from the Caribbean was 14%. On the other hand, they seemed to be less interested in chemistry. None of the Caribbean students did the chemistry course more than once, although six students of the USA did do the course twice.

During the eighteenth century chemistry was becoming of interest to men who did not intend to practise medicine. [[362]](#footnote-362) Johnson, in his *Guide for Gentlemen Studying Medicine at the University of Edinburgh,* claimed that “Chemistry is a highly ornamental accomplishment and ought to be studied by every Gentleman.”[[363]](#footnote-363) As Professor of Chemistry in a famous medical school, Cullen was virtually guaranteed an audience among future practitioners of medicine. By extending his lectures to include all aspects of chemistry, he seems to have been going to some lengths to obtain patronage from men who were not interested in becoming medical practitioners. It was this section of society which, although interested in chemistry,found it difficult to find suitable tuition because of their social position. By linking his chemical capital to natural philosophy Cullen provided the subject with an academic grounding which distinguished it from the type of chemistry that artisans practised.

It is no longer possible, by studying the lists of students who attended Cullen’s courses, to differentiate completely between medical students and the men who attended Cullen’s courses because of an interest in the subject *per se.* There are however, some clues. Of the 107 men whose place of residence Cullen did not record, none of them obtained a medical degree from Edinburgh University. *[[364]](#footnote-364)* This group contains all the men with the title *Esquire* andalmost a quarter of them (24%), did the course more than once. It seems reasonable to surmise that at least some of this group were more interested in chemistry than medicine.

The Oxford English Dictionary describes the title esquire as indicative of “a landed proprietor” so it seems likely that some of Cullen’s students were landed gentry. As a result, they were in a position to employ others, who could not only assist them with their own chemical projects, but also help them improve their estates.[[365]](#footnote-365) This, in turn, created an opening for men who had an interest in chemistry but did not have the sort of independent means which would have allowed them to become full-time chemists. A good example of the latter type of practitioner was John Walker (1731-1803). Although he started his career as a Minister of the Presbyterian Church, he later became Professor of Natural History at Edinburgh University. Cullen’s influence on Walker was profound and Walker went on to do work for the Earl of Hopetoun and undertook an official fact finding mission to the Highland and Hebrides in 1764.[[366]](#footnote-366) To obtain such employment, a man had to impress potential patrons with his knowledge and skill and Cullen’s courses provided them with the necessary cultural capital.

**History of Chemistry**

In his notes on how he was to structure his chemistry lectures, Cullen wrote that he would begin his courses with the history of the subject. [[367]](#footnote-367) By starting his lectures this way, Cullen was following a well-recognised practice. [[368]](#footnote-368) What made Cullen’s history so different from his peers was that he used the history of the topic to put forward his own views on the nature of chemistry and how it should be practised. He argued that the history of Chemistry “shows us by what means the Art has been brought to its present state of perfection.” [[369]](#footnote-369) As he believed that state of perfection was brought about the introduction of natural philosophy, his introduction of natural philosophy into his own lectures was a clear signal to the students that what they were about to hear was an account of that “state of perfection.” This novel feature of Cullen’s thought can be demonstrated by comparing his history to that of his contemporaries. They argued that chemistry had been a science since Egyptian times.[[370]](#footnote-370) Cullen justified his position by explaining that although “Chemical progresses have been made … it will appear from further examination that it was not reduced to a distinct science until many ages.” The difference between ancient chemistry and his up-to-date version was that, although many ancient theories of matter agreed with their modern counterparts, “these were only bold assertions.” [[371]](#footnote-371)

What distinguished the chemical discoveries of modern natural philosophers like Francis Bacon (1561-1626) and Robert Boyle (1627-1691) from their predecessors was they “followed a different and a better method.”[[372]](#footnote-372) They began with experiments and “from that Basis formed a just and firm theory.” [[373]](#footnote-373) This was in contrast to the ancient chemists who made their discoveries by a process of trial and error. Cullen claimed that the success of the modern method was “apparent from the great progress which chemistry has lately made.”[[374]](#footnote-374) This meant that the chemistry he was teaching was very different from the chemistry artisans practised and that the cultural capital of chemistry he was about to give them was the most advanced science on offer and very different from the chemistry taught by his predecessors.

Cullen had no doubts that the ancient Greeks and Egyptians, Galen and the Arabs had a vast store of practical knowledge. But he believed that there had been no real advances in the subject until the thirteenth century, when alchemy had developed. [[375]](#footnote-375) To what he described as the “tribe of Alchemists” he attributed a rapid increase of chemical know-how. By experimenting on how to change base metals into gold, “although they missed their point … yet they hit upon a number of Discoveries in chymistry.”[[376]](#footnote-376) Other men, looking for a universal panacea, had “by similar means discovered many efficacious medicines.” Once again he was stressing that until the seventeenth century, progress had been dependent on chance findings, not systematic research.

Things began to change with Paracelsus, who Cullen described as a “strange unaccountable man,” and whom he credited with freeing medicine from Galen and making way for “Experiments and free Reasoning.”[[377]](#footnote-377) It was those experiments and free reasoning which were to produce the philosophical chemistry he was teaching. Although Cullen does not refer to it directly, the findings of alchemists and iatrochemists had been recorded in numerous textbooks of chemistry. [[378]](#footnote-378) In Cullen’s view however, they were essentially recipe books which told the reader how to produce substances, not how to investigate them. What students would take away from Cullen’s lectures was cultural capital in the form of philosophical ideas which would enable them to carry out such investigations themselves.

According to Cullen, philosophical chemistry did not become important until the sixteenth century when what he described as “the Arts” were revived.[[379]](#footnote-379) (Art was a word with a much wider meaning in the eighteenth century when any technique for doing something was described as an art.) The revival of the Art of natural philosophy was started by Galileo in the mechanical sciences. Then Bacon, with his method of reasoning by induction, rejected the Aristotelean methods which had been accepted as the norm until his time. Cullen stated that although Bacon had “made no improvement in chymistry” himself, he had “planned out the Road by which we have made such great Discoveries.” [[380]](#footnote-380) It was Robert Boyle who “took up Chymistry where Bacon had left it.” [[381]](#footnote-381) Boyle was a practical chemist who showed “the use of facts and experiments.” [[382]](#footnote-382) Cullen described Boyle as “almost the first chemist that is worth reading.”[[383]](#footnote-383) After Boyle came the great Newton, “who has left several Folio Manuscripts upon chymistry which so far have never been published.”[[384]](#footnote-384) The point Cullen was making to his audience was that Robert Boyle had used Baconian ideas on natural philosophy to make chemistry a research process. [[385]](#footnote-385)

Cullen finished his history of the topic by discussing the chemists of the late seventeenth and eighteenth centuries. This allowed him to bring the topic up-to-date and in doing so, express his own opinions as to whose work was worth reading and why. Reading was an important means of gaining cultural capital during the eighteenth century and given the number of chemical recipe books, this information was very useful to students. Without it, there was a danger that not only would they fail to obtain cultural capital, but they might waste a considerable amount of financial capital by purchasing books that were of no use to them. By giving the students an account of the various authors and their works, as well as enabling them to be selective in their choice of reading, Cullen was also advertising his own cultural capital. The value of his choices was reflected in the libraries of his pupils. For example, the library of John Walker contained many of the volumes that Cullen recommended. [[386]](#footnote-386)

Cullen began this final part of the history of chemistry by discussing the German metallurgist, Georg Agricola (1495-1555).[[387]](#footnote-387) He also discussed Johann Rudolf Glauber’s (1604-1670) work on salts and Johann Kunchel, (1630-1703), sometimes known as Kunckle, on glass. However, Cullen warned his students that Kunchel’s observations “were obscured by his absurd chemical theory.” [[388]](#footnote-388) The works he was recommending described substances that were widely used by industrial chemists and apothecaries.

Cullen also praised the German chemists among his contemporaries and described chemistry as Germany’s “national science.” Chemistry had developed in Germany before the rest of Europe because much of the country’s early industrial progress was related to the mining of metals. As a result, German chemists had a lot of experience of chemistry as it related to metallurgy.[[389]](#footnote-389) After describing G.A. Hoffman’s (1660-1742) “excellent book”, he recommended works by Walter Henkel and Andrew Crammer. [[390]](#footnote-390) From the *Memoires de l’Academie de Berlin,* Cullen cited the work of Caspar Neuman (1683-1737) and Margraave.[[391]](#footnote-391)He finished his description of his contemporaries by stating that Herman Boerhaave (1668-1735) from Leiden was a “person of great learning and chief Reformer of the Language of Chymistry.”[[392]](#footnote-392) In addition, Boerhaave was “accurate in his Description of the Processes and has made great Discoveries …. Particularly in fire which if it be not compleat (sic) yet is an excellent treatise for the first of its kind.” [[393]](#footnote-393)

Cullen was not impressed by the efforts of the Royal Society of London who “have not done much to the improvement of Chymistry.”[[394]](#footnote-394) This situation was in sharp contrast to *L’Academie Royale des Sciences* in Paris. They published work by Wilhelm Homberg (1652-1715), Louis Lemery (1677-1743), his father Nicholas Lemery (1645-1715), Etienne Francois Geoffroy (1672-1731), Pierre Joseph Macquer (1718-1781), Henri Duhamel de Monceau (1700-1782) and several others. [[395]](#footnote-395) In addition to these works, which detailed early experiments in chemistry, the chemists in the Academy had also worked out a standard method for the distillation of drugs. [[396]](#footnote-396) Those distillation methods were important cultural capital for all practitioners of any form of medicine. To summarise, Cullen’s history of chemistry was essentially an attempt to persuade students that chemistry had only recently become a science and that it done so by basing itself on natural philosophical methods. By teaching his students the natural philosophy which explained this new branch of learning, Cullen was making it clear to his students that the cultural capital he was offering them was what would now be termed “cutting-edge” science.

**Cullen’s Baconianism and its Relevance to his Cultural Capital**

Cultural capital was essentially knowledge and expertise and encompassed many different topics. In the rest of this thesis I will discuss the many components of Cullen’s cultural capital, starting with the concepts of the two philosophers who dominated natural philosophy for the whole eighteenth century, namely Francis Bacon and Isaac Newton (1642-1726). Cullen’s natural philosophy was based on the ideas of both men and it is clear from his history of chemistry that he had a high regard for both of them. Cullen however, was lecturing students on chemistry, not the specific concepts of natural philosophers. Although he referred to their concepts, in most instances he did not discuss the rationale for those ideas. He was using them because they formed a part of the eighteenth-century scientific culture in which he lived and worked. Because Cullen’s chemistry incorporated what was then regarded as the latest thinking on natural philosophy, he was clearly seeking patronage not only from future practitioners of medicine but also from men who were seeking to be informed about the latest ideas in science and science was a fashionable pursuit during the eighteenth century. [[397]](#footnote-397)

Bacon’s natural philosophy was, as Roy Porter remarked, “a key Enlightenment Resource.” [[398]](#footnote-398) That resource was used by Cullen who, like many of his countrymen, regarded Bacon as an important philosopher of science.[[399]](#footnote-399) Bacon believed that science should be employed not as knowledge for knowledge’s sake, but because it could be used for the benefit of society as a whole. For Cullen, chemistry was that useful knowledge which he believed should be relevant to all sections of Scottish life and not just medicine. It was that attitude which ensured that Cullen’s chemistry courses were not limited to *materia medica*. Cullen appears to have acquired this part of his cultural capital through his reading. He owned Mallet’s, *Whole Works of Francis Bacon and his Life,* published in 1733; Peter Shaw’s *Philosophical Works Methodized and Made into English* 1733 and *Novus Atlantis.[[400]](#footnote-400)*

Robert Schofield commented that with the success of mathematics, thanks to Newton, enthusiasm for Baconian ideas waned during the late seventeenth century. However, with the realisation that mathematical abstraction could not explain everything, a new generation of natural philosophers, starting in the 1730s, adopted Bacon’s more pragmatic views. [[401]](#footnote-401) By the mid-eighteenth century, when Cullen was teaching chemistry, Bacon had been re-instated as one of the founding fathers of modern science. [[402]](#footnote-402) Bacon’s seminal text was *Novum Organum,* which advocated the construction of theories from observation.[[403]](#footnote-403) The famous Scottish philosopher Thomas Reid (1710-1796) even suggested that Newton’s rules for reasoning, which Cullen advocated, were derived from this work.[[404]](#footnote-404) Bacon was regarded as an innovator because he had questioned the Aristotelean concepts which had been accepted for hundreds of years. Aristotle had maintained that scientific truth could be reached by *a priori* reasoning. According to Bacon however, God had laid down laws for Nature to follow. If we wish to have power over Nature, then we must discover those laws.[[405]](#footnote-405) This was to be done by induction, which for Bacon, was the Aristotelian method of definition by genus/species relationships.

It was essentially a paper exercise because phenomena were to be investigated by compiling tables which set out the facts about their salient features. [[406]](#footnote-406) Bacon believed that this was possible because every phenomenon in nature has only a few such features. By comparing and contrasting them, the features which they did not share could be eliminated. Those which remained would enable the philosopher to decide on possible causes and suggest conclusions to be tested.[[407]](#footnote-407) Although Bacon realised that his experimental method would not yield absolute certainty, he believed it would generate knowledge. [[408]](#footnote-408) Opinions have changed since the eighteenth century and modern historians of the philosophy of science, like Stephen Gaukroger and Barry Gower, now argue that Bacon’s greatest contribution to science was not his natural philosophy, but his attitude to science.[[409]](#footnote-409) There is no doubt Cullen shared not only Bacon’s attitude, but also his belief that experimental methods would generate knowledge, albeit knowledge that may need to be revised. It was that knowledge which formed part of the cultural capital that Cullen used to obtain patronage from his students.

A second and equally important facet of Baconianism was his repudiation of trade secrets which restricted chemical expertise to the cultural capital of only a few men. [[410]](#footnote-410) Bacon, by advocating that all knowledge was public property, helped to change those attitudes too. Knowledge was no longer something that had to be kept a jealously guarded secret but was to be freely available to everyone. Bacon famously remarked that “knowledge was power”. What he meant was power over nature, not political power. Those with power over nature could control nature and as a result benefit mankind. [[411]](#footnote-411) By patronising Cullen’s lectures, students learned about chemical processes which, until a short time before, were known only to artisans and their apprentices.

**Cullen’s Newtonianism and its Relevance to his Cultural Capital**

Like his ideas on Bacon, Cullen did not teach Newtonianism as a specific doctrine. Newton’s ideas were part of the intellectual climate of eighteenth-century Scotland and by the time Cullen had started to teach, to many people in Scotland, Isaac Newton was infallible.[[412]](#footnote-412) However, a brief history of the way interpretations of Newtonianism changed during the eighteenth century is needed in order to understand the nature of Cullen’s cultural capital. Newton’s picture of matter was fundamentally the same as most natural philosophers of the seventeenth century in that he believed that the world consisted of fundamental micro particles which were in constant motion.[[413]](#footnote-413) Newton also believed that the corpuscles themselves were inert.[[414]](#footnote-414) Consequently, they were reliant on force to move them and it was the task of the natural philosopher to investigate those forces.[[415]](#footnote-415) Because of the success of Newtonian mechanics, attempts had been made at the beginning of the eighteenth century to apply Newton’s theories to every possible subject including chemistry, physiology and even moral philosophy. [[416]](#footnote-416)

By the mid-eighteenth century, when Cullen was teaching chemistry, mechanical concepts had been rejected as inapplicable to those topics. [[417]](#footnote-417) Newtonianism then became synonymous with his scientific methodology set out in his Second Edition of his *Mathematic Principles of Natural Philosophy* and in Query 31 at the end of the 3rd edition of his *Opticks*.[[418]](#footnote-418) In addition to his ideas on scientific method, in the *Queries* Newton suggested, not only the concept of an aether, but also that the forces acting on matter included chemical affinity. Cullen agreed with this. In other words, Cullen accepted the form of Newtonianism which dominated the mid-eighteenth century. This was the version of Newtonianism which Cullen believed was most relevant to chemistry and as a result, it formed an important part of the cultural capital which Cullen passed on to his students. Cullen seems to have acquired the Newtonian part of his cultural capital in much the same way as he learned his Baconian philosophy, namely through his reading. In addition to his copies of the *Principia* and *Opticks,* Cullen also possessed a copy of Colin Maclaren’s (1698-1746) book on Newton and another by Henry Pemberton (1694-1771), a physician and chemist who also set out to make Newton’s ideas comprehensible.[[419]](#footnote-419)

Newton’s ideas on scientific methodology were based on his concept of induction.[[420]](#footnote-420) It should be noted however that the word *induction* changed its meaning between the seventeenth and eighteenth centuries, a fact which Cullen does not seem to have appreciated. Newton, unlike Francis Bacon, defined induction as the collection of facts by observation *and* experiment, then drawing conclusions from them. It was not just an exercise on paper and it was the Newtonian version of induction which Cullen advocated. This interpretation of Newtonian induction was set out in the rough drafts Cullen made for his agricultural lectures. In them he stated that induction consisted of the collection of more and more facts, making more and more experiments “and so [the philosopher] has larger views.” [[421]](#footnote-421) Cullen also described Chemistry as the collection of empirical facts which were then applied by induction. [[422]](#footnote-422)

As far as those facts were concerned, Cullen was aware that they could not always be relied upon, especially facts “which pretend to be general and universal” and those “which writers are employed in using as a cause.” [[423]](#footnote-423) His statements on the credibility of facts seem to be warnings to his students about adopting speculative hypotheses with the minimum of evidence to support them. As such, they were re-statements of the philosophy of both Newton and Francis Bacon.[[424]](#footnote-424) Where Cullen differed from Newton was that although he warned his students against adopting hypotheses and establishing axioms from too few experiments, he also warned them about “hunting after primary causes.” [[425]](#footnote-425) Primary causes were essentially metaphysical and usually related to arguments about God, the primary cause of the universe.[[426]](#footnote-426) In fact, Cullen went so far as to criticise Newton for relying on God to fill the gaps in his knowledge.

*When the English Philosopher insisted that this is the first cause and admitted of no other intermediate cause than the power of the Creator, if we are to believe that there is no other cause, we would put a check on philosophy and it would be of no use. [[427]](#footnote-427)*

This seems to be a reference to Newton’s natural theology. Because of his belief that matter was inert and required force to move it, Newton postulated that ultimately the force was God.[[428]](#footnote-428)

Whether Cullen agreed with Newton’s religious beliefs or not is essentially irrelevant, but Cullen needed to be sure that his students did not share the eighteenth-century misunderstanding of Newtonian methods of investigation. [[429]](#footnote-429) A correct view of those methods was very relevant to the practice of chemistry. The misunderstanding arose because Newton had become embroiled in a dispute with the philosopher Gottfried Leibnitz (1646-1716). Newton was unable to explain how gravity operated. When Leibnitz asked for an explanation, Newton replied “*hypothesis non fingo”* andLeibnitz accused him of invoking occult forces. [[430]](#footnote-430) The statement was simply a response to Leibnitz’s question about the nature of gravity but it became for many, a principle of the scientific method. [[431]](#footnote-431) In fact, Newton defined an hypothesis as “something assumed or supposed without truth” and the *Queries* at the end of the *Opticks* are in fact a series of hypotheses. [[432]](#footnote-432) But the misunderstanding persisted throughout the eighteenth century and no doubt at least some of Cullen’s students must have started his courses with this misconception. The students’ note books show that Cullen himself had a much greater understanding of Newton’s thought and shared his ideas on the nature of hypotheses. As a consequence Cullen was in a position to use his cultural capital to correct any potential misunderstandings by his students.

While warning his students about the facile adoption of hypotheses, Cullen taught them that they needed a theory in order to practice philosophically. This is completely compatible with what Newton argued. Cullen told his students that,

*Arts are practised in Imitation or in accordance to the rules deduced from a knowledge of causes which are called Principles and such Principles, a Theory. The man possessed of a Theory practises with more certainty. All Theories are fallacious from hence the knowledge of Causes is entire (sic) by Experience.* [[433]](#footnote-433)

While Cullen’s statement that natural philosophers needed a theory and such theories were false may seem paradoxical, even nonsensical, he was in fact telling students that no natural philosophical investigation was possible without what is now called a “working hypothesis.” A later scientist, J.J. Thompson (1856-1940) expressed the idea more clearly when he remarked that “a theory is a policy, not a creed.”[[434]](#footnote-434) The point Cullen was making was that without what he termed a theory, chemistry would have been no better than the systems of trial and error which the artisans used. This was his justification for basing chemistry on natural philosophy.

The statement that theories are fallacious and only experience can determine causes was a re-statement of Cullen’s belief in empiricism. As Hasok Chang has pointed out, the problem with empiricism, which Cullen did not appear to appreciate, was that the argument is circular. It states that science depends on observations, but those observations can only be interpreted using a theory, which in turn, has to be constructed from the observations it is trying to explain.[[435]](#footnote-435) As Robert Schofield observed, Cullen’s claim “to have used a cautious and full induction” always meant he was about to state a theory.” [[436]](#footnote-436) It is unlikely however, that Cullen’s students would have seen the flaws in his arguments. They too, were products of eighteenth-century culture which had great faith in empiricism. [[437]](#footnote-437)

Cullen however, may have disagreed with Newton about the nature of the precise structure of the particles which made up the matter of the universe. Newton believed that all atoms were identical, explaining macroscopic differences between bodies by postulating that there were pores between atoms and the density of any substance depended on the size of the pores. This picture of matter however, failed to account for many experimental findings, including chemical affinity.[[438]](#footnote-438) Cullen, as a practising chemist, realised that such a uniform structure could never provide a fundamental explanation of chemistry. He avoided the problem of having to contradict the apparently infallible Newton about something as basic as the structure of matter, by pointing out to his students that as he (Newton) was referring to invisible particles, proof was lacking.[[439]](#footnote-439)

This lack of specificity ensured that if any of his students disagreed with him, he avoided a clash of opinions. Thanks to John Locke’s (1632-1704) work, *An Essay Concerning Human Understanding,* during the eighteenth century it was generally accepted that “we can have no knowledge further than we have perception.” [[440]](#footnote-440) Cullen’s statement that Newton was unable to prove the structure of matter was completely compatible with the current ideas on the way the human mind worked. As will be explained in a later section, this vagueness about the basic structure of matter left Cullen free to use his Principle based concepts, on which all the practical chemistry of the eighteenth century depended.

There seems to be no doubt that Cullen did accept one of Newton’s theories completely, possibly because of its explanatory value, namely the presence in matter of an *aether*. In the Queries at the end of the third (1713) edition of his *Opticks,* Newton postulated that the pores of all substances were void of air and water and instead contained an ultra-light-weight substance which he termed an *Aether*. [[441]](#footnote-441) This concept had arisen because the phenomenon of light refused to yield to Newton’s efforts to treat it mathematically. Because he was forced to look for a non-mathematical way of expressing its properties, Newton proposed an imponderable fluid, which he termed an aether, to account for the transmission of light rays*.* At the time, the defining characteristic of matter was extension, so the fact that a substance did not have weight was not considered significant.

By Cullen’s day, the aether was widely accepted, largely thanks to Bryan Robinson, (1680-1754) who wrote a *Treatise on the Animal Oeconomy* published in 1732. [[442]](#footnote-442) Cullen recommended the book to his students. [[443]](#footnote-443) As a result of the aether, “light, heat, electricity, magnetism and chemical properties all became material and were assimilated into Newtonianism.” [[444]](#footnote-444) All these concepts were incorporated into the cultural capital which Cullen passed on to his students. Students needed such concepts in order to form a mental picture of how the world might work. By using that picture they could develop a theory and would then be in a position to devise further investigations to test a theory’s accuracy.

**Cullen’s Natural Philosophy of Chemistry**

Cullen defined chemistry as “that part of Natural Philosophy which treats of the particular properties of bodies.” As I have shown in the last two sections, Cullen’s own ideas on why and how the particular properties of bodies should be investigated was based largely on his interpretations of the natural philosophy of Newton and Bacon. As neither Bacon nor Newton was a chemist, it was impossible to apply their ideas completely uncritically to the “particular properties of bodies,” so this section will be an account of Cullen’s own ideas on the topic. As Cullen’s courses were designed to attract not only the patronage of medical students but also men with an interest in other aspects of chemistry, they discussed a wide range of chemical topics along with the natural philosophy which supported them.

One of the main differences between Cullen and Newton was that Cullen treated matter theories as irrelevant to natural philosophy. This was not because he disagreed with Newton but because he felt that such speculations had nothing to contribute to chemistry. In doing so he could not distance himself too far from Newtonian ideas on matter for practical reasons. As the controversy between Newton and Leibnitz had demonstrated, the accusation that a natural philosopher was invoking occult forces to explain a phenomenon was an insult. It amounted to an allegation that the philosopher was practising magic. [[445]](#footnote-445) Chemistry had only recently separated itself from alchemy, which had been accused of using magic in its attempts to change base metals into gold. [[446]](#footnote-446) To gain patronage from students Cullen could not risk being accused of following the alchemists who explained their chemistry in terms of the occult forces.

There was of course, an obvious difference between the Newtonianism expressed in the *Principia* and chemistry. Cullen explained that, “While the form of (a) knife is mechanical the property of its hardness is chymical” (sic) [[447]](#footnote-447) Even Newton could not suggest a way of expressing the hardness of a knife mathematically. In other words, Cullen was emphasising to his students that there was a clear separation between mechanics and chemistry and that the former could not be used to explain the latter. Chemists like Cullen, while accepting Newton’s theory of gravity, realised that mathematics could not explain why some substances would unite with each other and were completely unresponsive to others. Although both men believed there was some form of force involved, they knew its exact nature was inexplicable.[[448]](#footnote-448) As Newton had described such a force in his *Opticks*, Cullen had no reservations about introducing it into his lectures.

Because Cullen believed that it was impossible to know what the smallest parts of matter were, it made no difference to him whether a philosopher used Atoms or Principles to construct theories. For all practical purposes, the end result was the same. Consequently, Cullen did not even attempt to speculate on the basic building blocks of matter. He told his students they were either physical, when they were named Atoms, or chemical when they were termed Principles or Elements. [[449]](#footnote-449) The term “Elements” was actually introduced by Aristotle.[[450]](#footnote-450) This meant that most students would have been familiar with the term and the concept.

While he was not ruling out the possibility that Atoms or Elements may be composed of even smaller parts, Cullen argued that both atoms and elements were “the most simple we can obtain by art.” All bodies were extended however, and were capable of being divided *ad* *infinitum*.[[451]](#footnote-451) As proof of the latter statement, Cullen cited the way a few grains of musk could perfume an entire room. Eighteenth-century chemical theorists also debated whether the properties of a substance were “resident substantially in the Elementary part” or were they determined by “a particular texture or arrangement of parts?”[[452]](#footnote-452) According to Cullen, that question too, was irrelevant. “Both these manners of reasoning are applicable.” This was another indication that Cullen regarded theories about the basic structure of matter as not only unprovable, but of little importance in the practice of chemistry. Theories provided a working hypothesis to be investigated, not a creed to be believed in.

Although Cullen described Newton’s matter theory as unprovable, he thought there was evidence which demonstrated that Boyle’s theory about the basic structure of matter was incorrect. Boyle believed that matter was made of corpuscles which were of different shapes and sizes. [[453]](#footnote-453) The different shapes and sizes of atoms meant that if they encountered each other, some would combine together while others remained free. It was the assorted shapes and sizes of atoms which explained affinity. Cullen disagreed. When discussing the properties of water with his students, Cullen noted that it could be a vapour and a solid as well as a liquid. He then went on to argue that if Boyle’s view was correct and water’s properties were dependent on the spherical shape of its corpuscles then those corpuscles would have to change shape almost instantaneously when water froze or became steam. He dismissed this as “not possible to believe.”[[454]](#footnote-454)

To explain how chemical reactions came about, Cullen turned to the Newtonian idea of force and suggested that such reactions could be explained on the basis of forces of attraction and repulsion acting between substances. “Separation depends on elective attraction or the action of fire.”[[455]](#footnote-455) (Like all eighteenth-century chemists, Cullen believed that heat and fire were the same substance.) “As fire sets things asunder it is a repellent power.” Elective attraction, otherwise known as affinity, was more problematic. It was debated at the time as to whether affinity could be explained by the Newtonian concept of gravity.[[456]](#footnote-456) Cullen accepted the Newtonian view, expressed in the Queries, that there were more forces in Nature than gravity.

*[I]t happens that though every body in Nature is attracted by other bodies yet any one body is not attracted by every other body but is by some and not by others and of such it attracts one more than the other.* [[457]](#footnote-457)

All the notebooks show that Cullen taught the standard eighteenth-century theory that there were four different types of attraction between bodies, “gravitation, electric, magnetism and the attraction of cohesion.” [[458]](#footnote-458) This latter force, another term for affinity, would only act if the particles were in close proximity. He stated that “This attraction we are chiefly to mind in chymistry and upon this depends the combination of bodies for the chymist.” [[459]](#footnote-459) The same force accounted for the formation of drops of water and globules of mercury. The most reasonable conclusion is that Cullen accepted gravity as a force but realised that it could not explain chemical reactions. There had to be more than one force and while gravity was constant, acted at a distance and could be expressed mathematically, affinity could not. In fact, as the above extracts show, Cullen, like Newton could not explain affinity. And if Newton was unable to explain affinity, then no reasonable student would have expected Cullen to do so.

Once it was accepted that mechanical forces could not explain chemistry, chemists turned to the ideas of Georg Ernst Stahl, (1659-1734) and Cullen was no exception.[[460]](#footnote-460) Stahl was introduced to the English-speaking world in 1730 through Peter Shaw’s translation of Stahl’s *Philosophical Principles of Universal Chemistry.* Reading the book, the similarity between Stahl’s ideas and Cullen’s are unmistakeable and Cullen described Stahl’s terminology in detail in his lectures.[[461]](#footnote-461) Cullen’s library at the time of his death contained no fewer than 88 volumes by Stahl.[[462]](#footnote-462) Like Cullen, Stahl saw chemistry as a means of improving the “useful Arts.” [[463]](#footnote-463) He too, felt there was no mechanical explanation for chemical phenomena. [[464]](#footnote-464) Stahl defined a chemical principle as, “*a priori,* that in mixt matter which first existed.” [[465]](#footnote-465) Although the reference to an *a priori* idea meant that Cullen may not have agreed with this completely, the lack of detail in Stahl’s definition accords with his view that it was impossible to know what the basic constituents of matter were.

Cullen also adopted Stahl’s system of dividing substances into either mixts, which could only be “resolved into their constituent parts” by chemical means, or aggregates which could be separated mechanically. [[466]](#footnote-466) In other words, if the substance was an aggregate, its constituents were held together without chemical union. [[467]](#footnote-467) A mixt, on the other hand, had to be broken down and reconstituted by other substances. He illustrated how their differences worked in practice by showing the students how chalk and sand mixed together can be separated. It could be done mechanically by pouring water onto the mixture. Once the chalk dissolved in the water, it could be separated from the sand by simply pouring off the water. Alternatively, the chalk could be removed chemically by adding vinegar to the aggregate. [[468]](#footnote-468) The vinegar would then unite chemically with the chalk. Like most chemists of his day, Cullen also accepted Stahl’s postulate that combustion of materials depended on the presence of a substance termed phlogiston. Cullen defined phlogiston as “that particular part of a body on which its inflammation depends but gives no occasion to heat or any phenomenon of fire.”[[469]](#footnote-469) Cullen did not elaborate on its nature but what he taught his students was generally accepted by most eighteenth-century chemists.

Once he had supplied his students with the philosophical principles on which eighteenth-century chemistry was based, Cullen needed to teach them how to actually do that chemistry. Cullen not only taught the techniques needed to practice chemistry, but their underlying natural philosophy as well. [[470]](#footnote-470) This was in keeping with his aim to strip chemistry of its “falsehoods and false philosophy.” To conduct chemical experiments students needed to know about what were described as “the instruments of chemistry.” The instruments of chemistry included not only the various pieces of laboratory equipment but anything which would facilitate a chemical reaction.

One of the most important factors in inducing substances to react is heat. [[471]](#footnote-471) Cullen agreed with the Newtonian explanation of heat.[[472]](#footnote-472) Heat, whatever it was, made the aether expand, enlarging the pores between atoms which forced substances to increase in volume. He stated that

*If we take notice how the power of heat operates it does it in this manner, heat expands bodies and restores the action of the subtle fluid in their pores and by a long continuation of the heat it will convert them into a fluid state and if it is longer continued it will convert them into a repellent state or vapour … this is supported so well in Nature that it is the foundation of chemical theory.* [[473]](#footnote-473)

Neither Newton nor Cullen made any attempt to describe the nature of heat. This is understandable because in the eighteenth century the nature of heat was completely unknown. [[474]](#footnote-474) Robert Boyle had advised against speculating on the topic and Cullen seems to have taken that advice. [[475]](#footnote-475) Although he could not find an explanation for heat in terms of natural philosophy, Cullen could provide empirical evidence for his claim by getting students to observe how substances expanded when they were heated. Effectively, what Cullen was doing, was providing students with a convincing theoretical explanation for one of the basic instruments of chemistry.

In addition to heat, Cullen, like Boerhaave, believed that solution was an instrument of chemistry.[[476]](#footnote-476) Under the heading of solution, Cullen included what he described as fusion or dry solution and also exhalation, otherwise known as evaporation. Solution was a “body diffused throughout a fluid,” fusion or dry solution was produced by heating substances together. [[477]](#footnote-477) Exhalation too, was the end result of heating substances but the effect produced depended on the substance being heated. If the substance was a fluid, then heating it resulted in evaporation. If it was solid then the end result was calcination (or roasting). In practice, the three processes were often combined, for example distillation used substances in solution which were placed in a retort and then heated, causing evaporation. What made the processes instruments of chemistry was that they provided a means of holding substances together to facilitate reactions. [[478]](#footnote-478) By postulating that there was a mechanism common to all these chemical methods, Cullen was trying to suggest an explanation for apparently complex processes which were often (as in distillation) used in combination. If these processes could be understood, Cullen hoped the end result would be to rid chemistry of its “false philosophy”.

On the theory underlying solution and evaporation Cullen had little to say, although he did warn the students that a substance in solution had to be distinguished from a mixt. [[479]](#footnote-479) However, he had some ideas about fusion which was brought about by heating substances like metals together until they melted and combined. Some chemists, he told his students, believed that all fluidity was due to the presence of water but he argued that was untrue.[[480]](#footnote-480) “We must say that fluidity is a correlation of bodies to fire and we must say that different bodies are capable of fluidity only in different degrees of heat.” [[481]](#footnote-481) What the students were being offered was an empirically verifiable explanation of fusion, based on a combination of the Newtonian concept of affinity combined with the action of heat.

In summary, an important part of the cultural capital that Cullen offered his students was the knowledge of how to actually conduct chemical experiments. He believed that it was possible to undertake those experiments without knowing the exact nature of the basic constituents of matter. Cullen was able to put forward such views in his lectures because by the time he began to lecture on chemistry, John Locke’s ideas had been widely accepted.[[482]](#footnote-482) Despite his sceptical attitude towards the various eighteenth-century matter theories Cullen was able to gain patronage from students because he was able to demonstrate to them that chemistry was compatible with the ideas of Bacon, Newton and Stahl. In short, it was his inclusion of the latest ideas in natural philosophy that distinguished Cullen’s courses, not only from those of his predecessors but from the type of chemistry practised by artisans.

**Conclusion**

Until Cullen began to teach chemistry, the subject had been regarded in Scottish universities as an adjunct to *materia medica.* It had originally been introduced into medical schools because aspiring physicians needed to know the technical details of how apothecaries made drugs in their shops.[[483]](#footnote-483) A striking difference between Cullen’s lectures and those normally given in medical schools was his inclusion of the natural philosophy of chemistry. The philosophical ideas on which Cullen based his teaching had only been recently introduced and not everyone took them seriously. [[484]](#footnote-484) As a result, there were numerous satires based on its concepts. A good example was that invented by Jonathan Swift, (1667-1745) in *Gulliver’s Travels.* Swift described a character called Lagado, who searched for sunbeams in cucumbers. Furthermore, it was not until the end of the seventeenth century that chemistry finally freed itself from its association with alchemy and the philosopher’s stone.[[485]](#footnote-485) When considered against that background, the radical nature of Cullen’s chemistry becomes apparent.

In *Homo Academicus,* Bourdieu pointed out that consecrated heretics have an advantage over professors who taught more conventional subjects because they have much more choice over the contents of their lectures. Unlike the professors of subjects like law or medicine who are constrained in what they can teach because of the need to repeat the topics on a set syllabus, consecrated heretics have much greater autonomy. [[486]](#footnote-486) Although Cullen refused to use the Boerhaavian system originally employed in both Edinburgh and Glasgow, his medical teachings were dictated by the nature of the subject itself. Because diseases did not change significantly during the eighteenth century, the medical syllabus was relatively fixed. With chemistry, it was different. Cullen could use his freedom as a consecrated heretic to introduce new topics and natural philosophy into his courses. [[487]](#footnote-487)

His natural philosophy was based on the concepts of Francis Bacon, Isaac Newton and Georg Stahl. Although the misunderstanding over Newton’s attitude to hypotheses persisted, Cullen knew enough about Newtonianism to be able to correct any misunderstandings his students may have entertained. Cullen appears to have agreed with the generally accepted eighteenth-century theory that matter was composed of sub-microscopic particles of one form or another. Because it was becoming apparent that the structure of those particles could not explain chemical affinity, Cullen was able to suggest that the structure of the unseen parts of matter were irrelevant to the practice of chemistry and introduce his students to the ideas developed by Georg Stahl. All these factors combined together to enhance the position of chemistry as a recognisable science and not just something workmen did in their shops. There is no doubt that students appreciated the changes in the curriculum because they described Cullen’s chemistry a “new modelling” of the subject. As a result of that new modelling, chemistry became a topic of interest to anyone wanting to know more about natural philosophy and not just medical students interested in drug manufacture. This raised chemistry “to the highest reputation.”[[488]](#footnote-488) As a study of the lists of men who attended his courses demonstrates, he was extremely successful in attracting patrons.

CHAPTER 4: HOW DID CULLEN USE HIS PRACTICAL CHEMISTRY TO GAIN PATRONAGE FROM STUDENTS?

**Introduction**

The previous chapter has shown how Cullen needed to demonstrate that chemistry was compatible with the principles of natural philosophy in order to get the subject accepted as worthy of study in a university. [[489]](#footnote-489) While grounding chemistry in natural philosophy did mean it could be regarded as an academic subject, it left Cullen (and all eighteenth-century chemists) with the problem that a knowledge of natural philosophy could not give students the expertise they needed to perform the practical procedures which were an essential part of chemistry. Because those techniques employed specialised equipment, they could only be learned from someone familiar with its use. This usually meant learning from an artisan, as Cullen had done in London, early in his career. [[490]](#footnote-490) Once he had learned those skills however, Cullen was able to teach them in a university. It was this practical aspect of his cultural capital which made his courses attractive to many university students.

The chapter starts with a discussion of what the various groups of students, described in the last chapter, would learn of the practical aspects of chemistry by patronising Cullen’s courses. I continue by showing how Cullen taught those students how to organise their knowledge. This was necessary because, at the time Cullen was teaching, there had been an explosion of chemical know-how. Most of this increased knowledge took the form of pragmatic solutions to technical problems, not theoretical insights.[[491]](#footnote-491) To students however, it must have seemed like an ever-increasing volume of disconnected bits of information that they had to remember. Cullen even warned them at his first lecture that “chemistry employs memory rather than judgement.”[[492]](#footnote-492)

In order to gain their patronage from students, Cullen had to devise a system which would reduce those facts into some sort of order, thereby making them easier to recall. Cullen worked assiduously at devising such schemes. This was a key aspect of his pedagogical skill. The results of his work were made available to students in the form of a classification system, affinity tables and his short-hand way of describing chemical reactions. Finally, Cullen turned to what he described as the “History of Chemical Bodies” which was a description of the type of substances which chemists actually used. The chapter will finish with a discussion of those substances and how knowledge of their chemistry was of value to students.

**The Practical Component of Cullen’s Cultural Capital**

Cullen’s ability to teach students how to use chemical apparatus was an important part of his cultural capital and it must have encouraged them to patronise his courses. As discussed in the last Chapter, the students attending Cullen’s courses can be divided into three groups, surgical apprentices, aspiring physicians and men with an interest in chemistry *per se.* The surgical apprentices would have already been familiar with the equipment. They did not need to be taught how to use it but they would benefit by learning the natural philosophical explanations of *why* the equipment worked, as described in the previous chapter.

Men intending to become physicians needed to know the technical details of how chemical equipment was used. They had to be familiar with it because it would be used to prepare the medicines they would prescribe for their future patients. As Johnson pointed out in his book, *Guide for Gentlemen Studying Medicine at the University of Edinburgh,* if they did not know the practical details of how drugs were manufactured, they might be obliged to confess their ignorance to surgical apprentices.[[493]](#footnote-493) As aspiring physicians, if they had been forced into that situation, their loss of face would have been considerable.

For students who did not intend to practise medicine this part of the course was very important. Their only other way of learning the skills needed to use chemical equipment was from artisans, which was socially unacceptable to them. In the seventeenth century Robert Boyle, a member of the aristocracy, had hired workmen to carry out his experiments in his private laboratory. By the time Cullen was teaching however, it had become acceptable for even the aristocracy to carry out experiments themselves. [[494]](#footnote-494) Consequently, the gentry had no problems about learning how to use the apparatus, provided that they were taught in a situation that was socially acceptable to them.

An indication of just how important Cullen regarded this aspect of his cultural capital was demonstrated by his insistence that all his students should come into the laboratory and learn chemical techniques. “Everyone therefore should in the first place endeavour by easy experiments to acquire some habit of properly conducting solution, diffusion and distillation and I propose that during the course you should have acquired some knowledge in that way.” [[495]](#footnote-495) The reason for this stipulation was that it would have been impossible for students to learn how to use the equipment without trying the various techniques for themselves. By patronising Cullen’s courses, they had an unrivalled opportunity to do so. It is obvious from reading the students’ note books that Cullen was demonstrating the chemical phenomena he was describing as he lectured. This meant that when they came to try the techniques for themselves, students did not have to guess whether they had achieved the correct result. Cullen had already shown them what should happen.

Much of the chemistry Cullen was teaching was already available in the form of textbooks, which were largely descriptions of the way substances were prepared and their uses.[[496]](#footnote-496) The drawback of trying to learn chemistry by reading such books was that they were essentially recipe books which assumed that the reader was already familiar with the use of the equipment.[[497]](#footnote-497) Although students could purchase the apparatus for themselves, that did not provide them with the knowledge and skills they needed to conduct chemical experiments.[[498]](#footnote-498) If students had been forced to learn chemistry by reading books and trying experiments for themselves it would have taken them years to master the art. Furthermore, the equipment was expensive and may have been beyond the means of many of them.[[499]](#footnote-499)

If they could afford to buy laboratory equipment however, it would not be difficult to do so because Cullen did not use specialised equipment when demonstrating chemical procedures. What he used were the standard glass and earthenware vessels which included measuring jugs and cylinders, beakers and the alembics (or retorts) needed to carry out distillation. As Cullen employed this equipment routinely during his lectures, students must have become familiar with it very quickly. This meant that once they had finished Cullen’s course, they could carry on experimenting themselves if they so wished. Because nearly every chemical reaction needed the application of heat to facilitate it, their main problem would have been acquiring a furnace.

This was the most important item of eighteenth-century laboratory equipment. The importance of furnaces for the practice of chemistry is clear from the illustrations in books written on the subject. From the earliest volumes on alchemy to the standard textbooks of the time, all of them contained references to, and often illustrations of, furnaces. If a student was going to practice chemistry, either for its own sake or to produce drugs, he would need to learn how to operate a furnace. An indication of the importance of furnaces comes from reading the students’ notes. One of the students’ notebooks contains a diagram of how to construct a furnace.[[500]](#footnote-500) Cullen warned his students repeatedly that the heat applied to any piece of chemical apparatus had to be carefully managed.[[501]](#footnote-501) Furnaces were the most expensive piece of laboratory equipment and learning how to use them properly needed hands-on experience, hence the value of Cullen’s courses.

As discussed in the last chapter, this practical experience was based on natural philosophical ideas. By patronising Cullen’s lectures, students benefited from Cullen’s cultural capital, not only by learning how to actually do chemical experiments and make a wide variety of chemical substances, but also by learning how to record their findings. This enabled the students to communicate their own research findings to other chemists and to interpret the results of other men’s investigations. Those features of Cullen’s cultural capital can be divided into three sections, how to classify substances, how to organise knowledge and the uses of the substances themselves. I will discuss each aspect in turn starting with the cultural capital of classification techniques and how Cullen taught students to organise chemical facts.

**Cullen’s Cultural Capital with respect to Classification and Organisation of Knowledge**

An important factor in persuading students to patronise Cullen’s lectures was his capacity for devising systems to organise knowledge. Cullen believed that “Students are apt to be confused by a multitude of things.”[[502]](#footnote-502) As a result of that observation, he attempted to reduce what were apparently unconnected facts into some sort of order. He was an obsessive classifier and that talent was an important part of his pedagogical skills. Without an ability to organise knowledge it would be difficult for a man to communicate his own observations to anyone with similar interests. Anyone who wanted to discuss natural philosophy intelligibly had to be able to classify substances. As Cullen never produced a textbook of chemistry, anyone who wanted to learn his classification system had to patronise his courses.

The need for a chemical classification system was well-recognised at the time but because of a lack of consensus about the theoretical background to chemistry, the exact classification of the different substances changed with the classifier. Georg Stahl used three Principles – salt, sulphur and mercury.[[503]](#footnote-503) Boerhaave in his *Elements of Chemistry* used seven; salts, sulphurs, stones, metals, semi-metals and animal and vegetable substances. Originally Cullen had cited only five Principles – salts, inflammables, water, earths and metals. In the 1760s, aerial had been added when Joseph Black discovered what was termed “fixed air.” [[504]](#footnote-504) A table of Principles and their characteristics compiled by Cullen and recorded in a student note book is given in Appendix 1 on page 259.

Because the system was common to all forms of chemistry, once a material was classified, no matter what its origins, its chemical properties were known. This made Cullen’s chemical classification system applicable not only to drug manufacture, but to things as diverse as the investigation of soils and the identification of minerals for the mining industry. As a result it appealed to a large number of potential patrons. The need for such a system to be applied to chemistry was explained by Thompson*.*

*It was only a short time before this period (when Cullen began to teach) that chemistry had begun to assume a systematic form … The chemical facts … were become so numerous as to render some arrangement of them necessary and to induce philosophers to seek for some common principles by which they might be connected.* [[505]](#footnote-505)

Cullen’s chemical classification system was based on the Aristotelean idea that classification gave some insights into the nature of the substances themselves. Aristotle believed that in order to understand what something was, it was necessary to understand what *kind* of thing it was.[[506]](#footnote-506) Cullen was able to devise a classification system because he believed that chemistry was “founded on principles as immutable as the laws of mechanics.” [[507]](#footnote-507) In other words, because chemistry’s common principles did not change, it was possible to identify substances by assigning them a place in a classification system. By learning how Cullen devised and operated his classification system, students learned eighteenth-century ideas about how the natural world was formed. They also gained some insight into how classification systems were compiled and how they operated. Given the explosion of knowledge in the eighteenth century, learning how to record information in a way that made it accessible, was an important skill for them to acquire. [[508]](#footnote-508)

Cullen’s system was based on his Chemical Principles, discussed above. They were the most basic components of matter which “could be achieved by Art.”[[509]](#footnote-509) One feature of the system, which dominated the chemical curriculum of most medical schools during the eighteenth century, was that it was based on experience. [[510]](#footnote-510) Materials were classified according to their features, which had been studied by generations of chemists and alchemists. [[511]](#footnote-511) Cullen’s knowledge was based on his extensive reading as well as his experience of utilising the findings described in books.

The analyses were carried out by studying the properties of the substance concerned and deciding which one of the Principles in Cullen’s system matched the material they were trying to identify. The system worked in the same way as any other eighteenth-century classification system. It began by assigning the unknown substance to a single Principle. Once that had been achieved, the investigator could then ignore the other five and concentrate on deciding which of the sub-groups of the relevant principle best described the substance. For example, if the unknown specimen was a solid, then watery and aerial principles could be ruled out immediately. If the substance was not miscible in water, it could not be a salt. If it was not fusible in fire, it could not be metal. If it would not burn, then it was not inflammatory. Having ruled out these possibilities, by a process of elimination, it must be an earth. The next step was to decide which of the five subgroups of earths it belonged to – absorbent, crystalline, argillaceous, talky or gypscous (sic). This was done by observing its reaction when heated and how it behaved when in solution.[[512]](#footnote-512)

Crystalline earths, unlike other earths, were so hard that they would strike fire from steel and, if heated, would form glass. This distinguished them from the rest of the group which were much more friable. Talky earths were unaffected by heating. Argillaceous earth could be separated from absorbent earth because the former would not dissolve in acids, whereas the latter would. Finally, gypscous, which Cullen declared was not a true earth, became a powder if it was heated. If water was added to that powder it hardened. This distinguished it from quick lime which would not harden in this way unless mixed with sand and gravel.

By subjecting the substance to those reactions, the chemist could decide what type of earth he was dealing with. Because of Cullen’s classification system, those findings could be communicated to anyone familiar with the system. As neither Cullen nor Black published a textbook, the best way of acquiring a knowledge of the system was to attend a chemistry course. The value to students of such cultural capital was illustrated by the monetary value of students’ lecture notes. They could change hands for four or five guineas each, making them more expensive than the course itself. [[513]](#footnote-513)

Being able to identify a substance and classify it was only the start of an investigation. The problem for Cullen, and all eighteenth-century chemists, was that they had no way of predicting how materials would unite or separate from each other when placed in contact, especially if they were heated. This, Cullen described as, “the foundation of chemistry.” While classification systems could identify a substance, students needed to know how that substance reacted with other substances to create new compounds. This was a vital part of the useful knowledge produced by chemical research. One student notebook documented the problem. It contains a table of the various substances which, when combined together, should, in theory, produce vitriolated tartar[[514]](#footnote-514). However, Cullen went on to state that “none but the first, third and fourth of these have ever been used. The rest were thought to produce salts of “peculiar and extraordinary properties and accordingly … have got distinct Names.”[[515]](#footnote-515) The only possible way to do such chemistry was by memorising the names and the possible combinations of the various substances. As more and more substances were discovered, and more and more combinations of them described, to students especially, this must have seemed an increasingly impossible task.

To solve the problem, Cullen had to compile a system that was logical and from which students could retrieve information easily when they needed it. Because of Cullen’s commitment to empiricism, it could not be an *a priori* system. It had to be based on facts that could be demonstrated to students because, as Stephen Shapin remarked, “within empiricist schemes of knowledge, the ultimate warrant for a claim to knowledge is the act of witnessing.”[[516]](#footnote-516) This meant that, once Cullen had worked out a system, he also had to devise experiments to demonstrate it. To do that successfully, he had to be sure that his chosen experiments were going to work consistently. This must have involved a considerable amount of work because he had to perform the experiments repeatedly to routinize them. [[517]](#footnote-517)

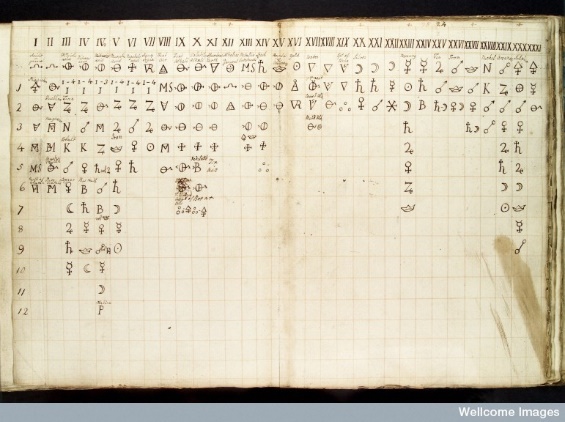
The system he adopted and later adapted to demonstrate how various substances combined and separated was Etienne Francois Geoffroy’s (1672-1731) Affinity tables. This table was first published in the *Memoires de l’Academie Francais* in 1718, then reproduced in Pierre-Joseph Macquer’s (1718-1784) *Elements of the Theory and Practice of Chemistry.* As Cullen mentioned Macquer’s book in his lectures, this seems to be the most likely source of his information.[[518]](#footnote-518) The tables themselves attracted little attention until Cullen introduced them into his courses. [[519]](#footnote-519) By using the tables, students had an easy way of finding what was likely to happen if substances were placed in contact with each other, especially if they were heated. This relieved them of the burden of trying to remember numerous, apparently disconnected facts.

Affinity tables had two great advantages for both Cullen and his students. First of all, they were based on observations. Even if the students had disagreed with Cullen’s ideas on the structure of matter, it was not important because it did not change the information set out in the tables. This made them independent of matter theories. As Georgette Taylor put it, “the strength of (affinity) theories lay in the fact that they were able to guide and assist the chemist whatever his ontological commitments.”[[520]](#footnote-520) Secondly (and perhaps of more importance), they were an effective visual aid for teaching purposes. As Geoffroy had evidently intended, Cullen used the table to provide a structure for his lectures. He did that by going through the table step by step, explaining to the students how the various substances combined together.

To explain how the tables worked, and in keeping with his attempts to ground his chemistry in natural philosophy, Cullen had to introduce his students to the concept of affinity, or chemical attraction. There were, he told the students, two main forms of attraction. It could be “absolute or relative, single or double.” [[521]](#footnote-521) The former explained how some substances would combine together and others would not. In keeping with his belief in empiricism, Cullen demonstrated this to the students by mixing water with nitre and camphor and showing that water would combine with nitre but not camphor. He explained this by postulating that there was an absolute attraction between water and nitre but an absolute repugnancy between camphor and water.

The Affinity tables themselves were based on the concept of relative attraction. Cullen’s explanation to his audience was based on the observation that “when a body may be united to a third but shows a greater readiness to mix with one rather than the other.” The substances with the greater affinity united, while the one with the lesser affinity separated out. [[522]](#footnote-522) He demonstrated this phenomenon by showing how water would displace camphor in spirit of wine. This, he explained, was because the water had a much greater attraction for the spirit of wine than the camphor. As a result, it displaced the camphor which had originally been combined with the spirit of wine. There was also double elective attraction which occurred between two mixts. The mixts separated into their elements which then recombined to form two new mixts.

The way substances combined to form mixts was recorded in the Affinity tables, which contained the information in a compressed form. They worked by setting out the various substances across the top of the table (see Cullen’s affinity table on the next page). In the columns below were the materials with which those substances were known to combine. More information was given by that material’s position in the column. The nearer the top of the column, the stronger the affinity between that material and the substance at the head of the column.

**Illustration 1: Cullen’s Affinity Table [[523]](#footnote-523)**

This meant that a student could predict what would happen if he added a substance to a mixt. If one of the materials forming the mixt was, for example, from line 2, then it would displace a substance from that mixt if that substance was from line 3. Substances from line 3 and below however, would not displace those from line 2. Cullen expressed the opinion that affinity tables only worked well for the first three substances of a column.[[524]](#footnote-524)

How the information in the tables could be utilised was not immediately obvious and Cullen had to show the students how to read them. When lecturing one class, he demonstrated the purification of antimony from antimony powder. Cullen began his demonstration by instructing his students to use the Affinity table and “see what stands above antimony in the table.” The answer was tin and iron. It followed from this, that if they put iron filings into a crucible and heated them, adding antimony powder would cause a metallic substance (pure antimony) to form in the bottom of the crucible. [[525]](#footnote-525) This occurred because the iron had a greater affinity for the substance which was combined with the antimony to form a powder. As a result of heating the substances together, iron combined with whatever was attached to antimony in its powdered form, and the pure antimony separated out.

When more chemical reactions were discovered, chemists, including Cullen, updated their affinity tables. In contrast to Geoffroy’s table, which had only sixteen columns including phlogiston, Cullen’s affinity table contained thirty-one columns and, unlike those of Geoffroy and Macquer, did not include phlogiston. By the later 1750s, Cullen had not only produced his own table but had had it printed and was distributing it to the students taking his courses.[[526]](#footnote-526) Because Cullen did not write a textbook, if students wanted the information in the table, they had no choice but to patronise his lectures. Given that the way substances combined was such a vital part of chemistry, it was an effective incentive.

The main problem with affinity tables was that they could only be applied to reversible reactions and to mineral substances. [[527]](#footnote-527) When it came to analysing animal and plant extracts, which do not react reversibly, affinity tables could not be used. While, at first sight, this may appear to be a disadvantage, in practice, it did not matter. Plant and animal extracts were commonly used as medicines and apothecaries used distillation methods in order to extract drugs from them. What they were trying to do was isolate the drug in as pure a form as possible. How it would react if combined chemically with another substance was of no interest to them, because changing the nature of any drug would change its effect on the human body.

Another benefit which students derived from the various illustrations which formed such an essential part of Cullen’s lectures was that they, in turn, could use the methods he had devised in order to teach their own pupils. This was a good example of the way the Institutional Patronage of an invisible college worked. (See Chapter 1) One example was George Fordyce who attended Cullen’s lectures in 1756 and went on to teach chemistry in London. Thompson quoted letters between Fordyce and Cullen which make it clear that Fordyce was using Cullen’s affinity tables for his own courses. In a letter to Fordyce, Cullen included a diagram he had devised which could be used to explain double elective attraction. [[528]](#footnote-528) By devising such diagrams Cullen made the way substances combined much clearer than would have been the case if the reaction had been described in words. As the above example demonstrates, Cullen’s cultural capital was not just confined to his chemistry. His pupils also benefited from observing his pedagogical skills.

**The Cultural Capital which Cullen termed the History of Chemical Bodies**

Studying how substances were classified and how they reacted together was of interest to all types of student and gave the subject itself a *gravitas* it had not had previously. In practice, however, students needed to learn about individual compounds. It was the substances themselves which were used to treat patients, to conduct experiments or to manufacture other materials as part of an industrial process. The final section of Cullen’s course was a discussion of some of those substances. Cullen termed these lectures the “History of Chemical Bodies.” As he needed the patronage of students, Cullen had to include in these lectures discussions of materials which students would be likely to use in their future careers. Because of his diverse audience, it goes without saying that some sections of this part of his course must have been of more interest to some groups of students than others.

As explained above, both groups of students needed to know how to classify materials. In order to do so, they needed to be familiar with the exact properties of the various acids, alkalis and the middle (neutral) salts which were produced when acids and alkalis reacted together. Contrary to modern practice, acids and alkalis were designated as saline bodies and in his lectures Cullen concentrated on those substances he termed “salts”, which demonstrated affinity. He justified the practice by saying that “they have more connections with the rest and the knowledge of them is greater than of any other kinds.” [[529]](#footnote-529) In other words, he was giving students information that had been widely investigated and consequently had a degree of certainty that studies of other substances, like plant and animal extracts, often lacked. In what follows, I will discuss the acids, alkalis and salts recorded in the students’ notebooks, highlighting how such information was of value to different groups of students. I start with those substances likely to be of most interest to medical students.

Cullen divided acids into three fossil acids – vitriolic (sulphuric), nitrous and muriatic (hydrochloric) – and vegetable acids. The fossil acids and their salts were important because they were believed to relieve the symptoms of fever, and fevers, of one sort or another, were the commonest forms of illness in the eighteenth century.[[530]](#footnote-530) As a result, students needed to know the chemistry of substances used to treat it. The characteristic feature of fevers was the excess heat produced by the body. Cullen told his audience that mineral acids were effective in reducing body temperature, because they were “refrigerants.”[[531]](#footnote-531) They would also check putrefaction in the blood of the patient. [[532]](#footnote-532) The putrefaction was believed to be one of the results of fevers.[[533]](#footnote-533) Acids had to be administered in a dilute form because they were too “violent” when in their concentrated state.

Middle or neutral salts, which were produced by combining mineral acids with alkalis, were also important because they, too, were often used as refrigerants.[[534]](#footnote-534) The best known of them were Glauber’s salt and *sal digestivum sylvi.* Glauber’s salt was made by distilling vitriol with nitre.[[535]](#footnote-535) In the eighteenth century it was used as a laxative.[[536]](#footnote-536) These preparations were employed because physicians believed that fever was exacerbated by the irritation caused by “a preternatural retention of foeces (sic) in the intestine.” [[537]](#footnote-537) In fact, purgation was one of the most frequently used treatments in eighteenth-century medicine.[[538]](#footnote-538) Another aspect of fever was the body’s failure to sweat. [[539]](#footnote-539) The salt, *Sal digestvum sylvi* was administered to counteract this phenomenon. [[540]](#footnote-540) It was believed that if the patient could be made to perspire, then the fever would remit.

Vegetable acids were important because, unlike fossil acids, they would cure scurvy. [[541]](#footnote-541) As discussed in Chapter 1, Scottish Medical Schools trained far more medical practitioners than the country could possibly employ. Many had to leave Scotland and not a few became ships’ surgeons. Scurvy was the scourge of the British Navy during the eighteenth century. While the exact nature of the condition was unknown, it was important for medical students to know about the condition and its chemistry because, for many of them, it was an illness they were likely to encounter in the course of their careers. James Lind’s work on the efficacy of citrus fruits for the treatment of the condition appeared in 1757 but he could not explain why how they worked. [[542]](#footnote-542)

Cullen divided alkalis into three types – vegetable, fossil and volatile. There was nothing in Cullen’s teachings on vegetable alkali, which would have concerned medical students. In his *Treatise on the Materia Medica,* Cullen is rather dismissive of the use of alkali *per se* as a medicine. [[543]](#footnote-543) He did note, however, that fossil alkali, which he defined as “natural substances being found in some parts of the Earth”, were often found in spa waters.[[544]](#footnote-544) The evidence shows that this information would have been of interest to medical students. The beneficial value of spas had been accepted since Roman times but what was new in the eighteenth century was the application of chemical analysis to their waters. [[545]](#footnote-545) It was the iron found in such water that was supposed to confer its medicinal value.[[546]](#footnote-546) By patronising Cullen’s chemistry courses, students could acquire the skills they needed to analyse spa waters. No fewer than six of Cullen’s students went on to publish their results of such analyses, including Thomas Percival, (1740-1804) and William Withering, (1741-1799). [[547]](#footnote-547) Although Withering became famous for his work on digitalis, he was invited by the government of Portugal to conduct an analysis on springs there. [[548]](#footnote-548) Thomas Percival analysed water in Manchester and noted the presence of lead, which he showed was poisonous. In his published work, he used affinity tables and gave credit to Cullen for compiling them.[[549]](#footnote-549)

The third type of alkali, volatile, “was always an artificial salt”. In other words, it was not known to occur naturally. [[550]](#footnote-550) It could be procured from some plants by distillation and adding chalk to *sal ammonium* also released it.[[551]](#footnote-551) During the eighteenth century, it was known as spirit of Hartshorn. Chemically, it had a pungent odour and later generations termed it “smelling salts.” Unsurprisingly, Cullen classified it as a stimulant. [[552]](#footnote-552) It was, in fact, the safest and most rapidly acting of the stimulants and as it was commonly prescribed at the time – students needed to know its chemistry. [[553]](#footnote-553)

Turning to the non-medical students, they were important to Cullen because their presence at his lectures showed that his extension of the course beyond what was needed for *materia medica* was a sound policy. In order to get their patronage, Cullen had to teach them about the substances that were relevant to Scottish agriculture and industry. This explains why an in-depth discussion of metallurgy was conspicuous by its absence from his lectures. Even though acids were a well-established means of separating precious metals from their ores, mining them was a German industry.[[554]](#footnote-554) The only metal mined in Scotland was lead, although there was some silver present in the ore.[[555]](#footnote-555)

The situation was very different with alkalis which were one of Cullen’s main research interests. [[556]](#footnote-556) This section of his course provided a classic example of the way a consecrated heretic was able to operate. He was, as Bourdieu put it, free to “explore (a) new area for the benefit of … future specialists.” Alkalis were of great interest to industrial chemists in Scotland because of their importance to the linen industry.[[557]](#footnote-557) This was Scotland’s premier industry, employing large numbers of people. As result, knowledge of its underlying chemistry was important. Cullen had used incinerated vegetable matter to produce alkali and he was quite happy to share his experience of using the technique with his students. This specialist knowledge must have been a strong incentive for non-medical students to patronise his lectures. While Cullen’s practical expertise could be acquired by consulting artisans, practical expertise which was based on natural philosophy was impossible to learn elsewhere.

Cullen did point out to the students that there were other methods of obtaining alkali. [[558]](#footnote-558) It could be obtained by calcination of certain sea plants and nitre. According to Cullen, calcination of sea plants produced a form of fossil alkali.[[559]](#footnote-559) This had industrial uses because fossil alkalis made good soap and could promote the fusion of metals and so were used in soldering. [[560]](#footnote-560) While none of Cullen’s students were likely to be actively employed in soldering or making soap, they needed to know the underlying chemistry if they were going to be in a position to employ artisans who would do the manual work for them.

One substance which was of interest to both land owners and future medical practitioners was the alkali, quick lime. From the medical students’ point of view, this was an age in which bladder stones were extremely common and the only hope of a complete cure was an operation with a distressingly high mortality rate. [[561]](#footnote-561) As bladder calculi are dissolved by “lime water and the caustic alkali” *in vitro,* it was hoped that ingesting a dilute solution of it would have the same effect *in vivo*.[[562]](#footnote-562) Cullen believed it could relieve the symptoms of the condition, but in order to do so, “it is necessary that (it) should be exhibited in considerable quantity and very constantly.”[[563]](#footnote-563) The same preparations could also be used as an antacid to counteract stomach disorders, which were also quite common, so the chemistry of the various preparations of lime was important to medical students.

Most quick lime however, was used in agriculture and its associated industries. If it was added to an alkali dissolved in water then it would become caustic.[[564]](#footnote-564) Caustic alkali dissolved oil and oily solids adhering to cloth which made it capable of being washed clean.[[565]](#footnote-565) In modern terms, it acted as a detergent, hence its usefulness to both the linen and wool industries. That property was of minor interest compared to the use of lime as a fertiliser and to make cement. The value to students of patronising Cullen’s classes is illustrated by the way two of them, James Anderson (1739-1808) and George Forsyth (1736-1802), applied the chemistry they were taught to the use of quick lime in agriculture.

James Anderson wrote a practical manual on farming entitled *Essays on Agriculture and Rural Affairs,* dedicating the 2nd edition to Cullen. The book contained a long appendix on the use of quick lime both as a cement and a fertiliser. In it, Anderson not only discussed the various uses of lime but explained them using Cullen’s chemistry, freely acknowledging his source. Fordyce’s book was entitled *Elements of Agriculture and Vegetation* and was published in 1771. He began the book with a chapter entitled “The Elements of Chemistry Necessary to be Understood for the Explanation of the Principles of Agriculture.” It was, in effect, a synopsis of Cullen’s lectures. The final chapter of the book contained precise instructions on how to analyse soils. Again, the debt to Cullen’s chemistry is clear. Paradoxically, the guidance Fordyce gave his readers was a lot easier to follow than that contained in Cullen’s own lectures on agriculture, given some 25 years earlier and the subject of Chapter 6.

The neutral salt of greatest interest to eighteenth-century land owners was nitre, because of its use as a fertiliser.[[566]](#footnote-566) Cullen had done research on the product himself. Just as he was willing to share his experiences of producing alkali with his students, he was also happy to pass on his ideas on the production of nitre and gave the students a detailed account of how to make nitre from materials that were easily obtainable locally. [[567]](#footnote-567) He commented that although it was usually manufactured in France or Prussia, he believed that “it might be made with advantage in this country.” [[568]](#footnote-568) This suggestion illustrates another reason for students to attend his courses. Cullen, like many of his compatriots, was anxious to develop Scotland’s industrial base. As a result of that attitude, he supplied his students with the knowledge they needed to develop industrial processes. If they were able to do so successfully, the resultant process had the potential to make money for them. In addition to its use as a fertiliser, nitre was also used as an antiseptic and, when combined with sulphur, was the basis of gunpowder.[[569]](#footnote-569) The sulphur referred to was sulphur “as found in the bowels of the earth” and not the alchemical term for an inflammatory substance.[[570]](#footnote-570) Nitre also formed a substrate for the production of other salts and as such was useful to all the men attending his courses.

The students’ notes do mention other substances but the above materials have been highlighted because they are discussed in the greatest detail and were evidently of the greatest use to the majority of students. This usefulness was another reason for them to patronise Cullen’s courses. Had he lectured them on compounds that had no medical or industrial applications, the lectures would have been much less valuable to them and they would have no incentive to attend.

**Conclusion**

The chemistry Cullen taught could be described as the “useful knowledge” advocated by Francis Bacon and his courses covered all aspects of the subject. Until Cullen introduced his new courses into Glasgow and Edinburgh Universities, virtually the only people who were in a position to teach the practical aspects of chemistry were artisans. Given the rigid social attitudes of the time, few gentlemen would care to learn from men they considered to be their social inferiors. By attending Cullen’s courses they could learn the techniques used by workmen but in a university setting. Cullen did not regard this part of his course as an optional extra. There is evidence that he insisted that students should go into the university’s laboratory and practice the techniques he was teaching them.

In addition to teaching the practical aspects of the subject, Cullen made the subject easier for students to understand by devising a classification system. This also served as a common means of identifying substances and was used throughout Scotland until the early nineteenth century. Any man who wished to be in a position to discuss chemistry and its associated disciplines with his peers had to be familiar with it. To demonstrate to students what was known about how substances were likely to combine if put in contact with each other, Cullen introduced affinity tables. As more compounds were discovered, he compiled his own version of the table, essentially by updating Geoffroy’s table. Because he did not write a textbook himself, if the students wanted the up-to-date information contained in the tables, they had to patronise his courses. Given the value of the information he provided it must have been a powerful incentive.

Cullen also had to teach students about the various substances they were likely to encounter when they came to practice their various trades and professions. The contents of the students’ notebooks demonstrate just how varied his lectures on the “History of Chemical Bodies” were. He was able to vary this teaching in this way because his position as a consecrated heretic ensured that he was not obliged to stick to a set curriculum. He promised one group of students that, “it will only be when the languor and debility of age shall restrain me that I shall cease to make some correction of my plan or some additions to my course.” [[571]](#footnote-571) Cullen’s success in attracting patronage from students can be shown not only by the large numbers who attended his lectures but also by their assertion that Cullen’s lectures were “always heard with attention and applause.”[[572]](#footnote-572) What attracted the students’ “attention and applause” was the unique nature of Cullen’s cultural capital.

CHAPTER 5: CULLEN AND HIS MEDICAL STUDENTS: HOW DID HIS *MATERIA MEDICA* GAIN HIM PATRONAGE?

The last two chapters described how Cullen sought to advance his own career by teaching students chemistry in a university setting in order to obtain patronage. This chapter deals with Cullen’s relationships with his students of medicine and demonstrates just how successful he must have been in his search for their patronage. To illustrate this, I use the *materia medica* course which Cullen gave in Edinburgh in 1761. Although Cullen lectured on *materia medica* in Glasgow, after he became Professor of Chemistry in Edinburgh in 1755, the 1761 course was the only full course of lectures he delivered on that topic.[[573]](#footnote-573) He was of course, constantly teaching the subject, in what could be described as a piecemeal fashion, in his many clinical lectures. [[574]](#footnote-574)

Cullen had been Professor of Medicine in Glasgow (see Chapter 2). When he moved to Edinburgh, even though he was officially Professor of Chemistry, he continued to lecture on medicine to students in the Infirmary. This clinical instruction was unlike the theoretical aspects of the topic covered by formal university lectures. It based on the illnesses of individual patients hospitalised in the Infirmary. This type of teaching had been largely confined to the Netherlands until 1754 when Doctor John Rutherford, who had been trained in Leyden, introduced the practice to Edinburgh. He was joined shortly afterwards by Cullen and later by Doctors Robert Whytt, James Gregory and Francis Hume (1719-1813).[[575]](#footnote-575) Although, by the mid-nineteenth century this sort of teaching was regarded as an essential part of a medical education, things were different during the eighteenth century. By helping Rutherford to introduce such instruction to Edinburgh, Cullen became one of the pioneers of the reform of medical education. He was allowed to pick his own subjects for demonstration and Thompson asserts that Cullen chose to demonstrate the “diseases which are of daily occurrence.”[[576]](#footnote-576) In other words, he was supplying the students with the type of cultural capital they were most likely to need for their future practices.

From Cullen’s point of view, dedication to such clinical teaching not only showed his practical concern for both students and patients, it also provided him with an unrivalled opportunity to demonstrate to the students that he was not only a good teacher of chemistry but had the cultural capital needed to teach medicine. Teaching in the Infirmary also brought him into contact with the management of the Infirmary. The Infirmary regulations stipulated that some of the managers of the hospital had to be members of the Town Council, and it was the Town Council who were responsible for appointments to the University Medical School.[[577]](#footnote-577) By teaching in the Infirmary, Cullen was able to signal to these more powerful patrons that he was qualified to hold a Chair of Medicine.

This chapter will be based on Cullen’s book, *A Treatise on the Materia Medica* which is essentially the notes compiled by one of the students attending his Edinburgh course. [[578]](#footnote-578) Before the book was published in its final form it was corrected and edited by Cullen.[[579]](#footnote-579) The book was chosen because it sets out his ideas on the topic systematically. Furthermore, as Cullen checked the text himself, it must be an accurate reflexion of his views on the subject. I start by relating the importance of *materia medica* andwho took the course. Then I discuss the course itself in detail. By analysing the way the course was structured I show it catered for the students’ needs and that Cullen was not just an experienced chemist but also a very effective teacher of medicine.

**The Importance of the *Materia Medica* Component of Cullen’s Cultural Capital**

In the eighteenth century, as Guenter Risse pointed out, while university educated physicians knew a lot about anatomy, chemistry and botany, that knowledge was only marginally related to the actual practice of medicine. [[580]](#footnote-580) Cullen’s *Materia medica* could be described as an attempt to take what was known of anatomy, chemistry and botany and apply it systematically to the treatment of patients. [[581]](#footnote-581) Knowledge of *materia medica* was the bedrock of all eighteenth-century medical practice and was so much a part of medical culture that Cullen in his *Treatise on the Materia Medica* did not even feel the need to define it.[[582]](#footnote-582) This form of cultural capital was needed by all practitioners of medicine from university-trained physicians to the lowliest apprentices of surgeons and apothecaries. As Charles Alston put it, “If every other part of physic were brought to perfection, if *materia medica* were neglected it would be the same to the sick as if physicians were ignorant of all.”[[583]](#footnote-583)

Treating a patient was not based solely on a knowledge of *materia medica*. From the practical point of view, before any patient can be treated, the practitioner has to make a diagnosis. Treating the patient for the illness concerned then depends on what the practitioner believes is causing that illness. In the eighteenth century, theories of disease causation were many and varied. In his *Nosologie Methodique,* Boissier de Sauvages listed no less than eight different theories of the causes of fevers alone. [[584]](#footnote-584) In other words, in the eighteenth century, there was very little agreement about the rationale for using any particular drug. Cullen was a man of his time, and so his system of *materia medica* was of necessity, based on his views on disease causation.[[585]](#footnote-585) Cullen argued that the cure of any particular disease consisted in the removal of what he termed its “proximal cause.” [[586]](#footnote-586) He went on to state that those causes were to be sought through “the knowledge of the structure, actions and functions of the human body; of the several changes which it may undergo; and of the several powers by which it can be changed.” But he had an important caveat, “our knowledge of these particulars, however is still incompleat (sic), is in many respects doubtful and has often been involved in mistake and error.”

This pessimistic statement was modified by Cullen’s Newtonianism. He argued that “the similitude in the cause of a disease argues a similitude in the disease thence arising.”[[587]](#footnote-587) When translated into medical practice this meant that patients with almost identical symptoms were almost certainly suffering from the same disease and therefore were likely to respond to the same types of medication. This was an important practical point because it introduced an element of empiricism into a system that was very dependent upon uncertain theories. Those theories had been mercilessly satirised by authors like Moliere (Jean Baptiste Poquelin 1622-1673) and Lawrence Sterne (1713-1768). If they were to retain their credibility as medical practitioners, Cullen’s students needed cultural capital, not only to form a rational basis for their own practice but more importantly, they needed Cullen’s knowledge of what were effective treatments and which medications should be discarded as worthless.

Cullen was asked to teach *materia medica* by his chemistry students in the winter of 1760, when the Professor of *Materia Medica,* Charles Alston (1683-1760), died suddenly. While undoubtedly the students were paying Cullen a compliment by asking him to add the *materia medica* courseto his workload, they were in effect patronising him and were probably aware that they were increasing his income for that year significantly. Because of the need to retain their good will and to demonstrate his ability to lecture on a topic so closely related to clinical medicine, Cullen may have found it unwise to refuse them. The students approached Cullen with their request because, according to John Thompson, they had such a high regard for his teaching.

The class lists (Appendices 2 and 3) for Cullen’s chemistry lectures and the *Materia Medica* course support Thompson’ judgement.[[588]](#footnote-588) They show that out of the 62 students known to have taken the *materia medica* course in 1761, more than half (33) were doing Cullen’s chemistry course and another 21 had done the course at least once in previous years. This means that the majority of the students on the *materia medica* course had been taught chemistry by Cullen, so they must have been aware of his teaching ability. Thompson speculated that it was Cullen’s previous experience of teaching both chemistry and medicine in Glasgow and Edinburgh which enabled him to step in at such short notice. This explanation was probably only part of the story. In addition to his clinical teaching, Cullen, when he was a surgeon in Hamilton, dispensed drugs. [[589]](#footnote-589) Those experiences too, would have contributed to the practical expertise he used to put the course together.

Although *materia medica* was of vital importance to any student of medicine, not all of them took the course. Charles Alston estimated that less than half the students did so.[[590]](#footnote-590) This was not because it was unimportant but because it was so ubiquitous. It occurred in the clinical practice of every medical practitioner. As lectures on *materia medica* had ante-dated clinical teaching at the Edinburgh Infirmary, it seems to have been regarded as equally as important as clinical teaching.[[591]](#footnote-591) Cullen himself had no doubt that *materia medica* lectures were essential for the study of medicine.[[592]](#footnote-592) By 1768, the Edinburgh University authorities had decided that all candidates for an MD degree had to complete a course in *materia medica*. [[593]](#footnote-593)

J. Johnson’s book, *Guide for Young Gentlemen Studying Medicine at Edinburgh,* gives an explanation for why not all students took the course. Johnson believed that *materia medica* lectures were not necessary for anyone with experience of working in an apothecary’s shop.[[594]](#footnote-594) A possible reason for Cullen’s insistence on the need to study *materia medica* in order to obtain an MD degree, was that learning *materia medica* from experience, as Johnson advocated, was not without its problems. What apprentices learned depended on which illnesses their master’s patients happened to be suffering from. *Materia medica* taught during clinical lectures at the Infirmary suffered from the same drawback because only patients with non-contagious and potentially curable illnesses were admitted there.

Students who attended the course could be divided into two broad groups. The smaller group were mature students who went to Edinburgh as part of what Lisa Rosner described as a “Medical Grand Tour.” [[595]](#footnote-595) They were there to polish their medical education and for some, to enhance their status with a university degree.[[596]](#footnote-596) Most medical students however, were fairly young when they went to university and as a result, lacked clinical experience.[[597]](#footnote-597) It is probable that Cullen was aiming his teaching at this, latter group because he began his treatise by explaining his terms. Although he stated that such a list was needed because he used some terms in a different sense to other writers, he gave his main reason for compiling the list as “throw(ing) the whole of the terms into an alphabetical order, and thus give a dictionary which I hope will be useful and convenient for *persons* *entering upon a study of materia medica. [[598]](#footnote-598)*

What Cullen termed a “dictionary” took up an entire chapter in the book and in it, Cullen gave a full explanation of the terms used by writers on the subject. For example *antemetica* was the term used for any preparation used to stop vomiting and *diaphoretica,* for substances which induced sweating. The importance of this facet of Cullen’s cultural capital is obvious because, without knowing what such terms meant and how they were used, students would not be able to make sense of either Cullen’s course or any of the literature on the subject. The information, however, would not be needed by the more mature group who were already familiar with the subject.

**How Cullen used his Cultural Capital to Compile the Course**

Cullen’s cultural capital made him an ideal lecturer on *materia medica* because not only did he have an extensive knowledge of drugs and how they were produced, he also had years of experience of using them. When the students invited Cullen to teach them *materia medica,* he did not have to convince them of how good a teacher he was, they already knew that. But, if he was to retain the students’ faith in his pedagogical ability, Cullen had to devise a course of lectures which would appeal to them. What he did was use the technique he was employing so successfully in his chemistry courses – he devised a classification system. That system was essentially the application of his extensive knowledge of chemistry and botany to medical practice. The system served as an *aide-memoir,* as well as helping students to decide on the best medicine for a specific patient.

The course Cullen devised had a very different emphasis from the *materia medica* Cullen taught in his lectures on chemistry. Although Cullen believed that “Chemistry has … greatly improved the state of *materia medica,”* he knew that medical students needed to learn not only the chemical properties of drugs but how they effected the human body in health and disease.*[[599]](#footnote-599)* Most eighteenth-century systems simply gave a list of the medicines available, often in alphabetical order or by dividing them into groups according to their chemical composition.[[600]](#footnote-600) The classic example was the Edinburgh Pharmacopoeia published in 1746. Although such systems were essentially simple, they had two disadvantages. From Cullen’s point of view, they were widely available, so a course of lectures which simply repeated their contents was unlikely to appeal to students. From the students’ view point, it left them without any guidance as to which drug was likely to be the most useful for whatever condition they were treating. In order to choose a drug, they had to trawl through a long list of preparations with no indication of which one was most likely to be effective.

The system Cullen devised was a radically new method which combined his clinical experience with his chemical expertise. [[601]](#footnote-601) What was different about Cullen’s system was that he classified medicines by their effects on the body, irrespective of their chemical properties or their origins. As Cullen expressed it, practitioners should “practice on general indications” so the medicines which “answer those indications” should be grouped together. This, he described as an arrangement of substances, “according to their agreeing in some general virtues”[[602]](#footnote-602) (a drug’s virtue being its effect on the human body). Cullen believed that by linking the actions of drugs to the way the body behaved in health and disease, “it may be possible in a more simple and clear manner, to explain the operation and virtues of particular medicines.” [[603]](#footnote-603) According to Cullen, the only other writer who had used such a system was Jean Baptiste Chomel, but he considered his work “extremely imperfect.”[[604]](#footnote-604) The drawback of Cullen’s system was that it assumed that the students knew something about how the human body functioned, a feature common to all *materia medica* courses. The students themselves seem to have appreciated that fact and the majority of them who took *materia medica* courses did so in their second and third years. [[605]](#footnote-605)

Another reason for compiling such a different system was that novelty appealed to students.[[606]](#footnote-606) Alexander Coventry, who attended Cullen’s lectures in 1785-6 believed that Cullen had made a mistake by publishing his *First Lines.* The book’s publication meant that the students attending Cullen’s lectures were not hearing anything new and as a result, were “less attentive” to the lecturer. The same criticism could not be made of Cullen’s *materia medica* course. It was totally different from anything that had been offered before. The popularity of his system was demonstrated by the fact that when it was eventually published as a textbook, Cullen’s *Treatise of the Materia Medica* went into several editions very rapidly. It was also recommended by Johnston in his *Guide*. He maintained that the book taught the student “of (drugs) and the diseases in which they are presently used.” [[607]](#footnote-607)

**The Cultural Capital of Cullen’s History of *Materia Medica***

Cullen began his *materia medica* lectures in the same way he had started his chemistry lectures, with a history of the topic. Like his history of chemistry, discussed in Chapter 3, Cullen used the history section of his *materia medica* course to give students an overview of the subject together with his ideas on the natural philosophy of how drugs worked. What was different about his history of *materia medica* was that he was extremely critical of his predecessors. He maintained that in most instances they had simply compiled lists of drugs taken from the works of earlier authors, irrespective of whether they were effective or not. To overcome this problem, Cullen included in his history his evaluation of the various authorities on *materia medica*. By doing so, he was offering his students cultural capital in the form of his own extensive experience of actually using drugs. This gave students the sort of knowledge that could only be gained from the actual practice of medicine. If they had been forced to rely on their own experience, it would have taken them years to acquire Cullen’s expertise. From Cullen’s point of view, it enabled him to justify his practice of omitting from his own course medicines which he believed to be of no value.

In the course of his history Cullen criticised Boerhaave because he had adopted the Corpuscularian philosophy devised by Archibald Pitcairne (1652-1713). [[608]](#footnote-608) That philosophy was based on Newton’s ideas about the basic structure of matter. Pitcairne had adapted those ideas in an attempt to explain how the body worked. By the time Cullen came to teach however, the theory had been widely discredited. As discussed in Chapter 3, it was the Queries at the end of Newton’s *Opticks* which dominated Newtonianism. Because of the change in thinking, Cullen probably felt he could convince students that the Boerhaavian ideas, which dominated the Edinburgh curriculum, were out-dated. While this probably appealed to some of the students, it certainly did not endear him to some members of the Edinburgh medical establishment. [[609]](#footnote-609)

Having dismissed Corpuscularianism, Cullen went on to complain that “since the introduction of chemical reasoning, physicians have generally considered the cause of diseases to be dependent upon the state of the fluids and so have considered the operations of medicines chiefly on the fluids, a doctrine which he “judged to be improper.”[[610]](#footnote-610) Cullen’s rationale for that statement was that chemistry had shown that certain substances had an affinity for each other. It had been demonstrated that where affinity was present “a certain proportion of one to the other is always necessary.” Where there was very little of one substance with respect to the other, the changes produced were “very inconsiderable or hardly assignable.” As the quantity of medicine administered to the patient could only be very small when compared to the total volume of fluid in the body, then it followed that any changes in the body’s fluids produced by the medicine would be almost insignificant.

He then went on to quote Friedrich Hoffman’s (1660-1742) theories on the nervous system.[[611]](#footnote-611) It was Hoffman’s theory which dominated Cullen’s ideas on how the human body functioned and, unsurprisingly, he was anxious to convince his students of its applicability to every branch of medicine. Cullen believed that the body’s fibres were a mixt and that muscles were a “continuation of the medullary layer of nerves.”[[612]](#footnote-612) Whatever stimulus was applied to one part of the body could be transmitted to the rest, if there was free flow of the “nervous fluid.”[[613]](#footnote-613) He believed that this explained why a stimulus applied to one part of the body acted on another part of the body without any “particular connection of nerves.”[[614]](#footnote-614) This accounted for the fact that drugs taken into the stomach could have an effect on other parts of the body.

Geoffroy, Cullen described as a “man of genius but not in his *materia medica.”[[615]](#footnote-615)* There was no doubt that Cullen had a high regard for Geoffroy’s chemistry because he adopted Geoffroy’s Affinity Tables for his own use. His disagreement with Geoffroy was over the use of chemistry to assess the effectiveness of drugs. Geoffroy had attempted to use the “salts, oils and earths,” found as a result of chemical analysis to explain a drug’s virtues. Cullen believed that the only way to assess the effect of a drug was by directly observing its effects on patients. [[616]](#footnote-616)

Cullen was one of the first to adopt the plant classification system devised by Linnaeus. Although he praised Linnaeus for his botanical system, Cullen complained that Linnaeus’ writings on *materia medica* showed a lack of judgement because Linnaeus had included many preparations which he admitted were of no use. [[617]](#footnote-617) By contrast, he praised Petrus Jonas Bergius’ book, *Materia Medica ex Vegetabilius* because although he used the Linnaean system, Bergius omitted drugs he believed to be useless. The only English work Cullen considered to be of any value was that of William Lewis.[[618]](#footnote-618) Cullen believed that Lewis’ description of the action of drugs was accurate and that he “gave a sounder judgement on the action of drugs than had been given before.”[[619]](#footnote-619)

As discussed in the opening part of the chapter, devising a treatment regime for a patient often depended upon the medical theories the man accepted. Because the rest of the Edinburgh professoriate had been taught by Boerhaave and still accepted his theories, Cullen must have been conscious that the rationale for some of his treatments was controversial.[[620]](#footnote-620) In the *Preface* to his *Treatise of the Materia Medica* he wrote that his “speculations may often appear doubtful.” [[621]](#footnote-621) The fact that his nickname was “Old Spasm” shows that at least some students agreed with that statement, regarded his ideas on the nervous system as something of an obsession and did not accept them.[[622]](#footnote-622) Some students, like John Coakley Lettsom objected to Cullen’s use of chemistry to explain the action of drugs.[[623]](#footnote-623) In the absence of a consensus on how drugs effected the human body, students had to simply decide for themselves which of the different opinions were correct.

Cullen concluded the history section of the course by explaining, “I … have taken the liberty of offering the judgement which I have formed on the chief writers who have written upon it. As there has occurred more occasion to blame than to commend, it has been a disagreeable task; and I am afraid that public opinion may be offended.”[[624]](#footnote-624) It is not clear from the text who Cullen regarded as the public. However, criticisms of Cullen’s theories on how the human body worked did not significantly devalue the cultural capital he gave his students. Theories might determine which drugs any physician recommended but as Cullen pointed out in a later section of his course, the only thing that was important in practice was how a patient responded to them. That was something which could only be learned by experience.

**The Cultural Capital in Part 1 of Cullen’s *Thesis of the Materia Medica***

Students, when they came to set themselves up in practice, were dependent upon patronage from patients. They must have been aware that as practitioners of medicine, they would be judged by the success or otherwise of any treatment they recommended. This explains why they needed the *materia medica* component of Cullen’s cultural capital. That cultural capital gave them the knowledge they needed to prescribe a drug for whatever condition they judged the patient to be suffering from. What was probably more important to them however, was Cullen’s experience of using the drug. Almost certainly in time, they would develop their own ideas about which drug was most effective for any particular condition but until they did so, they were reliant on the cultural capital of men like Cullen in deciding which form of medication to recommend to patients.

During the eighteenth century, there was plenty of competition to supply medical advice. Even physicians with an MD were forced to compete for their fees, not only with other physicians, but with everyone from wise women to snake oil salesmen.[[625]](#footnote-625) The dilemma faced by Cullen’s students arose because, in the absence of a legally enforced regulatory system, anyone could describe themselves as a medical practitioner. [[626]](#footnote-626) The competition came, not only from other medical practitioners of one sort or another but from the numerous books on the subject of diet and health. Many of the latter were intended for those with no medical training.[[627]](#footnote-627) Books with titles like *Health Restored or the Triumph of Nature over Physick, Doctors and Apothecaries* were ubiquitous.[[628]](#footnote-628) With such wide-spread medical knowledge, self-diagnosis was common.[[629]](#footnote-629) Emma Spary has shown the difficulties physicians had in convincing their patients of the value of their advice.[[630]](#footnote-630) As personal experience was the final court of appeal, physicians were regarded as just one more source of information rather than authorities on the subject. One physician lamented “whether tis better to be a Knave and increase his practice by humouring the Fools and letting them die in their own way; or to be honest and lessen his practice in saving them with methods displeasing, because really there are no other which can help them.” [[631]](#footnote-631)

To overcome these problems, Cullen supplied his students with not only his experience of using drugs, but also the theoretical background to *materia medica.* He was firmly convinced, this was the nervous system. “The peculiar effects of substances … which we call *medicines,* when applied to the human body, depend upon their action upon its sentient and irritable parts.”[[632]](#footnote-632) By linking the action of drugs to natural philosophical ideas, Cullen was following the same philosophy he was using in his chemistry courses. Introducing a philosophical explanation of drug action was in keeping with his belief that although theories were rarely true they were needed for the practice of any “Art.” Without a theory to investigate, no progress was possible in any branch of natural philosophy. In practice this meant that as medical practitioners, his ex-students would be investigating the rationale for using any particular drug by assessing its effects on their patients.

Cullen ended the First Part of his course with a section on the chemical composition of various food stuffs. Although from a twenty-first century perspective this appears to be far removed from *materia medica,* it was an important part of eighteenth-century medical practice. The fact that the section of food stuffs takes up approximately 50% of the first volume of Cullen’s *Treatise* is an indication of just how important the topic was at the time. Cullen based his natural philosophy of diet on the fact that all animal tissues (which included the human body) must ultimately have resulted from the conversion of vegetable matter. In his *Treatise*, Cullen stated that food analysed chemically, had three components – acid, sugar and oils. Although he could not explain how vegetables became animal tissues, he did remark that what he described as the gastric menstruum was different in different animals and appeared to be related to their diet.[[633]](#footnote-633)

His second reason for imparting this form of cultural capital was connected to the eighteenth-century idea that everyone needed a dietary regime tailored to their own particular requirements. The educated elite of the time believed themselves to be members of the “Age of Enlightenment” which had great faith in the ability of reason to improve society. One of the things deemed capable of improvement was the health of the population and that depended upon what they ate.[[634]](#footnote-634) Sickness was thought to be an avoidable evil. In order to avoid illness, a knowledge of the individual’s constitution was required so that a personal health and fitness regime could be worked out by either the person concerned or their medical advisor.[[635]](#footnote-635) Cullen’s many consultation letters demonstrate this phenomenon. A large number of them refer to the patient’s constitution and give advice on ways of improving it, usually by diet and exercise.[[636]](#footnote-636) Medical students intending to become physicians, had to have the cultural capital needed to devise such regimes because compiling them for patients would constitute a significant part of their future practice.

This idea of a regimen had a long history. It could be traced back to Galen’s concept of the *Non-Naturals* which were air, food and drink, motion and rest, sleeping and waking, retention and evacuation and passions of the soul*. [[637]](#footnote-637)* By Cullen’s day, the Non-Naturals had become detached from their theoretical roots, the Humoral Theory. [[638]](#footnote-638) According to that theory, the humoral balance in each individual was different, giving rise to different Temperaments. As Cullen was convinced that the Greeks had arrived at the idea of Temperaments by observation, he used the natural philosophical component of his cultural capital to suggest a modified version of the theory. He postulated that the state of the body’s solids and fluids could explain the differences between individuals.[[639]](#footnote-639) That belief was supported by experimental work done by Bryan Robinson. In his book, *Animal Oeconomy* Robinson reported his investigations on the effects of “various fluids, of age, of different kinds of Weather, and of exercise” on bodily fibres.[[640]](#footnote-640) These ideas enabled students to give their patients an up-to-date explanation of why everyone needed their own personal regimen. When combined with his comprehensive, scientific analysis of food stuffs, it gave Cullen’s students an advantage over unqualified practitioners because they were able to use natural philosophy to justify the regimens they were suggesting.

**The Cultural Capital in Part 2 of Cullen’s *Thesis of the Materia Medica***

Cullen’s *Materia Medica* course was intensely practical. This was another of his pedagogical strengths. He realised that he needed to provide medical students with the cultural capital needed to actually *practice* medicine. As a result, Cullen began this second section of his course by giving students the benefit of his own experience on how to evaluate drugs. This was a vitally important skill for students. As future practitioners of medicine, they needed to know not only how to evaluate any drug in current use, but also how they should go about assessing the effects of any treatment which might be introduced at a future date. It was those skills which would ultimately become an important part of their own cultural capital.

He began that section of his course by discussing the various ways in which natural philosophers had sought to find objective methods of assessing the effects of drugs. His discussion started with his own area of expertise, chemistry and he had to admit that chemical analysis *per se* had “not answered the expectations entertained of it.” [[641]](#footnote-641) In other words, there was no chemical analysis of a drug which would indicate how it would act in or on the human body. One eighteenth-century technique which played an important role in the chemical analysis of any substance was simply to smell and taste it.[[642]](#footnote-642) This technique too, Cullen was forced to admit was of no help in assessing the effects of a drug. He did add that as a general rule, substances without any smell or taste “may be considered inert and useless” as medicines.[[643]](#footnote-643)

Smell and taste however, were used to identify substances whose effects on the body were already known. It was such observations that made the production of drugs by distilling plant and animal extracts possible. During the seventeenth century, the French *Academie des Sciences* had developed standard methods for this procedure.[[644]](#footnote-644) The drawback of the methods was that the only means of assessing which fraction of the distillate contained the active drug was by smelling and tasting the various products coming from the retort. In other words, what the French academicians had done was develop reliable methods of purifying drugs rather than investigating their effect on the human body.

The next topic Cullen discussed was the possibility of assessing medicinal virtues based on botanical similarities. This method had become feasible once Linnaeus had introduced a viable form of plant classification. Using Linnaeus’ binomial system, it had been observed that plants of the same genus might have similar medicinal properties. Cullen did not endorse this method wholeheartedly. It “may be of some use … but cannot be applied … without a great deal of caution.”[[645]](#footnote-645) He finished this section of his course by concluding “an experience of the effects of substances upon the living human body, is certainly the only sure means of ascertaining medical virtues.” [[646]](#footnote-646) Effectively, what Cullen was teaching was that there was no substitute for experience. By attending his course, students obtained the benefit of Cullen’s experience of treating patients.

Cullen finished his course by discussing the use of drugs in treating established disease. In other words, what to do if adjusting the Non-Naturals had failed. Because his course was based on his ideas of natural philosophy, he divided the section into two parts, drugs which acted primarily on the solids and those whose main effect was on fluids. Although he disagreed with many of his contemporaries over whether solids or fluids were more important in explaining disease, Cullen, like them, believed illness was a result of disturbances of the solids and/or fluids. What was of more importance to students was that his classification was structured, not according to a drugs chemical composition but its likely effect on a patient.

This was the part of Cullen’s course which students needed some medical knowledge to understand. Until he knew something about the way the animal oeconomy changed in disease, a student would be unable to follow Cullen’s rationale. Once he could make a diagnosis and work out how the patient’s illness effected the animal oeconomy, then he would be able to decide on a suitable treatment. If the student had concluded that his patient’s condition needed for example stimulants, he could look up possible treatments by turning to the relevant section in Cullen’s book. Under the heading of *Stimulants,* he would learn that they were substances which “excited the motion of the living principle or produced action of the moving fibres.” They acted on the solid fibres. [[647]](#footnote-647) In that same section, the student would find all the different forms of stimulant set out, along with Cullen’s experience of using them. This section contained no fewer than 50 pages of the various substances thought to act as stimulants. The plants were classified according to the Linnaean system. Also included were brief details of how the drugs were manufactured. As most of the students taking the course were doing or had done his chemistry course, Cullen knew he could refer to the various methods of preparing drugs without having to spell out the practical details.

The above sections have demonstrated why medical students patronised Cullen; it was because he was such a good teacher. This applied not only to chemistry, but also its clinical applications in the form of *materia medica.* His extensive cultural capital was demonstrated by the fact he was able to devise a course at a few weeks’ notice. In other words, Cullen had the experience required to supply students with what they needed to know and the pedagogical skills to put the information across.

**A Comparison of Cullen’s and Alston’s Courses**

The merits of Cullen’s course can be demonstrated by comparing it with that of the man who Cullen had replaced at such short notice. Comparing the two sets of lectures demonstrates that Cullen’s cultural capital was far more relevant to the actual practice of medicine than Alston’s because his classification of drugs was linked to the way the human body behaved when effected by disease. Furthermore, in his lectures, Cullen included his own experience of using drugs and did not rely on extensive quotations from other authors.

Charles Alston’s lectures were published after his death with an Introduction by the man appointed to be his successor, the botanist, John Hope (1725-1786). [[648]](#footnote-648) In his *Preface*, Hope stated that Alston had finished writing his book just before he died so that he (Hope) felt that it should be published as Alston had left it. Alston’s lectures open with the statement “that a knowledge of simples is absolutely necessary for everyone who designs to make physic or pharmacy his profession … can’t be denied.” [[649]](#footnote-649) Although *simples* was a well-known medical term during the eighteenth century, Alston made no attempt to define it, even though he was addressing students who may not have been familiar with it. He continued with several pages of complaints about the number of errors in the numerous books on the subject and in the *New Pharmacopoeia*. While the text may have been of interest to someone like Cullen who was familiar with the problems Alston addressed, Alston’s comments would not have made sense to students who were almost certainly attending *materia medica* lectures because they knew little or nothing about the subject.

Alston did not make any attempt to explain the action of drugs until Lecture IV when he stated that “the changes produced by medicines are either the natural effects of their physical powers or the consequence of the impression made by them on the sensory faculty that is the sensation they excite.” [[650]](#footnote-650) Alston’s “power” was the equivalent of Cullen’s “virtue.” Some physicians linked this “power” to the concept of chemical affinity. [[651]](#footnote-651) A search of Alston’s work produced no evidence that he had done so. [[652]](#footnote-652)Although he stated that the action of a drug could be physical, mechanical or chemical, he went on to state that, in his opinion, the effects of most drugs were mechanical “because of the sensation (they) cause.”[[653]](#footnote-653) Alston, like Cullen could not adequately explain the action of drugs. He differed from Cullen in that he did not attempt to support his ideas on how drugs might act with explanations based on natural philosophy.

Alston also maintained that it was impossible to make “any judgement on any medicine without being acquainted with the simples themselves.” As a result of this belief, he structured his course the conventional way, around the drugs themselves, rather than the indications for prescribing them. [[654]](#footnote-654) This meant that his lectures simply detailed the substances listed in pharmacopeia and consequently were of no help when it came to deciding which drug should be prescribed for any particular disease. Unlike Cullen, Alston refused to accept the Linnaean classification of plants which he criticised for its “wanton innovation of names and terms.”[[655]](#footnote-655) As a result, plants were cited in alphabetical order and classified according to which parts of them were deemed to have medicinal value, that is, roots, leaves, seeds or fruits. Once again, this was of no help when the student was wondering which treatment was likely to be the most effective for a patient’s illness. Cullen’s major insight when he devised his own course, was to see that what students wanted to know was how to treat patients. It was that form of cultural capital which students would find it difficult to extract from Alston’s lectures.

Alston’s basic problem was that although he possessed a very large fund of cultural capital, he lacked Cullen’s pedagogical skills. Alston’s cultural capital can be demonstrated by his original research on the action of opium. This he carried out both on himself and on various isolated muscles and nerve preparations in frogs. [[656]](#footnote-656) He had also published work on the action of quick lime and been part of the committee which revised the Edinburgh *Pharmacopoeia*.[[657]](#footnote-657) The lectures themselves were further evidence of his cultural capital. He backed up almost every assertion he made with at least one quotation from a learned authority on the subject --- usually at great length and often in Latin. He explained “I would have you carefully mark the citations from the authors and experiments to be mentioned so that you may consult one and repeat the other” [[658]](#footnote-658)

This was a common practice at the time and for someone with an in-depth knowledge of *materia medica* his lectures would almost certainly have been of interest. From the students’ point of view however, it seems reasonable to suggest that Cullen’s method of summing up an author’s arguments in a few sentences and in English must have been easier to understand and annotate. Cullen’s *Treatise* was an excellent example of the way he was able to take a mass of information, reduce it to a set of basic principles then demonstrate how those principles could be applied in practice. Even allowing for the fact that Cullen may have had ulterior motives, his verdict on Alston’s lectures as “tedious and of little importance” does seem to be justified.[[659]](#footnote-659)

**Conclusion**

The students who asked Cullen to teach them *materia medica* were for the most part already familiar with his teaching skills from his chemistry course. Although other students were probably aware of Cullen’s teaching ability from the clinical lectures he gave in the Infirmary, the bulk of his *materia medica* students were doing or had already done his chemistry lectures. In other words, it was his cultural capital to which they responded. Cullen’s relationships with them were a vivid illustration of the way the patronage system operated in the eighteenth century. He responded to their needs by teaching them. They appreciated his efforts and in turn gave him a degree of financial security by attending his lectures, paying him to put on a *materia medica* course for them.

Within a few years the students to whom he had taught chemistry and *materia medica* would have left the university and be practising medicine themselves. Despite that, Cullen was still in a position to benefit from their patronage. Cullen had an extensive medical practice which he carried out, not only by visiting the patients personally, but also by writing to them. If the patient or their doctor believed that their symptoms were particularly troublesome they would often seek the advice of a well-known physician like Cullen. In looking for someone to consult, patients often asked their doctor to recommend someone. As a result, Cullen’s ex-students were then in a position to offer Cullen patronage by referring their patients to him.[[660]](#footnote-660) This ultimately benefited not only the patient’s doctor and the patient, but also Cullen.

Chapter 6: HOW DID WILLIAM CULLEN’S AGRICULTURAL LECTURES GAIN HIM PATRONAGE?

This chapter continues the theme of Cullen’s search for patronage by discussing one of Cullen’s earliest, and probably least successful innovations, namely agricultural chemistry. The evidence suggests that he introduced the topic because there was, in early eighteenth-century Scotland, a growing realisation among some land-owners that their farming methods were in need of improvement.[[661]](#footnote-661) As Cullen’s chemistry lectures were intended for a general audience and not just medical students, he seems to have thought this was a situation he could exploit by introducing agriculture into his courses.[[662]](#footnote-662) This was a radically new departure.*[[663]](#footnote-663)*

Cullen’s rationale appears to have been that by teaching the natural philosophy underpinning agriculture he could gain patronage from men who had an interest in improved farming methods. Although he does not say so, he seems to have been targeting students who did not intend to make their livelihoods from medicine. Cullen gave his reasons for including agriculture as part of his chemistry course in a letter to Lord Kames.[[664]](#footnote-664) With the letter to Kames, Cullen enclosed a draft of his lectures. As the letter referred to lectures “already given”, this must mean that agriculture was part of his chemistry course when the letter was written in 1749.[[665]](#footnote-665)

As none of the students’ manuscripts from Cullen’s chemistry lectures contain material from the draft of his agricultural lectures, it seems safe to assume that Cullen did not lecture on the topic for very long. He did lecture on the subject in Edinburgh in 1768 but those lectures were delivered privately, presumably to audiences with a direct interest in the subject.[[666]](#footnote-666) The lectures of 1768 were subsequently published as *The Substance of Nine Lectures on Vegetation and Agriculture, delivered privately in 1768.* They were not published until after Cullen’s death.

The reason for Cullen’s removal of agriculture from his course can be explained by his need to obtain the students’ patronage. To do so, he had to teach them what they wanted to learn. His removal of that part of his course suggests it was of little interest to the men who attended his lectures. This is not surprising. We know that Cullen’s Glasgow lectures were intended for students with an interest in all aspects of chemistry, but evidence from other sources suggests that in the 1740s the only men who were likely to have an interest in the improvement of agricultural methods were a few wealthy landowners and their agents, not students.[[667]](#footnote-667) T.C. Smout described them as a “coterie of feudal amateurs, aristocrats and lairds, many with an elite legal background.”[[668]](#footnote-668) The group concerned was small and for the most part, inter-related. As I.H. Adams put it, they had “a great interest, almost interference was manifested by relatives when it came to the improvement of each other’s estates.” [[669]](#footnote-669)

Worse still was the fact that during the eighteenth century, it was disputed whether chemistry had anything to contribute to improving farming methods. With the benefit of hindsight it is possible to see that it was not until the mid-nineteenth century that chemistry had made enough progress to be of value to farmers. Justus von Liebig (1803-1873), generally regarded as the father of organic chemistry, summed up what appears to have been the a common opinion of eighteenth-century agricultural chemistry when he stated that “agriculture knew nothing about the soil, the atmosphere or the action of the plough or manure.” [[670]](#footnote-670) In other words, Cullen had misjudged his potential audience in two ways. The first was that he had seriously over-estimated the number of men who had an interest in improved farming methods. Second, for reasons that will be explained later in the chapter, the type of chemistry he was teaching was of no real help to farmers when they sought to improve agricultural methods.

Cullen may have missed an opportunity to make agricultural chemistry of some relevance to medical students. When he gave his course on *Materia Medica* in 1761, he included a long discussion of foodstuffs, which took up nearly 200 pages of text of the resultant book. The composition of the various food stuffs, including vegetables, was important to medical students who were going to have to prescribe dietary regimens to their future patents. Reading the text of this later work makes it clear that Cullen knew how food was grown, as well as its nutritional value. Yet at no point did he attempt to introduce the topic into his agricultural lectures. Had he done so, he could have made them more relevant to the practice of medicine and as a result, persuaded some medical students to patronise his lectures on chemistry as well as his lectures on *materia medica*.

I start this chapter with a brief discussion of the state of farming in early eighteenth-century Scotland in order to show why Cullen thought he could attract patronage from students by lecturing on agriculture. Then I turn to Cullen’s plans for a research project on the chemistry of agriculture which shows how he thought his cultural capital could benefit agriculture. Next I discuss the lectures themselves. This part of the chapter is based on documents held in the Special Collections of Glasgow University Library. They consist of Cullen’s (undated) notes for his lectures and a folder of miscellaneous notes, also undated which appear to be jottings of his ideas for those lectures. By comparing the content of his lectures with later works by Kames and James Anderson (1739-1808), I demonstrate why Cullen’s lectures were unlikely to be of use to men who actually wanted to know how to manage a farm. Finally, I discuss how, although the lectures did not appeal to students, they were successful in gaining him powerful patrons because they brought Cullen to the attention of Lord Kames who was in a position to offer him the patronage which was vital for his future career.

**The State of Agriculture in Cullen’s Day**

This section will demonstrate why Cullen thought that by including agriculture in his courses he could earn patronage from men who were anxious to improve agricultural standards. It is followed by a short discussion of the economic factors, largely unrelated to agriculture, which were eventually responsible for improvements in Scotland’s farming methods. The story begins in the 1690s when there had been two Scottish catastrophes. The first was the spectacular failure of the Darien Scheme and the second was the result of a few years of abnormally bad weather in Scotland itself. This destroyed crops, causing a serious famine, “the memory of which lasted for generations.”[[671]](#footnote-671) As a consequence of those two disasters, by the beginning of the eighteenth century Scotland’s economy was virtually bankrupt. [[672]](#footnote-672) There were also food shortages in 1740-41.[[673]](#footnote-673) In addition to these major disasters, Adams suggested that a further reason for Scotland’s underdevelopment compared to England were the political uncertainties, which did not begin to resolve until after the 1707 Act of Union. [[674]](#footnote-674) Those misgivings persisted until after the 1745 rebellion, when the Stuarts were decisively defeated and the political situation rapidly stabilised.[[675]](#footnote-675) That stabilisation situation coincided with Cullen’s entrance into university life.

A number of historians have suggested that at the time, Scotland was two nations.[[676]](#footnote-676) One was the Highlands, with marginal land inhabited by men who were Gaelic-speaking, making their living from cattle-droving and enlisting in the army. The other was the Southern part of the country where there was good arable land with good communications to the main cities and inhabited by English-speakers.[[677]](#footnote-677) At the beginning of the eighteenth century, many Scottish farms were still being run according to the old medieval system where there were no closed fields, the land being worked by several farming families in a system known as “runrig.” [[678]](#footnote-678) Many large estates were so underdeveloped economically that tenants frequently paid their rents in kind, usually by helping out on their Laird’s land at busy times, like the harvest. Land improvement however was virtually synonymous with enclosure and to effect this, the peasantry had to be turned off the common land which had supported them and their families for centuries.[[679]](#footnote-679) As a result of the paternalism associated with aristocratic patronage, some landowners refused to change their farming methods because they were conscious of the hardships that reform could bring their tenants. [[680]](#footnote-680)

Improvements in agriculture did not occur automatically from farming good land in the Lowlands. Attempts to raise agricultural standards there were hampered because most farmers possessed neither the level of literacy nor the financial resources needed to avail themselves of the knowledge of improved farming methods.[[681]](#footnote-681) At the beginning of the eighteenth century, most of the English-speaking Lowlanders were subsistence farmers too, and rented land on short-term leases.[[682]](#footnote-682) Such individuals had no interest in improving their farms because they had no guarantee they could reap the benefits of their labours. William Mackintosh argued that the holders of short-term leases frequently left the land in a worse state than it was when they took it over.[[683]](#footnote-683) As a result of the all these factors, there was no possibility that most farmers (who were the largest occupational group in eighteenth-century Scotland) would patronise Cullen by attending his lectures.

The driving force which eventually led to agricultural improvement in Scotland was the economic factors associated with the relationship between political power, land-ownership and 1707 Act of Union. Because land ownership was synonymous with power and because there were so few land owners, political power was concentrated in the hands of a small number of wealthy families like the Campbells, Dukes of Argyll. [[684]](#footnote-684) The system was blatantly undemocratic and was the result of Scotland’s system of primogeniture and entail which meant that only the eldest surviving son could inherit land. The younger sons of landowners were usually trained in a profession, most often law.[[685]](#footnote-685) Originally, the aristocracy had seen their estates as sources of military power which, during previous centuries, were needed to protect their holdings from the depredations of their neighbours. As the rule of law gradually extended from Edinburgh, large numbers of potential soldiers were no longer needed. Instead these men became subsistence farmers. After the Union of 1707, wealthy landowners tended to migrate to London and needed money to support their London life-styles.[[686]](#footnote-686) As a result, they had to adopt improved agricultural techniques to increase the income from their land. It has been claimed that their zeal for land improvement was driven by the fact that it enabled land owners to increase the rents they claimed from their tenants.

James E. Handley argued that Scottish farming methods had, in fact, begun to improve in the few years after the establishment of the Hanoverian dynasty in 1688. He noted that at first, “many Scots gentlemen from prudence, or from adherence to a lost cause, preferred to reside abroad.”[[687]](#footnote-687) That period of exile brought them in contact with advanced farming techniques on the continent which they brought back to Scotland when they returned home. Hadley also pointed out that most innovations began in the Scottish Lowlands among landlords who had had the opportunity to observe developments in the North of England at first hand. [[688]](#footnote-688) T. M. Devine agreed that agricultural improvements began in the Scottish border regions. From the early eighteenth century, the small-scale arable farmers who rented land there were displaced so that the landlords could introduce sheep farming which generated much higher incomes. [[689]](#footnote-689) This displacement did not give rise to wide-spread poverty because the families concerned moved into the adjacent villages and earned a living working either as farm labourers or in the developing wool and linen industries. As Cullen was raised in this area, he must have seen those changes for himself, hence he had no qualms about advocating agricultural improvement.

The aftermath of the 1745-46 rebellion, not only stabilised the political situation but also provided the government with an opportunity to introduce further improvements to Scottish agriculture. When the fighting was over, the government confiscated the estates of men who had been involved.[[690]](#footnote-690) This placed large areas, especially in the North, under the direction of men, like Lord Kames who were very knowledgeable about improved farming methods. They based their innovations on their own experience of trying out the new farming methods for themselves. Thanks to his Kames’ patronage, Cullen was one of their expert advisors. [[691]](#footnote-691) Lord Kames became one of the most active of the commissioners of the board appointed to run the Annexed Estates.[[692]](#footnote-692) The Board, however, did not become fully functional until 1760 when it received government funding.[[693]](#footnote-693)

Another problem which may have suggested to Cullen that it would be advantageous to him to introduce agriculture into his chemistry lectures was the fact there were almost no books on scientific agriculture, as it applied to Scotland, until the mid-eighteenth century.[[694]](#footnote-694) This meant that landowners could not acquire cultural capital from reading. While there were a significant number of books on farming in England, almost the only book on specifically Scottish agricultural problems was George Donaldson’s *Husbandry Anatomised* published in 1697 (which Cullen owned). Such books did not begin to appear in any number until the late 1750s. One exception to that rule was Robert Maxwell’s *Select Transactions of the Honourable the Society of the Improvers of Agriculture* published in 1743*.* In his preface, Maxwell complained that there were “few Scots books upon Husbandry; and the Rules adapted to foreign soils and Climates cannot easily be applied and often won’t answer to ours.” [[695]](#footnote-695) It was this deficiency which Cullen tried to use his cultural capital to remedy.

In summary, there was an appreciation among some Scottish landowners that they needed to know more about modern farming methods in order to feed a growing population.[[696]](#footnote-696) Cullen saw that need and set out to supply it in the form of the cultural capital of chemistry and botany. By doing so he seems to have misjudged the size and interests of his potential audience. Smout has argued convincingly that agriculture only became of general interest after the 1760s when the ideas of a few improving landlords were taken up by the rural middle classes and the clergy.[[697]](#footnote-697) It was the generation educated after the 1760s which introduced land improvements on a large scale. Furthermore, those improvements were driven by economic necessity and were dependent upon the experience of men with a practical knowledge of agriculture, not on the chemical analysis of plants and soils.

**The Cultural Capital of Cullen’s Agricultural Lectures**

The first suggestion that agriculture was a subject worthy of study in a university had come from Robert Maxwell, in his *Select Transactions of the Honourable the Society for the Improvement of Agriculture*.[[698]](#footnote-698) The members of the Society believed very strongly that there was a need for research and development. As the book was published just before Cullen began to lecture on the topic, it is tempting to speculate that by teaching agricultural chemistry, Cullen was using his cultural capital to respond to Maxwell’s suggestion. If he had been able to obtain the patronage of members of the Honourable Society it would have improved his career prospects considerably. Even if Cullen was not responding directly to Maxwell, he must have been aware of the changes in farming practices in the area around Hamilton before he left for Glasgow. Whatever his primary motivation was, Cullen’s lectures were designed to use his cultural capital to supply students with a knowledge of agricultural chemistry which he hoped could be used to help them to improve farming methods.

In his lectures, Cullen took the agricultural methods which had been used for centuries and tried to explain them in terms of eighteenth-century natural philosophy. In the notes he made for the lectures, Cullen stated that “a Man profest of a Theory practises with more certainty.”[[699]](#footnote-699) It followed from that belief, if Cullen could supply agriculture with a theoretical grounding which could be tested, then better farming methods would result. Without natural philosophy, most farmers would continue to use the same methods that had been handed down from father to son for centuries. Cullen hoped that by patronising his lectures, agricultural improvers would learn the natural philosophy of agriculture and as a result, be able to conduct chemical experiments whose results would lead to improved farming methods.

Cullen must have given some thought as to what his own cultural capital could contribute to agriculture. In a letter to Kames in 1750, he set out his ideas for a research project designed to discover which substances should be added to soil to improve the growth rate of plants.[[700]](#footnote-700) The theory underpinning the experiments was based on the work of Tournefort, presumably Pitton de Tourniquet (1656-1708), who showed that what was in soil was also present in plants.[[701]](#footnote-701) Tournefort had investigated the composition of plants used as medicines. Cullen proposed to extend Tournefort’s research by investigating the composition of plants grown for food. As Cullen proposed to use the same type of soil each experiment, his rationale seems to have been that any changes in the growth rate of the plants must be due to what was being added to the soil.[[702]](#footnote-702) Among the substances Cullen intended to use were quick lime, putrefied manure and sea salt. He proposed to carry out his experiments indoors to obviate the effects of the weather.

Once the plants had matured, a chemical analysis was to be performed in order to assess the amount of nitre they contained. He had already observed that a solution of nitre applied to plants increased their growth rates but nitre applied directly to the roots of plants killed them. From this Cullen concluded that nitre itself was not a source of nourishment. Cullen’s aim seems to have been to test the efficacy of the various forms of fertiliser that were being used routinely on Scottish farms. His reference to previous experiments suggests that the experiments he discussed in his letter to Kames were part of an on-going project. What is not clear from the letter is whether he ever found the time and/or the money to carry on with his experimentation. [[703]](#footnote-703) It seems reasonable to suggest that by informing Kames about his proposed experiments, Cullen was attempting to advertise his cultural capital.

In the rest of this section, I will discuss the lectures themselves in some detail. There are two reasons for such an analysis. First of all, with the exception of Charles Wither’s paper and Jan Golinski’s work, the lectures have had little historical attention. [[704]](#footnote-704) Second, without a detailed account of what Cullen was teaching, it is impossible to understand why the lectures were so little help to agricultural improvers. In a letter to Kames, Cullen expressed the view that the whole of agriculture could be discussed under two headings, “those that relate to the nourishment of plants or … the application of that nourishment.”*[[705]](#footnote-705)* However, the seven lectures themselves can be summed up under three headings.[[706]](#footnote-706) The first three lectures aim to explain the basic facts of agriculture like the feeding and growth of plants and the composition of soils. How to analyse soil chemically was the subject of the next two lectures and the course concluded with his explanations of why different methods of agriculture were successful.

Because Cullen was convinced of the importance of plant nutrition, he started his first lecture by stating, “All plants derive their nourishment from soil … we must enquire what is the nourishment? And whether all plants have one common nourishment.”[[707]](#footnote-707) He then declared that he was inclined to answer the latter question in the affirmative. His reasoning was that although different soils contained whatever nourished plants in different proportions, the quality of that nourishment was the same. He postulated that this was demonstrated by the fact that soil taken from a garden would support the growth of tropical plants in a greenhouse and one tree could be grafted onto the root stock of another. His reasoning appears to be that the nourishment the different types of plants received was identical, no matter what its source.

He then went on to discuss the work of men who had done experiments in an attempt to explain the exact nature of the nourishment of plants. The evidence was problematic because there was a discrepancy between the experimental evidence, which showed that water alone was needed and the fact that all farmers knew that fields had to be manured regularly. [[708]](#footnote-708) In the lecture, Cullen mentioned Charles Bonnet (1720-1793), Du Hamel de Monceau (1700-1782), Robert Boyle and Van Helmont (1580-1644) all of whom had all grown plants in pots by simply adding water to the soil which surrounded them.

Cullen attempted to explain the discrepancy between the experimental evidence and farming practice by suggesting that the reason why water alone appeared to be sufficient to support plant growth was because the earth in the pots acted as some sort of filter. He speculated that what he described as the “alimentary matter” in water (which was feeding the plants) was not elementary water but “an impregnation of it (we need not enquire what).” The nourishment could not be separated from ordinary water by distillation. In other words, he was suggesting that there was something in the water which was providing the plants with their nourishment but was so intimately bound to the water that it was impossible to separate the two components.

The statement “we need not inquire what” shows how Cullen approached the apparently contradictory nature of the evidence. His perspective on what might be present in the water which nourished plants displayed the same attitude to the unknown that he adopted towards the sub-microscopic structure of matter in his chemistry lectures. In those lectures, Cullen maintained that speculations about unobservable structures were not important because such knowledge did not affect what could be observed directly. By the same token, knowledge of the exact properties of the water which found its way into plants did not have a material effect on what was observed in agricultural practice. In another borrowing from chemistry, Cullen introduced the chemical concept of affinity to explain how plants take in water. He suggested that plant roots have an elective affinity for some sorts of nourishment but they cannot completely reject any nourishment presented to them.[[709]](#footnote-709)

As plants derive their nourishment through their roots, this led on to the subject of the second lecture which was entitled “Roots.” Cullen began by stating that, “multiplication of roots was the chief object of husbandry.” In keeping with his aim to support the known facts of agriculture with the latest research, he quoted the work of Charles Bonnet, who in 1754, published a book entitled *Researches sur L’Usage des Feuilles dans les Plantes; et sur autre Subjets relatifs a l’Histoire de la Vegetation.* [[710]](#footnote-710) Bonnet had immersed plants in water containing a small amount of dye and observed how the dye had travelled from the finest roots towards the plant’s central stem. He had also made observations on the way the roots of plants develop, which Cullen quoted. Du Hamel had carried out similar experiments with identical results. Cullen noted the mutual dependency of roots, leaves and the penetrability of soils, which he summed up in the statement that “the tillering of plants is somehow connected with the progress of vegetation in the roots.”[[711]](#footnote-711) He also commented that he thought that hoeing improved the growth of plants by cutting their roots. It is interesting to note that Cullen did not seem to be aware of the work of Stephen Hales (1677-1761). Hales had carried out experimental work on how plants absorbed water, which he published in a book of 1727, entitled *Vegetable Statics*.[[712]](#footnote-712)

What Cullen did in his first two lectures was provide experimental confirmation of how plants grow. In his next lectures Cullen turned to the medium in which that growth was taking place, namely soil and its constituents. Lecture three began with the statement that the constituents of soil were clay, sand and mucilage and a perfect soil contained all three components. [[713]](#footnote-713) He went on to describe these three constituents of soil in some detail. Sand would not support growth because it would not hold water. Clay, on the other hand retained water but would only support growth on its surface. Mucilage was the chemical term for a substance that would absorb water and soften. It was an essential part of soil because it promoted growth.*[[714]](#footnote-714)* There were numerous varieties of it and it was effective because “whether animal or vegetable, (it) can unite with a considerable quantity of water so as to entangle it and destroy its fluidity.” This destruction of fluidity explained why, although plants needed water, if land was flooded (a common problem in Scotland) then the soil would not support anything but aquatic plants. [[715]](#footnote-715)

Lectures four and five were dedicated to the analysis of the various components of soil. He began his fourth lecture with a macroscopic analysis, noting that soils differed according to the proportions of sand, clay or mucilage they contained. Except for his use of the term “mucilage,” the majority of farmers would recognise what he was describing. [[716]](#footnote-716) He went on to postulate that it was the varying amounts of sand, clay and mucilage in different soils which determine their overall character and ended the lecture by dividing soils into heavy or light soil, loam and deep soil. When it came to describing the appearance of soils, Cullen did not rely on the Principles he used for chemical analysis. He seems to have changed his classification system according to the information he was trying to convey. In lecture three a perfect soil was one which contained clay, sand and mucilage but in the next lecture, he defined a perfect soil as one which “contains the most water without being in a fluid form.” In lecture Five, he divided soils into “warm and cold” which were the same as “dry and wet.” While the descriptions he used were almost certainly immediately recognisable by anyone familiar with agriculture, it did mean that he was not entirely consistent when describing soil types.

Soils do contain other components which can be detected solely by chemical analysis. This was the sort of cultural capital which students could only obtain from someone like Cullen. In contrast to what he had to say about the macroscopic appearances of soils, his analysis of soil *components* used his Principle based system as set out in Appendix 1. For example selenites were described as a calcareous earth. It is clear that Cullen had analysed soils himself because, in the lecture, he expressed surprise at the amount of selenites he had found in some soils. [[717]](#footnote-717) There were, Cullen informed the students, substances present in all soils such as acid soluble, calcareous earths and vegetable fibres. The latter “abounded in every soil.”

In addition to the above substances, which were universally present, Cullen also stated that soil could contain saline and oleaginous substances derived from putrefaction, and sometimes metals, as well.[[718]](#footnote-718) According the Cullen’s system of chemical Principles, a saline substance was one which would dissolve in water. Oleaginous substances were classified by Cullen under the Principle “Inflammatory.”[[719]](#footnote-719) They could be animal, vegetable or mineral in origin.[[720]](#footnote-720) The putrefaction he described was also recognised as a chemical process during the eighteenth century, although its exact nature was uncertain.[[721]](#footnote-721) As far as metals were concerned, Cullen believed that the only metal that was immediately recognisable in soil was iron, which was present in all forms of clay. He thought it might be responsible for its viscidity.

The fifth lecture was devoted to a detailed analysis of the types of soil described in his previous lecture. Effectively, what Cullen was doing in this lecture was explaining how to conduct a chemical analysis which would detect the various substances in soils which he had described in his previous lecture. He began with a discussion of mucilage which he thought was responsible for a soil’s friability. He thought that friability was a characteristic feature of good soil and could be directly observed. Despite the fact that it could be observed, he told students that it could be detected by lixiviating the soil. [[722]](#footnote-722) This term was so widely used in the chemistry of his day that Cullen did not feel the need to define it but it referred to placing the substance to be analysed in water and boiling it. This would separate the soluble mucilage from the insoluble components of the soil as the former would dissolve in the heated water. After pouring off the water, the substance could be recovered from the water by evaporation. The amount of sand present in soil could be ascertained by effusion.[[723]](#footnote-723) Once again, Cullen did not explain what the term meant but it was a similar process to lixiviation, except that no heat was applied to the added water. The soluble parts of the soil would dissolve in the water leaving the insoluble sand behind. In his chemistry lectures, Cullen used the process when demonstrating the difference between an aggregate and a mixt. (See Chapter 3)

Clay and pure sand are both white in colour. If sand was red or yellow it meant that minerals were present and could be detected by the appropriate analysis. Finally, the amount of calcareous earth present in the soil could be ascertained by pouring weak acids onto the sand and clay. The acids combined with any earths present which could then be poured off, thus separating them from the sand and clay which remained. These were simple chemical analyses which could be carried out on any farm by anyone with a little basic equipment. The lectures demonstrated how a simple chemical analysis could contribute to the knowledge of soil composition.

The weakness of Cullen’s position was that it was impossible to use eighteenth-century chemical analysis to improve crop yields because no-one knew which substances in soil were responsible for the growth of vegetation. As a result, farmers had to rely on their experience to assess the effects of different additives. In other words, all they could do was apply different forms of manure to the soil and see what effects they produced. [[724]](#footnote-724) The difficulties were expressed by James Anderson in his *Essays on Agriculture and Rural Affairs*

*Thus it appears that in whatever light we view this subject, we meet with uncertainty and doubt. Were we to proceed forward and consider the nature and distinguishing qualities of different soils;-and the several changes that may be produced upon these by culture or other circumstances;-the properties of the different manures and the effects of these various circumstances … we would still find the same uncertainty prevail. [[725]](#footnote-725)*

Cullen finished the lecture with a section entitled, “In what manner a soil may deviate from fertility and how recovered.” This seems to be a reference to the Scottish practice of dividing farms into infields, which were manured regularly and outfields which were not. The outfield would produce a crop of oats for three to four years but then had to be “rested” for a similar period until the soil recovered its fertility. [[726]](#footnote-726) If land was left to “rest” for too long, its clay would concrete. While topics like the freezing of water and its effects on soil were regarded as a part of chemistry in the eighteenth century, in attempting to teach farmers how to reduce the recovery period of “resting” soil, Cullen cited known agricultural methods. These included the effects of frost, ploughing and allowing cattle to break up the ground by trampling on it.

Lecture 6 was entitled “The Effects of Roots.” This was an expansion of the topic of the second lecture and what Cullen did was use natural philosophy to explain the necessity of crop rotation. This had been of interest to farmers for millennia and even in the eighteenth century, men writing on farming often took classical authors as their authorities.[[727]](#footnote-727) Cullen postulated that plants produce their effects on the earth through their reactions with the water in the soil. He maintained that roots not only took moisture from the soil but also communicated water to soil. This moisture, which plants received from their leaves, was transmitted back to the soil through their roots. Cereals, he observed, take a lot of moisture from the ground when they ripen, while legumes add to the soil. The fact that legumes could enhance the fertility of soil had been known since Roman times and was referred to in Virgil’s *Georgics*. Although Cullen did not mention Virgil in his agricultural lectures, he did quote him when talking about the effect of legumes on soil in his *Treatise of the Materia Medica.[[728]](#footnote-728)* Cullen’s rationale for crop rotation was that in order to get the best yield from something like corn, which took what Cullen described as “moisture” out of the soil, it needed to be grown after legumes which improved the soil. [[729]](#footnote-729)

He continued by discussing the effects of different crops on soils, including turnips, carrots and parsnips which he claimed if harvested before they seeded, improved the soil. These crops were relatively recent additions to Scottish agriculture and Cullen was evidently endorsing their use.[[730]](#footnote-730) He also cited work on potatoes but was unable to say whether potatoes improved the soil or not. Cullen concluded the lecture by postulating that soil could be prevented from concreting by “dissolving the mucilage.” This was necessary to allow the roots to penetrate the soil as he had described in his second lecture. It was to be done by using “manures of a saline kind.” He then listed the various types of substance which were being applied to soils in Scotland in the hope of increasing their fertility, along with their effects on the soil.[[731]](#footnote-731)

The final lecture also dealt with other ways in which soils could be improved. Cullen started this lecture by dismissing Jethro Tull’s system of relying “wholly on pulverising the earth” which he claimed would not correct soil’s deficiencies.[[732]](#footnote-732) To do that, it was necessary to add the missing components to the soil. He then went on to discuss his own ideas about what should be applied to the soil to improve its fertility. Mucilage, he claimed, was the most important. Cullen maintained that it could be lost by being washed away or it could evaporate once it had reached an advanced degree of putrefaction. This provided an explanation, based on natural philosophy, as to why fields had to be manured regularly. The two basic substances he recommended as manures were vegetation and dung. Both substances needed to be putrefied and mixed together to be effective. That process was usually achieved by allowing both substances to rot down together in a heap. There followed a long section of advice on how to maintain dunghills, a topic unlikely to be of any interest to chemists or medical students.

Vegetation, like legumes, if left in the ground could also be used to improve its fertility. This too, had been known since Roman times. Cullen provided an up-to-date chemical explanation of the phenomenon by postulating that while in the soil, they underwent a process of “acetous fermentation,” which resulted in putrefaction. Shortening this process was one of the aims of agriculture and Cullen recommended the application of marle to achieve it.[[733]](#footnote-733) He concluded by suggesting that “water is a great source of mucilage … All water putrefies and thereby shows that it contains animal or vegetable substances, the only two sources of Putrefaction that we know of in Nature.” This was a re-statement of his belief, expressed in his first lecture, that there was something in water that provides nourishment for plants.

The above account has shown that Cullen had taken his cultural capital in the form of his botanical and chemical expertise and applied it to agriculture. The lectures do succeed in giving an explanation, in terms of eighteenth-century chemistry and botany for what most farmers knew from practical experience. But, in trying to apply natural philosophy to the *improvement* of agriculture, Cullen was undertaking an almost insurmountable task because there had been insufficient research done to relate the chemical analysis of soils and vegetation to the factors needed to promote the growth of crops. This is of course, a retrospective judgement, but it does explain why most farmers had so little interest in chemistry.

**A Comparison of Cullen’s Cultural Capital with that of other Agricultural Improvers**

In this section I discuss the various reasons why Cullen’s lectures did not appeal to students. I start with what appears to have been a common view on the value of the cultural capital of chemistry when applied to agriculture and conclude with a discussion of books by Scottish agricultural improvers to show how they actually went about improving agricultural yields.

Although Cullen believed in chemistry as useful knowledge, the value of the cultural capital of chemistry in relation to agriculture was regarded as debatable until the mid-nineteenth century. Phillip Pusey (1799-1855) claimed that it was absurd to “put any value on the doubtful precepts of chemistry.”[[734]](#footnote-734) Pusey was not an eccentric, but a noted agricultural improver who wrote extensively on farming. As he was also a Member of Parliament and President of the Agricultural Society of England, he was clearly influential and there were many who shared his opinions. [[735]](#footnote-735) It was not until Justus von Liebig (1803-1873) published his *Chemistry in its Applications to Agriculture and Physiology* in 1840 that the importance of the chemical analysis of soils and crops became generally accepted.[[736]](#footnote-736) In the eighteenth century, because so little was known about the chemistry of plants and soils, no-one was able to translate Cullen’s chemical analysis of soil into any meaningful suggestions about improving farming methods.

Agricultural methods were being improved by men with experience of farming and unlike his *materia medica,* Cullen’s practical experience of agriculture was probably limited. It is difficult to imagine how someone with an extensive medical practice and a full schedule of lectures on chemistry, botany and medicine, would have the time to devote to the labour intensive practice of farming. When he came to publish his own book, *The Gentleman Farmer,* Kames complained that “writers on agriculture, very few excepted, deliver their precepts from a study lined with books.” [[737]](#footnote-737) To a certain extent, this criticism must have applied to Cullen. [[738]](#footnote-738) Although John Thompson thought Cullen’s management of his brother’s farm in Parkhead near Glasgow gave him the necessary experience to teach agriculture, recent research on such farm ownership suggests that he was unlikely to have done any actual farming. [[739]](#footnote-739)

Writing in 1842, Charles Daubeny (1795-1867), Professor of Chemistry at Oxford and at the same time, holder of the first Chair of Rural Economy there, stated that

*It cannot be denied that experience and tradition are still the main sources to which the farmer looks for information and that it* (chemistry) *is as yet far from having shed any steady light over the obscurity in which his processes are veiled. [[740]](#footnote-740)*

If a noted agricultural chemist, who was one of the earliest advocates of the work of Justus von Liebig could make such a statement in the nineteenth century, then it must have been true a hundred years earlier. [[741]](#footnote-741) This can be demonstrated by comparing Cullen’s lectures with four of the best known works on farming that were written during the eighteenth century. Two publications that were available before Cullen began to teach were Donaldson’s *Husbandry Anatomised,* of 1697 and Maxwell’s *Select Transactions*. Both books addressed the problems which contributed to the poor standard of Scottish agriculture and both offered practical solutions like where to dig ditches and plant trees. In the case of the *Select Transactions,* what was published was, for the most part, problems of land management that had been put to the Honourable Society for the Improvement of Agriculture, along with their suggestions for dealing with the difficulties. The answers to the queries were suggestions about applying recognised farming methods and did not include chemical analysis of soils and vegetation.

Later in the eighteenth century, when there was more interest in farming in Scotland, more books began to appear. Two of the best known were James Anderson’s *Essays Relating to Agriculture and Rural Affairs,* published in 1775 and Kames’, *The Gentleman Farmer,* published in 1776*.* Both books offered the sort of practical advice that every farmer needed. Anderson’s book concentrated on how to enclose land, the relative value of hedges and ditches, how to drain bogs and how to sow seeds. His appendix, entitled an *Essay on Quick Lime,* described its use as both a cement and a fertiliser. The book did include the chemistry Anderson had learned when he attended Cullen’s chemistry lectures in 1757, including a detailed account of how the analyse lime stone. [[742]](#footnote-742) Although Anderson described the uses of limestone at some length, he admitted that he had no idea of how it produced its effects in promoting the growth of crops. [[743]](#footnote-743)

Kames’ book described how to clear land, discussed whether to use horses or oxen to pull a plough, the types and rotation of crops, how to fertilise them along with similar, related topics. These aspects of agriculture took up about 75% of the book. The last part of Kame’s book was entitled *Theory of Farming.* Although it was based on natural philosophy and the experimental basis of agriculture (the part of farming ostensibly covered by Cullen’s lectures), Kames commented that “agriculture depends not much on theory.” [[744]](#footnote-744) He based his own natural philosophy of farming on the Newtonian concept of gravity which, for Kames, included elective attraction and repulsion. He discussed this at some length because he thought it accounted for the water retaining properties of various soils. He was evidently familiar with Stephen Hales’ book *Vegetable Statics* because he referred to it on several occasions but concluded that the mechanism by which plants converted the water they imbibed into sap “will for ever remain a secret.” [[745]](#footnote-745) His verdict on the purpose of agriculture was that its sole object was to restore fertility to exhausted fields by “the plough, by dung or other manure.”[[746]](#footnote-746) At no point does he suggest that chemical analysis of soil had anything to contribute to that process. There were simply too many unknowns for it to be effective. [[747]](#footnote-747)

From the above considerations, it has to be said that anyone wanting to know the practical details of agricultural methods would be better served by Kames’ or Anderson’s books. Cullen’s lectures were designed for the man who already had practical experience of farming and was interesting in learning about the natural philosophy which explained it. They were of no interest to the average farmer, much less a chemist or a medical student. This explains why Cullen’s agricultural lectures never attracted the attention of his chemistry lectures. His failure to pursue the topic in his ordinary lectures shows how conscious Cullen was of the need for student patronage. If they did not want to know about a topic, he did not risk annoying them by persisting with it.

**Patronage and Cullen’s Agricultural Lectures.**

Cullen’s attempts to introduce agriculture into his chemistry lectures had mixed results when it came to obtaining patronage. In relation to students, Cullen’s lectures on agriculture seemed to be counter-productive. The only plausible explanation for Cullen dropping the agricultural component of his courses was that he realised that his attempts to “open Young Gentlemen’s views” on the subject were not a success.[[748]](#footnote-748) In Glasgow, professors were paid a salary, so their need to attract an audience was not as pressing as in Edinburgh, where they were not. Once Cullen moved to Edinburgh his income depended on the size of his audience.[[749]](#footnote-749) If his students were not receptive to what he was teaching, then he would suffer financially. It seems to have been the “coterie of feudal amateurs, aristocrats and lairds” described by Smout who appreciated Cullen’s attempt to teach the natural philosophical principles underlying agriculture. Unlike most students, they already had a knowledge of, and an interest in, farming.

Cullen was simply ahead of his time because, although the majority of men in eighteenth-century Scotland were farmers, the improvements in agricultural practice were being driven by the few men who owned land.[[750]](#footnote-750) Attitudes in Scotland began to change after the 1745 rebellion and an interest both in agriculture and the Highlands started to develop. After the publication of *Ossian* and Edmund Burke’s essay on *The Sublime and the Beautiful,* tourism to remote regions became fashionable. [[751]](#footnote-751) Men like Cullen’s pupil, John Walker, began to take an interest in investigating the natural history of the area, which was seen as ripe for economic development.[[752]](#footnote-752) The methods of improving farming techniques became known to the wider farming community through the popular and practical works of men like Maxwell, Kames and Anderson. Cullen did offer lectures on agriculture in 1768. By then the subject was much more popular and the lectures were delivered privately, not to his usual audience of students.

One of the most powerful men with an interest in agricultural improvement was Lord Kames. Kames was not only a landowner but also an influential lawyer. Ian Simpson Ross has argued that Kames had an interest, not only in agricultural improvements, but also “in encouraging merit in the youth of his of Scotland.”[[753]](#footnote-753) This made Cullen an ideal client for Kames’ patronage and that patronage introduced Cullen to some of the most influential men in Scottish society. In addition to his connections to many of the leading families in Scotland, Kames was also a client of the Duke of Argyll. It was Kames who arranged for Cullen to meet the Duke of Argyll, who was known as the “uncrowned king of Scotland” because he wielded so much power and influence.

By becoming acquainted with Kames and his friends, Cullen gained a great deal of social capital. According to Thompson, Kames was attracted to Cullen because of what he had heard of Cullen’s lectures and because they shared an interest in “chemistry, agriculture and philosophy.” [[754]](#footnote-754) In other words, it was Cullen’s cultural capital to which he responded and it was Cullen’s position as a consecrated heretic which gave him the freedom to introduce that capital into his lectures. Those shared interests seem to have developed into a life-long friendship and there is no doubt that Kames’ patronage proved invaluable to Cullen on numerous occasions.

**Conclusion**

Agriculture in Scotland in the eighteenth century was less advanced than its English counterpart. Cullen’s inclusion of agricultural science into his chemistry course showed how forward looking he was. However, his introduction of the topic into his ordinary chemistry course was premature and possibly counter-productive, as far as his students were concerned. Cullen was very conscious of the fact that he needed to teach students what they felt would be useful to them in their future careers. Agricultural chemistry did not interest the majority of students because very few of them were landowners.

In his 1749 letter to Kames, Cullen stated that he was not well prepared to lecture on the topic. This statement about his lack of preparedness may refer to the fact that compared to his lectures on chemistry and *materia medica* Cullen lacked direct experience and there were few up-to-date publications on the subject that he could have consulted. Furthermore, although he was giving students valuable cultural capital in the form of chemical analysis, he could not tell them how the chemical properties of the soil were related to the types of crops it would support. There had simply not been enough work done on the subject to draw useful conclusions from such analyses. The actual work of land improvement meant learning how to drain land, where to plant hedges, different methods of ploughing and the how to care for the new breeds of sheep and cattle. Chemical analysis of soils had very little to contribute to these topics. While the lectures contained the most up-date natural philosophy and chemistry of the time, this form of science was completely new. It was only of interest to those who were already familiar with eighteenth-century farming practices *and* had an interest in natural philosophy.

Although Cullen’s attempts to introduce agriculture into his chemistry courses were not entirely successful with students, they did however, gain him a lot of social capital. It was a shared interest in agricultural improvement that brought Cullen to the attention of Lord Kames and other progressive land owners. They were all influential Scottish patrons. Cullen’s time in Glasgow along with his interest in agriculture established his scientific credentials and enabled him to make a name for himself, in other words, to gain symbolic capital.

CHAPTER 7: HOW DID CULLEN’S INDUSTRIAL CHEMISTRY GET HIM ARISTOCRATIC PATRONAGE?

This chapter will show how Cullen used his knowledge of industrial chemistry to secure the patronage of aristocrats and land-owners. An account of the philosophy underlying that chemistry, its practical aspects and how he taught it to students have already been discussed. This chapter focuses on analysing how Cullen used his cultural capital in the form of his chemical expertise to target patrons from outside the universities. Because of this aspect of his work, Cullen contributed to what future generations would term “the Industrial Revolution”.[[755]](#footnote-755) Jan Mokyr has argued convincingly that the revolution was not a series of profound insights into scientific theory *per se* but compilations about what worked in practice. [[756]](#footnote-756) It was Cullen’s knowledge of “what worked in practice” which enabled him to gain patronage from wealthy entrepreneurs and landowners, including Scotland’s most powerful patron, the Duke of Argyll. It was the latter’s aristocratic patronage which was responsible for Cullen’s appointment to the Chair of Chemistry in Edinburgh.[[757]](#footnote-757)

I will concentrate on three industries which were important to Scotland in the eighteenth century and show how Cullen’s cultural capital consisted of his research into the chemical processes upon which those industries depended. The industries will be mining, the production of salt and the manufacture of linen. I will first describe the state of these industries in eighteenth-century Scotland and follow this by a discussion of how Cullen’s industrial chemistry appealed to the men who ran the industry from whom he hoped to gain patronage. I start the chapter with a long quotation from a draft for a lecture which spells out Cullen’s thoughts on the potential for chemistry to improve Scotland’s industrial base. It shows the breadth of Cullen’s chemical knowledge and its relevance beyond medicine.

**Cullen’s Justification of the Need for the Cultural Capital of Chemistry**

Like most well-educated Scotsmen, Cullen was aware that both Scottish agriculture and industry were not as well developed as those of her Southern neighbour. [[758]](#footnote-758) In one of his early courses, Cullen lectured on what a study of chemistry might achieve for Scotland. [[759]](#footnote-759) I quote from the lecture because, in it, Cullen sets out his aims clearly. The fact that Cullen felt the need to deliver such a lecture suggests that when he began to teach his expanded chemistry curriculum most students were unaware of the relevance of the subject to industrial development.

*In this course I have given you some of the applications of chemistry to Arts to convince you of the great and general utility of this study. By looking into the Arts as commonly practised you will soon perceive that most of them are incomplete and imperfect and at the same time, their improvement is to be desired.* [[760]](#footnote-760)

Cullen held that his system of chemical classification, which was based on five bodies was better than previous systems because it related to chemistry’s practical applications.[[761]](#footnote-761) He then went through the various Arts in detail pointing out where improvements could be made and how the chemistry concerned was related to his classification system. Cullen explained that Saline bodies were valuable because of their use for bleaching, dying and preparing manures. He also pointed out that the substances currently used were far from perfect. Oily bodies were needed because they were used to make candles and soap. If a way could be found to make purer wax, candles might burn more slowly and last longer and soap would be of a higher quality. Moving on from salts and oils, he emphasised the importance of Earthy bodies for the production of quick lime and cement and their potential uses in the search for cheap and plentiful materials to prepare porcelain. In addition to the above, work on metallic substances might produce a way of extracting precious metals from the common ones and also offer insights into improving the tempering of steel. Finally, he turned his attention to water, mentioning that research into “find(ing) the safest means of correcting the faults of common water” would be of benefit to the whole of society. He concluded:

*These are a few instances of chemical inquiries, most of which are particularly interesting to this country and in which a discovery would certainly be attended with profit. And now let me advise any of you who would prosecute any of these to consider that a general knowledge of chemistry is, if not absolutely necessary, at least highly useful in every particular enquiry.*

The topics he discussed in his lecture make it clear that Cullen saw there was a strong connection between his cultural capital, in the form of his chemistry, and the needs of eighteenth-century Scottish industry. Cullen’s vision for Scotland’s development was based on the Baconian idea that chemistry was a useful science. The chemistry Cullen included in his new courses was vital for Scottish improvers, who were some of the most influential men in Scotland. Cullen seems to have reasoned that if he could make them aware of the cultural capital he possessed then his prospects of attracting their patronage were greatly increased.

**Cullen’s Cultural Capital and the Mining Industry**

Cullen’s cultural capital was linked to the mining industry through his knowledge of mineralogy. The central question for eighteenth-century mineralogy was how to recognise which rocks contained valuable minerals and earths and were therefore worth the trouble and expense of mining them. This was the sort of information which was vital to the men who owned the land on which those minerals were to be found. As landowners, they all had the symbolic capital which was often associated with aristocratic patronage. The cultural capital Cullen was offering them was a better way of judging the significance of any substances found on their land.

For centuries, the only means of deciding where to sink a shaft was by studying the features of the landscape. [[762]](#footnote-762) Things began to change when, in the eighteenth century Cullen and other chemists endeavoured to add the chemical analysis of minerals tothearmamentarium available to landowners and gentlemen*. [[763]](#footnote-763)*Because the chemical analysis of rocks could detect the various types of substances present, chemistry contributed significantly to the development of geology as a science, particularly in cases where practitioners and their advisors were university educated. UntilLavoisier’sideasweregenerally accepted, the chemistry practised in Scotland was based on the system of Principles developed and taught by chemists like Cullen.[[764]](#footnote-764) In other words, the understanding of eighteenth-century Scottish mineralogy and geology was based on the cultural capital supplied by chemistry.

Before he went to teach in Glasgow, Cullen’s own knowledge of chemical mineralogy seems to have been limited to what he learned by working in Murray’s shop in London and his own shop in Hamilton. His time spent in an apothecary’s shop in London would have given him a grounding in the manufacture of those mineral compounds which were used as medicines. They were widely synthesized by apothecaries and surgeons, once iatrochemical ideas had been accepted. [[765]](#footnote-765) As the compounds concerned were minerals, their chemistry was applicable to mineralogy. But, if he was going to gain patronage from outside of the university, Cullen needed more cultural capital then his early experience seems to have given him. The evidence suggests that he realised this himself and began to acquire that capital when he moved to Glasgow.

Like his knowledge of Baconianism and Newtonianism, Cullen appears to have acquired his knowledge of mineralogy mostly through his reading. Thanks to Thompson, we know the titles of the books relating to mineralogy that Cullen was anxious to acquire when he arrived in Glasgow. [[766]](#footnote-766) They were works on metals and mineralogy written by Georg Stahl’s teacher, Johann Joachim Becher (1635-1682), Stahl himself (1659-1734) and his pupil, Johann Pott (1692-1777), and Johann Bohn (1640-1718). As he also asked for a German dictionary, he was clearly planning to read them in the original German. Although they were written by authors who had trained as medical doctors, the men concerned were primarily mineralogists. Their chemistry was based on the concepts of mixts and aggregates that characterised Stahl’s and also Cullen’s chemistry*.*

Cullen was committed to learning about chemistry as it related to mineralogy because of the opportunities it offered to acquire patronage. To that end he also enlisted the help of William Hunter and John Moore. In September 1748, William Hunter wrote to Cullen telling him he had bought books for him on a recent journey to Europe. He expressed regret at being unable to obtain Johann Kunckle’s (1630-1703) *Philosophia Chemicae,* René Antoine de Ferchault de Réaumur’s (1683-1757) *L’Art de Convertir le Fer Forge en Acier* and Stahl’s *De Elogiis Vitriolli.[[767]](#footnote-767)* Glasgow University Library has a letter written to Cullen in 1749 from George Moore, one of his students who had gone to Paris to train as a surgeon. [[768]](#footnote-768) In the letter, Moore mentioned that he had bought many of the chemistry books that Cullen had asked him to purchase and was arranging to have them sent to him. In other words, Cullen was going to considerable lengths to expand his cultural capital by obtaining books on chemistry and its application to metals and mineralogy. [[769]](#footnote-769)

The reason for his interest in German works on the composition of stones was that mineralogy was far more advanced in Germany than in Britain. This was probably because mining in Britain was predominantly coal and lead mining, which uses very different techniques from those used in the mining of metals.[[770]](#footnote-770) Germans, as Cullen acknowledged in his lectures on the history of chemistry, had far more experience of mining for precious metals. The earliest systematic textbooks of the chemistry of minerals were those produced in the seventeenth century for German mining engineers.[[771]](#footnote-771) Because they were intended for artisans, not academics, they were written in the vernacular and German became the standard language of mineralogy.[[772]](#footnote-772) Anyone, like Cullen, who was anxious to acquire an in-depth knowledge of the chemistry of metals had to be able to read the authorities on the subject in German. We do not know how fluent Cullen’s German was, but as his lectures, discussed in the History section of Chapter 3, indicated, he knew enough to be able to read a textbook. All the evidence points to the fact that Cullen was equipping himself with the cultural capital he needed to teach mineralogy. However, he was not simply an academic chemist who supplied his students with the theoretical background to the subject. Thanks to John Walker (1731-1803), we know that Cullen, (along with Walker and other students,) travelled around Lowland Scotland to study the practical form of mineralogy through its links to geology. *[[773]](#footnote-773)* Both men collected minerals which they subjected to chemical analysis.[[774]](#footnote-774) This was this aspect of mineralogy that explains its appeal to land owners. It did so by telling them if there were any commercially viable mineral deposits to be found on their lands.

Mineralogy was not just a search for rocks from which metals could be extracted. It also included a study of earths. This interest in earths was precipitated by the introduction into Europe of high quality porcelain from China in the sixteenth century.[[775]](#footnote-775) As the Chinese refused to disclose how porcelain was made, a search began for its manufacturing secrets. One of those employed by the German authorities to investigate porcelain was J.H. Pott (1692-1777). Pott was a pupil of Stahl and Hoffmann and, as noted previously, Cullen was anxious to study his work when he first began to teach chemistry. Cullen himself undertook research in an attempt to find how to make “Porcelaine” (sic).[[776]](#footnote-776) Because he believed that Scotland’s prosperity would be enhanced if porcelain could be made from Scottish raw materials, he confined his search to minerals that were easily accessible locally.[[777]](#footnote-777)

Finding the type of clay needed to manufacture porcelain would have had considerable commercial implications for Scotland and if Cullen had succeeded in finding it, he would certainly have had no trouble in attracting wealthy patrons to help him exploit that discovery. Unfortunately the kaolin clay, which is the basic raw material needed, is not found in Scotland (but that was not known at the time.) J.F. Bottinger (1682-1719) did eventually discover a way to produce porcelain in Europe and he established the Meissen factory in Saxony to exploit that knowledge. But he, too, refused to divulge the secret of its manufacture. Although he did not succeed in discovering how to manufacture porcelain from Scottish clays, Cullen’s work did enable him to improve the methods of investigating earths and to upgrade Pott’s system of classifying them. This cultural capital Cullen incorporated into his lectures and so his students benefited from it. This was especially true of chemistry as it related to mineralogy. In the following paragraphs, I give examples of how some of the students who patronised Cullen’s courses utilised this aspect of his cultural capital.

Cullen’s attempts to connect chemical mineralogy to the industrial and agricultural interest of patrons proved to be of interest to some students, especially those who wanted to become advisors to aristocrats or industrialists. This applies to the two most famous chemists taught by Cullen, Joseph Black and John Walker. Both of them were able to exploit his system of chemical principles in the service of mineralogy.[[778]](#footnote-778) They also provide a good illustration of how relationships changed over time and of how what started off as a patron/client association, could develop into genuine friendship, if the men came from the same social group. Black succeeded Cullen as a lecturer in Glasgow and then obtained Cullen’s Chair of Chemistry in Edinburgh when Cullen became the Professor of the Theory of Medicine. According to Thompson, it was Cullen’s regard for Black which motivated him to resign the Edinburgh Chair in order to create a vacancy for Black.[[779]](#footnote-779) In his lectures, Black taught Cullen’s chemistry and its application to mineralogy. Black was known to have carried out chemical analysis of mineralogical specimens for men from outside of the university.[[780]](#footnote-780)

In 1779, John Walker acquired the Chair of Natural History at Edinburgh after a protracted struggle to obtain the support of influential patrons.[[781]](#footnote-781) Walker was able to gain the support of those patrons because he had used his skills to act as a scientific advisor for several members of the aristocracy. [[782]](#footnote-782) He was introduced to many of the men concerned by Cullen. Walker was primarily responsible for expanding mineralogical teaching in the Medical School. By doing so, he made a significant contribution to the development of geology as a branch of natural philosophy. [[783]](#footnote-783) In compiling his classification of the various components of the earth, Walker employed Cullen’s system of chemical Principles.[[784]](#footnote-784) Both Black and Walker achieved a more lasting fame than Cullen’s but there is no doubt that the cultural capital they used for their own investigations was based on Cullen’s work.

Although Black and Walker achieved fame by utilising Cullen’s chemistry in a university setting, there were many other less famous students, who worked outside of academic circles and attracted the attention of wealthy patrons. Most earned their living as physicians or surgeons but in their leisure time, they took an interest in mineralogy and geology. As a result of that interest and the training in chemistry they had received from Cullen, they were the pioneers of what became known as the Literary and Philosophical Societies.[[785]](#footnote-785) These societies were dedicated to studying natural philosophy, especially as it related to geology and mining, as well as literature and antiquarian matters.[[786]](#footnote-786) Formed by the rising middle classes, the societies provided a forum to share cultural capital in the days when there were few textbooks or opportunities for formal study. They were good examples of how institutional patronage operated and were of vital importance to the development of geology and the mining industries. [[787]](#footnote-787)

Two of the earliest of those societies were associated with former pupils of Cullen. The first to be established was the Manchester Literary and Philosophical Society, founded in 1781 by Thomas Percival. He had taken Cullen’s chemistry course in 1761 and 1764 and worked as a physician in the Manchester Infirmary. It was there that he made an important contribution to public health by analysing Manchester’s water supply. (See Chapter 4.) In Newcastle-upon-Tyne, a similar society was formed in 1793 by Reverend William Turner (1761-1859).[[788]](#footnote-788) One of its founder members was another student of Cullen’s, the Newcastle-upon-Tyne physician, John Clark.[[789]](#footnote-789) In his opening address at the first meeting of the Society, Turner stated that he was founding the society in order to amalgamate the practical experience of engineers with “the speculative philosopher.”[[790]](#footnote-790) At the time, the only place a man could learn “speculative philosophy” was in a medical school while engineers were trained through the apprenticeship system. Hence the value of a forum where the two groups could exchange ideas. The first membership lists still exist and show how successful the institution was because most of the early members were either medical practitioners or mining engineers.

Apart from being relevant to students, mineralogy was important to Cullen personally because it was a very effective way of reaching beyond the university to obtain patronage directly from landowners. As already explained, this was because landowners needed someone with a knowledge of mineralogy to help them exploit the mineral deposits found on their estates.[[791]](#footnote-791) Those mineral resources were usually coal or limestone.[[792]](#footnote-792) As T.C. Smout remarked, “Dubious mineral concerns were fatally attractive to the eighteenth-century instincts for gambling and amateur science.”[[793]](#footnote-793) Because of the large sums of money involved in such undertakings, many of the land owners did try to assess whether their potential gains were worth the financial risks they were about to take. To give them some idea of the value of their resources, they needed a mineralogical analysis of their lands and that in turn meant a chemist capable of carrying out the tests, hence the importance of someone like Cullen. A good example of someone who benefited from Cullen’s knowledge of minerals was James Anderson who was discussed in Chapter 6. From the point of view of the chemists concerned, it was an important means of obtaining the patronage of land owners.

Cullen was able to tap into this source of patronage through his membership of the Edinburgh Philosophical Society, which he joined in 1749.[[794]](#footnote-794) He went on to become its vice-president in 1768.[[795]](#footnote-795) The society was founded in 1737 and provides a good example of the way institutional patronage worked. The society’s members were professors, members of the professions and improving landowners like Kames. It was founded explicitly to give all those with an interest in natural philosophy a chance to meet socially. This enabled the landowners to contact those with the chemical expertise needed to assess the value of their resources. Those with chemical expertise, on the other hand, were able to become acquainted with potential patrons.

In 1743, Andrew Plummer inaugurated a scheme to facilitate this interaction. Under the scheme, the secretary of the Philosophical Society would arrange for the chemical analysis

*of unusual kinds of earths, stones, bitumens, saline or vitriolic substances, mercasites, ores of metals and native fossils whose uses and properties they may not have the opportunity of enquiring into themselves.* [[796]](#footnote-796)

This facility operated for many years and although the results of its routine investigations have not been documented, there is no doubt that it provided a means of checking the exact nature of mineral deposits for those who owned land. It is interesting to note that the minutes of the meetings of the Philosophical Society are characterised by a lack of discussion on ores and minerals.[[797]](#footnote-797) This may seem odd, considering that there are numerous references in the Society’s papers to correspondents living in Russia who sent rock samples to members of the society. Emerson, in his paper on the society, suggested that the reason for this apparent anomaly was that such topics were too closely related to financial speculations to be talked about openly. As will be discussed in the next section, in the eighteenth century laws regarding patents were lax and often abused. Emerson postulated that such discussions did take place, but in private between men who trusted each other. The next section of this chapter provides evidence that this supposition is correct.

This importance of patronage for the development of Scottish industry can be illustrated by the fact that Cullen certainly discussed chemistry with influential men who were actively exploiting the mineral resources of the Edinburgh area. In fact, he was originally introduced to Lord Kames through a Mr Martine, brother of a chemist and physician, who had worked in both Edinburgh and St Andrews until his death in 1740.[[798]](#footnote-798) The surviving Martine brother owned a brick works. This was an important industry at the time. It was dependent on the brick clays of Portobello, which stretched from the eastern slopes of the Arthurs Seat Hills to the coast.[[799]](#footnote-799) Another important eighteenth-century Scottish export was lead mining. [[800]](#footnote-800) Leadhills, in the Scottish borders was the main mining town and was about 40 miles south of Hamilton and chemistry was one way of identifying the rocks containing lead-bearing ore.[[801]](#footnote-801) While Cullen did not document his mineralogical experiences, John Walker did. Walker visited the mines at Leadhills on numerous occasions and as he was accompanied on some of his journeys by Cullen, then Cullen must have been familiar with the area too. [[802]](#footnote-802) However, the main mining activity in Scotland during the eighteenth century was coal mining, with seams located through trial borings in areas where coal was already known to be present. [[803]](#footnote-803) The location of the coal bearing strata was also mentioned by Walker in his essay.

This chemical contribution to geology has largely been ignored by historians, mainly because most eighteenth-century natural philosophers like Cullen were uninterested in theories of how the earth developed. [[804]](#footnote-804) Unlike James Hutton (1726-1797), they believed that however intriguing such ideas might be, as they could not be tested empirically, they were incompatible with natural philosophy. They were much more interested in the current composition of the earth. Unlike Hutton, Cullen had not inherited wealth, so he had more to gain by investigating substances found in the earth in its present form, for wealthy landowners or by teaching others how to carry out such investigations. This enabled him to gain the good will of the men like Kames and the Duke of Argyll who were in a position to use their influence to enhance his career prospects.

**Cullen’s Cultural Capital and Salt Production**

Another Scottish industry in which Cullen took an active interest was the production of common salt. In the seventeenth century, salt constituted about one third of Scotland’s exports.[[805]](#footnote-805) Common salt, now known as sodium chloride, was used to preserve meat, fish and butter throughout the winter. It was, as Archibald Cochrane, Earl of Dundonald and an active chemist put it, “a necessary of life.”[[806]](#footnote-806) He estimated that every man in the United Kingdom consumed 33 pounds of salt per year. [[807]](#footnote-807) In Scotland, salt was, for centuries, obtained by the evaporation of sea water. [[808]](#footnote-808) The industry had thrived where coal was available near a sea shore. It was one of the major sources of employment around the Firth of Forth. [[809]](#footnote-809) The problem with the production of salt by evaporation of sea water is that sea water does not only contain sodium chloride, it also contains impurities in the form of calcium and magnesium salts. [[810]](#footnote-810) While it was possible to remove some of these impurities, the salt produced in Scotland was far from pure and not good for preserving food.

Given the importance of salt to Scottish industry, if Cullen had been able to supply the cultural capital in the form of his knowledge of salt and its chemical qualities, needed to solve that problem, he would have been assured of patronage from the landed and aristocratic members of the Board of Trustees for the Encouragement of the Improvement of Fisheries, Arts and Manufactures in Scotland. [[811]](#footnote-811) This Board had been established in 1727 to administer the *Equivalent,* which was a sum of money granted annually by the English Parliament as a result of the Act of Union of 1707. It was intended to aid the development of Scottish industries. [[812]](#footnote-812) The Board was set up as a result of lobbying by the Honourable Society of Improvers in the Knowledge of Agriculture. The Society included many of the leading landowners, who subsequently became members of the Board.

Another major problem for the salt industry was the difficulty and expense of providing the fuel needed to evaporate the sea water. Archibald Cochrane estimated that in order to obtain 2 tons of salt, 100 tons of sea water was needed and that required 17 tons of coal to supply the heat needed to evaporate the water. This would not have been important until, in 1760, rock salt was discovered in Cheshire. [[813]](#footnote-813) This form of salt was much purer and as it is solid, did not need large amounts of fuel to separate it from water. Consequently, it was about half the price of sea salt.

Good salt was needed to preserve herrings. The Duke of Argyll had proposed the import of rock salt in 1744 to help the herring fishing industry, in which he had an interest. [[814]](#footnote-814) He was persuaded against the measure by the proprietors of the salt pans on the banks of the Firth of Forth.[[815]](#footnote-815) They pointed out that importing the much cheaper rock salt would make Scottish salt economically worthless. Salt production from sea water employed thousands of people and was the only industry in the area. This was another incentive for Cullen to try and solve the problems of the salt industry.

By the time he had established himself in Glasgow, Cullen was no stranger to the way patronage worked. His interest in the chemistry of salt was connected to his early experiences in Glasgow. If he was to progress further, he needed to use his knowledge of salt to make contact with patrons with real political power in Scotland. The previous chapter has shown how Cullen’s lectures on chemistry, especially his interest in agriculture, brought him to the attention of Lord Kames.[[816]](#footnote-816) In 1749, through the auspices of Lord Kames, Cullen became acquainted with the Duke of Argyll. [[817]](#footnote-817) The Duke had had an interest in improving the Scottish economy since he was a young man. [[818]](#footnote-818) Given the control that the Duke exercised over university appointments, it was extremely important to Cullen to make the Duke aware of his cultural capital and of their shared interest in improving Scotland’s industries. Cullen’s introduction to Argyll took place at a meeting which was set up by Kames. It included not only the Duke, but also Martine and Alexander Lind, an Edinburgh advocate, chemist and a founding member of the Philosophical Society.[[819]](#footnote-819) Cullen seems to have impressed the Duke with his chemical expertise and, as a result, Argyll consulted him on the subject of salt.

Glasgow University Library has drafts of a reply written by Cullen in 1751, to the Duke of Argyll.[[820]](#footnote-820) It appears to be a response to a letter from the Duke who wanted Cullen’s opinion on (among other things) William Brownrigg’s (1711-1800) book on salt production. Although the letter to Cullen from the Duke no longer exists, judging by Cullen’s response, it seems that the Duke was consulting Cullen about Brownrigg’s suggestion that the best way to purify sea salt was by the addition of muriatic acid during the boiling process. [[821]](#footnote-821) Cullen disagreed and suggested that Brownrigg had mistaken the contaminant in the sea water for an alkali. Cullen on the other hand, thought it was a neutral salt.[[822]](#footnote-822) The drafts also make it clear that Cullen also disagreed with Brownrigg’s suggestion that the Dutch method of adding sour whey to the salt might improve its quality. In his letter to the Duke, Cullen suggested that Brownrigg had never tried the method for himself.

Another feature of Cullen’s reply to the Duke was his attempt to use his leverage in the form of his cultural capital of chemistry to try and obtain Argyll’s patronage for a project of his own, designed to improve the purity of common salt by removing the bulk of the contaminants. Cullen’s research initially led him to suggest that adding a vegetable alkali would purify the salt. Further experimentation caused him to modify his findings and suggest that a lixivium of potash would be better. Both substances, if added to the brine in the salt pans, would precipitate out the impurities, leaving a relatively pure solution of table salt behind.[[823]](#footnote-823)

The evidence suggests that Cullen had hoped for some financial rewards for this work, but commercial exploitation of discoveries was not easy in the eighteenth century. Cullen’s difficulties in trying to interest the Duke in his project are testimony to that fact. In all three drafts of his reply, Cullen’s problems in trying to extract money from the Duke are apparent. Even the deference with which Cullen addresses the Duke shows not only the social gulf between the aristocracy and the middling sort, but also Cullen’s consciousness that his future prospects of obtaining patronage might depend upon the Duke’s good will.

*How far they* (his experiments on salt) *may be useful to the publick (sic) I subject it to your Grace’s opinion. How they may prove beneficial to myself I humbly beg to have your Grace’s advice.* [[824]](#footnote-824)

In his letter, Cullen explained to the Duke that as chemical experimentation was both expensive and time consuming, he was hoping for some financial benefit from this research and continued,

*I must beg your Grace not to communicate the contents of this letter to anybody. You will not be surprised to find a Chemist become a projector. I have hitherto kept pretty clear of this character but like many Chemical enthusiasts having spent more time and money than I could well afford I begin now to wish that my Chemical labours would afford me some returns.* [[825]](#footnote-825)

The situation in Cullen’s case was doubly difficult, because he had not only to convince Argyll that his ideas were commercially viable, he had to do so without earning himself the reputation of being a “projector,” a word which has changed its meaning over the last two centuries. The *Oxford English Dictionary* defines the eighteenth-century term as, “some-one who promoted unsound business adventures.” To make matters worse, even if the projected scheme was sound, securing a patent to make sure that no one could steal the idea meant applying for an act of parliament.[[826]](#footnote-826) That in turn meant having the money and the social capital needed to lobby MPs. As a result, anyone with a new and better idea for manufacturing a product often, like Cullen, resorted to secrecy to protect it.[[827]](#footnote-827) This was contrary to the Baconian tenet that natural philosophical knowledge should be available to everyone and that trade secrets interfered with the free flow of knowledge. Cullen was conscious of Baconian ideals and, as someone who’s living depended upon being accepted as trustworthy, he needed to protect his symbolic capital. Any attempt to seek a monetary reward for what would now be termed intellectual property was regarded with suspicion by many people in eighteenth-century Scotland.[[828]](#footnote-828)

This did not, however, appear to deter chemists, including Cullen, from trying to discover other men’s secrets. The fact that high-quality Chinese porcelain found its way into Europe in the sixteenth century has already been alluded to, along with the fact that the Chinese refused to tell anyone how it was made. All the evidence points to the fact that Cullen was actively engaged in pursuit of the sort of “useful knowledge” that might have benefited the Scottish salt industry. He appears to have undertaken the research at his own expense, in the hope that he would benefit financially. At the same time, he had to be careful about who he confided in. If the Duke had wanted to undermine Cullen’s reputation, suggesting that he was a projector would have been an effective way of doing so. However, as Donovan pointed out, Cullen’s suggestion was not economically viable because the lixivium he proposed was far more expensive than the salt it was intended to purify.[[829]](#footnote-829)

**Cullen’s Cultural Capital and the Linen Industry**

In this section I discuss the industry on which Cullen did most of his research and contributed most to his fame as a chemist outside of medical circles. The linen industry itself was one of the most successful in Scotland and that success can be attributed to the foresight and hard work of the Duke of Argyll and Lord Milton who were of course, Scotland’s most powerful patrons. They acted through the Board for the Improvement of Fisheries and Manufacturing. Since the manufacture of linen was “Scotland’s premier industry” in the eighteenth century, the Board decided that concentrating its resources on that industry would be the best way of improving the Scottish economy as a whole. [[830]](#footnote-830) Roger Emerson described the results as “a great success.” [[831]](#footnote-831) The production of linen rose seven fold between 1739 and 1790 and created employment for large numbers of people. There were also spin-offs in bleaching, dying and printing and the gentry acquired the experience of financing large enterprises. The work also increased the cultural capital of scientists and engineers. One of those scientists was Cullen, and this section describes how he tried to use his capital to benefit the linen industry. This was an eminently sensible thing to do given the fact that the industry was controlled by Scotland’s most powerful aristocratic patrons.

Like all textile industries, the Scottish linen industry had started as a domestic craft and, until the middle of the eighteenth century, it remained so. Unfortunately, most of the linen produced in Scotland was a coarse type of fabric. The fine linen worn by the rich (which generated the largest profits) was made by the Dutch.[[832]](#footnote-832) The poverty of the weavers and their lack of technical expertise meant that most of the linen woven in Scotland had to be exported unbleached. By the time Cullen arrived in Glasgow the situation was improving but it was still far from ideal. In order to describe Cullen’s involvement and how he benefited, it will be necessary to discuss how linen is produced, in particular the bleaching process.

Bleaching was the costliest part of linen manufacture and the subject of Cullen’s research. The process involved first steeping the linen in a hot alkaline solution, known as the ley. [[833]](#footnote-833) It was the most expensive part of the process because affordable alkali in industrial quantities was difficult to obtain. [[834]](#footnote-834) Most of it had to be imported at vast expense.[[835]](#footnote-835) Once it had been soaked in the ley, the linen was washed, dried and steeped in an acid solution, the sour. The latter was made from bran or buttermilk. After washing the linen again, the process was repeated until the brown linen was bleached white. While bran and buttermilk were readily available and cheap, most of the alkali came from wood ashes and by the eighteenth century, timber was a scarce commodity in large areas of Scotland. [[836]](#footnote-836)

One way of obtaining material that could be used to make alkalis, especially potash was to import timber from the Baltic region. Cullen complained to his students that “hundreds of thousands of pounds sterling go yearly out of this kingdom to Russia for the potash which might easily be made, if not in this kingdom, at least in our American colonies.”[[837]](#footnote-837) The second possibility was to buy potash produced by burning a form of seaweed, *Salsola soda,* knownas *Barilla.* This was produced in the Alicante region of North East Spain. [[838]](#footnote-838) Because of the intermittent warfare between England and Spain during the eighteenth century this too, suffered from the twin problems of scarcity and increasing cost. Some way of producing a cheap bleaching agent locally was the obvious answer. This was a problem that many chemists, including Cullen, tried to solve. Cullen realised that research into locally produced alkali, if successful, would be of benefit not only to the workers in the industry but to the aristocrats who financed it and, of course, it would be a good way to obtain their patronage. In 1755 he wrote an (unpublished) essay, entitled *Remarks on Bleaching* in which gave the results of his research. In the same year the Board for the Improvement of Fisheries and Manufactures awarded him three sets of table linen in recognition of his work.[[839]](#footnote-839)

This award encouraged him to believe that investigating alkalis was a good way to attract the attention of potential patrons who were members of the Board. However, Cullen’s attempts to obtain patronage from the Duke of Argyll for the local production of alkali seem to have met with a less than enthusiastic response. Someone like the Duke often had more than one advisor and although he was very knowledgeable about science, he occasionally found it difficult to decide whose advice to take.[[840]](#footnote-840) Not everyone agreed with Cullen’s findings and at times he had to defend his research. To do so, he needed both his cultural and symbolic capital, not to mention a considerable degree of diplomacy.

Another client of the Duke’s was John Mitchell (1711-1768), whose scientific credentials were impeccable. Mitchell, in addition to being a physician and chemist, was a Fellow of the Royal Society and the first man to map the North Western states of America accurately.[[841]](#footnote-841) He also did research on potash and his findings differed from Cullen’s in some important respects. Those findings were evidently mentioned in the letter the Duke of Argyll sent to Cullen in 1751. [[842]](#footnote-842) Mitchell’s ideas on the subject were set out in a paper he delivered to the Royal Society in 1748, antedating Cullen’s essay by some two years.[[843]](#footnote-843) His description of the way potash was produced was almost identical to Cullen’s but he stated that ash obtained from pines, firs and ferns, (typical Scottish vegetation), contained very little “salt”.[[844]](#footnote-844) If Mitchell was right, then Cullen’s research project was essentially useless because it involved making potash from Scottish conifers and ferns. In Mitchell’s opinion, barilla was the best source of potash. His solution to the supply problem was to grow barilla in the UK or failing that, one of the colonies.

Cullen’s response to the Duke, in the letter of 1751, stated that he had only just acquired Mitchell’s Royal Society paper. Rather than attack Mitchell’s findings directly he embarked on a long discussion of alkali. In it, he suggested to the Duke that the alkali found in plants growing inland was different to fossil alkali and that it was fossil alkali which occurred in marine vegetation, like Barilla. He backed up his own opinion by citing a paper by Gmelin, (presumably Johann Georg Gmelin 1709-1755) in the *Journal of the Russian Academy*.[[845]](#footnote-845) The nearest he came to a direct criticism of Mitchell was to comment that he thought Mitchell had been misled by his workman, presumably about the amount of salt they had obtained. Cullen himself thought that the fossil alkali contained in Barilla was only suitable for soap and glass.

Despite the fact that the Duke’s chemist did not agree with his research findings, Cullen remained convinced that the alkali required for bleaching could be made in Scotland.[[846]](#footnote-846) It may be significant that, when Cullen eventually got the funding to carry out his own large-scale research in 1762, it came, not from the members of the Board for the Improvement of Fisheries and Manufactures, but from men who were part of the Board of Trustees for the Annexed Estates. Notably, it was granted the year after Argyll’s death. [[847]](#footnote-847) The actions of the individuals involved provide a good illustration of the way the aristocratic patronage system worked. Initially, Lord Kames, who had an honorary peerage based on his status as a judge, had tried to exert his influence on Cullen’s behalf with the Board for the Improvement of Fisheries and Manufactures. He did so by presenting Lord Milton with a letter from Lord Deskford, a well-known expert on linen production, stating that Cullen’s experiments were worth trying. [[848]](#footnote-848) Lord Deskford (1714-1770) was James Ogilvy, the future Earl of Findlater and Seafield. Ogilvy had established a bleach field at Deskford in 1752 and like Argyll, did much to improve the Scottish linen industry.[[849]](#footnote-849)

When Kames told Cullen that it was by no means certain that Lord Milton would accept Cullen’s “generous offer” to carry out large-scale experiments on the production of alkali, he suggested to Cullen that should continue with small-scale research. He also advised Cullen that he should keep Lord Deskford informed of the results, and tell him that he (Cullen) had done so “by my advice.”[[850]](#footnote-850) Cullen’s persistence with his experiments, as Kames had advised, eventually paid off. Cullen received the funding to carry out the large-scale experiments he had suggested from the Board for the Annexed Estates.[[851]](#footnote-851) The Board was an organisation which was set up to run the estates of those landowners who had joined the Jacobite Rebellion in 1745 and whose properties the government had confiscated by way of retribution.[[852]](#footnote-852) Both Kames and Deskford were members of that Board.[[853]](#footnote-853)

Cullen spent the summer of 1762 carrying out the planned experiments on an annexed estate in the Highlands. [[854]](#footnote-854) The experiments were designed to investigate the different sources of potash which could be obtained from different types of vegetable ashes. Cullen’s work showed that imported ashes were no cheaper than trees felled in Scotland. He also tried using ash obtained by burning ferns. This, he thought would be less expensive than wood ash because ferns could be handled by women, who were paid less. A third source of alkali was that obtained from burning the seaweed known as kelp. This, Cullen concluded, could only be justified if timber became more difficult to obtain as it was no cheaper than wood ash.[[855]](#footnote-855)

A characteristic of Cullen’s research on bleaching was his realisation that those directly involved in the industry knew more of the practical aspects of it than academics who had learned their chemistry from books, supplemented with small-scale experiments. Evidence of the way Cullen thought about artisans was contained in a letter Cullen wrote to Kames, dated February 1753. Cullen stated that “the most part of the instruction [on bleaching] I had received on the subject” had come from John Chrystie, who was one of the bleachers.[[856]](#footnote-856) In the same letter, he commented that “in some particulars, he differs from me, and I am ready to believe he is right.” It appears that Cullen was making suggestions for changes to their techniques and Chrystie was trying them out.

By accepting Chrystie’s expertise, Cullen was following the tenets of Francis Bacon’s philosophy. Bacon had advocated co-operation with, and learning from, artisans. This attitude was in sharp contrast to the culture prevailing in France, where there was a marked social division between academics and inventors.[[857]](#footnote-857) Cullen’s research supports Margaret Jacob’s suggestion that this egalitarian attitude explains the early development of British industry, because it supported the “trial and error (methods) that lie at the heart of technical innovation.” [[858]](#footnote-858) In other words, another of Cullen’s contributions to the Industrial Revolution was his realisation that artisans too, had cultural capital which was not to be despised. His attitude must have been shared by many of the landowners who employed the artisans. Their patronage resulted in the employment not only of scientific advisors but also skilled workmen. [[859]](#footnote-859)

**Translating Cultural Capital into Academic Patronage**

Despite his disagreements with the Duke of Argyll over Mitchell’s research findings and the Duke’s refusal to accept his suggestions for improving methods of salt production, Cullen’s attempts to secure patronage for academic posts were not affected. In 1755, he was appointed to the Chair of Chemistry in Edinburgh. The post became vacant because the incumbent, Doctor Plummer was unable to teach after a stroke and seemed unlikely to survive. [[860]](#footnote-860) There were three men with the cultural capital needed for the chair, Doctor Francis Home, Joseph Black and Cullen. Joseph Black refused to stand against his friend and mentor and Lord Milton supported Home.

As more than half of the other medical professors of Edinburgh objected to Cullen, his position looked bleak until the Duke of Argyll threw his weight behind him. As Thompson put it, “but for the exertions of that public-spirited and intelligent nobleman upon this occasion, it seems doubtful whether Dr Cullen would ever have obtained a seat in the University of Edinburgh.”[[861]](#footnote-861) It would appear that even though he may not have agreed with the results of Cullen’s researches, the Duke was sufficiently impressed with Cullen’s knowledge of chemistry and its application to industry to insist that the Chair of Chemistry in Edinburgh was given to his former advisor and client. Argyll’s rationale was almost certainly based on his desire to raise the standards of Scottish industry. To achieve that goal, he needed men who were well-informed about chemistry. For that reason, he had to appoint someone to the chair of chemistry in Scotland’s leading university who was capable of teaching all aspects of the subject and not just the chemistry of *materia medica.* His support signalled that Cullen fulfilled those criteria. From Cullen’s point of view, his years of converting chemical knowledge into cultural capital and his lobbying of potential patrons had finally paid off when he became a Professor in Edinburgh’s Medical School.

From a twenty-first century perspective it seems paradoxical that it was Cullen’s interest in and knowledge of chemistry which eventually resulted in his becoming Professor of the Practice of Medicine in Edinburgh. This apparent anomaly was the result of the eighteenth-century system of patronage and the way universities functioned at that time. As discussed in Chapter 1, eighteenth-century Scottish society was significantly influenced by the aristocracy, who used their symbolic capital to influence anyone who they thought might be able to assist their attempts at wealth creation. From their point of view, the cultural capital of someone like Cullen was invaluable. Cullen himself realised at the start of his career that knowledge of chemistry was needed to improve Scotland’s industries. As I showed in the first section of this chapter, he seems to have appreciated this fact before many of his students. Although he was more than happy to pass on his cultural capital to them, he was very aware of its value in his search for aristocratic patronage from benefactors like Kames and his circle. Cullen was able to make contact with such patrons by utilising the symbolic capital he acquired, not only from his chemistry courses, but also from his membership of institutions like the Philosophical Society. It was his relationships with patrons like Kames and other knowledge brokers like Martine which brought him to the attention of the Duke of Argyll, that is, a powerful aristocrat, who was responsible for so many university appointments.

Gaining an Edinburgh chair was of vital importance to Cullen because not only did it place him in one of Europe’s leading universities, albeit as a consecrated heretic, but also because it offered the possibility of further promotion. Those opportunities for promotion were due to the lack of specialisation by university teachers during the eighteenth century. Specialised teaching and research, as we now know it, did not develop until the mid-nineteenth century.[[862]](#footnote-862) As a result of this phenomenon, it was possible for a man to start his university career lecturing on one subject and then transfer to another chair where he was required to teach a totally different subject. [[863]](#footnote-863) In Scotland, this was almost certainly the legacy of the regenting system when groups of boys were taught different subjects by the same man over a period of four years.[[864]](#footnote-864) Whatever the explanation, once established in Edinburgh, Cullen set about gaining the patronage he needed to establish himself as an academic physician. Although it took him almost another twenty years, he eventually succeeded in obtaining what was then regarded as the senior chair in the Medical School, namely that of the Practice of Medicine.

**Conclusion**

As Roger Emerson has pointed out, Scottish geography limited eighteenth-century Scotland’s capacity for industrial development. [[865]](#footnote-865) As a result, forward-thinking Scots had to focus their attention on the best way to make use of what they had. Emerson maintained that “Scots became chemists in order that they might find better fertilisers, bleaches and dyes for their fabrics and geologists as they sought to find mineral wealth.” This chapter has demonstrated Cullen’s part in the attempts by eighteenth-century Scots to improve their manufacturing base with a view to benefiting society as a whole. I have shown that Cullen did not just take an academic interest in Scottish industries but actively investigated their underlying chemistry. It was those investigations which brought him to the attention to the most powerful men in Scottish society and it was their patronage which ensured that he was able to obtain professorial chairs in Edinburgh.

Cullen manifestly had the practical benefits of chemical mineralogy in mind when he went to Glasgow, because one of his first acts was to acquire the books he needed to learn it. As this subject had a limited connection to the kinds of topics which students wanted to learn by attending a *materia medica* course*,* it suggests that Cullen went to Glasgow with the idea of expanding the scope of the chemistry course to include topics of practical interest to Scottish industry. Likewise, his interest in both salt and linen show that he was aware of the problems with the Scottish economy. He believed in the potential for those industries and he was confident that the solution to their technical problems was unlikely to lie wholly in the trial and error methods employed by artisans working in them. While not despising their practical know-how, he realised that such methods, when used without theoretical chemistry, were dependent largely on chance. Putting this awareness into practice showed how he was steeped in the Baconian philosophy of useful knowledge.

It was Cullen’s interest in improving Scotland’s industrial base which brought him to the attention of Scotland’s most powerful patron, the Duke of Argyll. And it was Argyll who decided he was the best candidate for the chair of Chemistry in Edinburgh University. Edinburgh had a much greater reputation than Glasgow and, for an ambitious man like Cullen, it represented significant progress in his career. The Chair of Chemistry was not one of the more prestigious chairs but it did give Cullen *entrée* into what was then generally regarded as Europe’s best medical school. Once there, although he had still some battles to fight, he was in a much better position to attain his ultimate goal of becoming an academic physician, a career which was a big step up from the lowly position of ship’s surgeon where he started.

**CONCLUSION**

This study of Cullen’s career has shown how the patronage system was woven into the fabric of eighteenth-century society. No man, even a genius, could avoid using it if he wanted to progress professionally. Cullen’s success however, was not due to the patronage system alone. Chemistry was the cultural capital he used to buy his way into the relatively closed world of the universities. What this final chapter will do is to show the way Cullen’s career was moulded by political situation, (in the widest sense of the term) which characterised the eighteenth century. That century was known to its educated elite as the Enlightenment. One of the characteristics of Scottish Enlightenment thinking was its interest in what became known as science. As David Hume expressed it, “the spirit of the age … roused the minds of men from their lethargy and put them into a fermentation … to carry out improvements into every art and science.” [[866]](#footnote-866) What this thesis has shown is how Cullen took advantage of the eighteenth-century desire for improvement to obtain one of the most senior chairs of medicine in Europe.

When Thompson was writing his biography of Cullen it was widely felt that pursuing natural knowledge tended to make men serious, simple and sincere. [[867]](#footnote-867) This is evidently the picture that Thompson sought to paint of Cullen. But, as Stephen Shapin asked, “Is there some methodological sin that is inherently attached to asking whether eighteenth-century men of science … “really” possessed the virtues, vices or capacities attached to them?” [[868]](#footnote-868) This thesis has answered “no” to that question. By doing so, it has avoided the nineteenth and early twentieth-century perspective which saw scientists as engaging in a disinterested search for truth. [[869]](#footnote-869) Instead it has shown Cullen to be a member of a society whose culture was not based on a disinterested search for abstract truths, but useful knowledge. In keeping with eighteenth-century mores, Cullen was prepared to exploit that useful knowledge for in order to obtain patronage.

Although Cullen’s achievements were heavily dependent on his cultural capital, it is difficult to believe that his personality did not play some part in his eventual success. He appears to have been blessed with the ability to acquire social capital easily and this factor almost certainly helped him to gain patronage, not only from his students but also from men working outside of the universities. Writing an obituary of Cullen in the *Bee,* James Anderson remarked that Cullen was possessed “of a secret charm that he ever carried about with him which fascinated such numbers of those who had intimate access to him.” He also commented that “in his private capacity, by his students, he deserved to be *adored.”*  [[870]](#footnote-870) Furthermore, Cullen was, in modern parlance, a workaholic. Guenter Risse in his book *Hospital Life in Enlightenment Scotland,* described the “gruelling schedule” that Cullen imposed on himself.[[871]](#footnote-871) Besides his extensive medical practice, his lectures on chemistry (which he up-dated regularly), his research and his time-consuming clinical lectures, Cullen gave extra tuition to groups of students who were attending his courses for the second time. [[872]](#footnote-872) In other words, Cullen did not attract patronage by charm alone. He had to work hard for it.

Chapter 1 provided the framework for the rest of the thesis because Bourdieu accepted Kant’s insightful observation that there is a basic similarity between all universities, stretching back to their foundation in medieval times. As a result, Bourdieu’s concept of capital, even though it was based on twentieth-century French universities, provides insights, not only into eighteenth-century Scottish universities, but also the patronage system. Furthermore, Bourdieu’s observations on how outsiders can obtain entry into the relatively closed world of the university are very apposite. In particular, his phrase *consecrated heretic* seems a particularly apt description of Cullen.

Chapter 2 is based on Thompson’s biography, which ensured that Cullen’s search for patronage has been more extensively documented than most eighteenth-century physicians. Cullen’s first patrons were his extended family and their friends. As Cullen’s father was the factor for the Duke of Hamilton, one of the premier Dukes, and his mother from a prominent legal family, Cullen almost certainly possessed some degree of what Bourdieu described as “professional heredity.”[[873]](#footnote-873) Admittedly that professional heredity was connected to the legal profession but despite that, he must have been raised in a household which was very aware of how the patronage system operated. While many of the details of Cullen’s professional life are in Thompson’s biography, the significance of them has not been explained. Thompson did not need to. He was writing for an audience who were well aware of how the patronage system worked. Furthermore, Thompson did not have access to the official documents in the Scottish National Records and the National Archives in Kew which he needed to complete his study of Cullen’s early years. Consequently, this thesis gives a much fuller account of Cullen’s early struggles than that recorded in Thompson’s *Life.*

The chapter also dealt with the way Cullen started his climb up the academic ladder. Thompson does not explain exactly how Cullen came to be teaching in Glasgow but there seems to be little doubt that patronage played a vital role in the process. He was able to earn himself cultural capital there because he had the foresight to see the potential for chemistry as a subject in its own right. When Cullen began his teaching career in Glasgow, the arts and humanities were well taught there, but Glasgow was much slower to modernise than Edinburgh. For example, Edinburgh abolished the regenting system in 1709, while Glasgow retained it until 1727. In 1714 the Provost of Glasgow refused to allow an Englishman to conduct a course in experimental science at the university. Even allowing for an element of xenophobia in that decision, it does suggest that the authorities in Glasgow were reluctant to introduce the teaching of most forms of science.[[874]](#footnote-874) This meant that they were losing pupils to dissenting academies.

Cullen seems to have thought that he could prevent the haemorrhage of science students from Glasgow University but a letter to Cullen from William Hunter provides evidence that the university authorities frustrated his efforts. The letter stated that the Duke of Argyll was “heartily sorry to hear that your encouragement at Glasgow has been so narrow.”[[875]](#footnote-875)This explains why Cullen was so anxious to move to Edinburgh. He was able to achieve that goal as a result of the patronage he received from the Duke of Argyll, but as I have shown, the move was not without its problems. Once in Edinburgh, the evidence suggests Cullen’s ultimate ambition was to be appointed to the Chair of the Practice of Medicine, then regarded as Europe’s most prestigious medical position. He was to suffer further setbacks in achieving that end because the Duke of Argyll died in 1761 and he had to acquire a new set of patrons.

Chapter 3 started with an account of the students who attended Cullen’s courses and their reasons for doing so. Until he began to lecture on the topic, the chemistry which was taught in universities was intended to give medical students some insight into the production of drugs. Cullen made chemistry acceptable among the wider academic community by showing how it could be linked to natural philosophy. As a result of his demonstration that “knowledge otherwise obtainable only through workmen” could be explained by the latest ideas in philosophy, Cullen ensured that chemistry became the “study of a gentleman.” [[876]](#footnote-876) This factor increased the audience for his lectures significantly. He was almost certainly helped to achieve this by the fact that Francis Bacon’s concept of “useful knowledge” was gaining ground among the educated elite. Cullen was quick to spot a trend and exploit it.

While introducing natural philosophy showed that there were academic aspects to chemistry, such philosophy was essentially useless when it came to the actual practice of chemistry. Chapter 4 discussed how Cullen solved that problem. When Cullen began to teach almost the only sources of expertise in the actual practice of chemistry were artisans and during the eighteenth century there was a rather disdainful attitude on the part of the educated elite towards manual labour. In the previous century, Robert Boyle employed workmen to carry out his experiments, Cullen demonstrated chemical procedures himself.[[877]](#footnote-877) By showing that it was difficult to be a chemist without what would now be termed “hands on” experience, Cullen’s teaching style went some way to overcome the prejudice against manual labour.

Another problem, which William Lewis had pointed out, was that artisans, while they had a detailed knowledge of the processes which they used on a regular basis, were usually ignorant of similar processes used by artisans working in a different trade. [[878]](#footnote-878) One of Cullen’s strengths was his breadth of knowledge. This enabled him to link together the different aspects of artisanal expertise as well as connecting that expertise to contemporary natural philosophy. As a result, he was able to provide students with the skills they needed to practice all forms of chemistry. This chapter also highlighted another aspect of Cullen’s pedagogical ability by discussing his chemical classification system and how he used affinity tables to predict how substances were likely to react together.

Although the scope of Cullen’s chemistry course was a radical innovation, his teachings themselves were orthodox. Because it was impossible to explain why substances combined and why they separated, eighteenth-century chemistry was basically a technology. A technology which was advancing rapidly, but a technology non-the-less. Cullen was very aware that progress in improving that technology would lead to improvements in Scotland’s manufacturing base and an increase in his symbolic capital. His research interests were related to the chemical technology that underpinned Scotland’s leading industries.

Chapter 5 illustrates the fact that Cullen was not only an excellent teacher of chemistry but medicine also. Numerically speaking, medical students were his most important patrons. This chapter uses his textbook of *materia medica* to demonstrate his skill as a teacher of medicine. It also showed how his medical practice was informed by his chemistry. The fact that Cullen taught clinical medicine at all shows that he was using his chemical expertise as a means to an end. That end was to advance his career as a physician. If his primary interest had been chemistry *per se,* he would surely have contented himself with the Chair of Chemistry at Edinburgh and not pursued the Chair of the Practice of Medicine.

There were other factors within the medical educational establishment which also contributed to Cullen’s success. Although they have not been discussed in detail in this thesis, they were a vital part of the background against which Cullen worked. One of the most notable was the change in the way medical practitioners were trained. Cullen’s career illustrates this phenomenon. He began his training the way that surgeons had done for centuries, as an apprentice. How that apprenticeship was arranged, we do not know but “kinship and patronage” were the commonest methods.[[879]](#footnote-879) By the end of the century, many apprentices attended courses at Edinburgh University, which had a policy of admitting anyone who could afford their fees. This put Cullen in contact with many more students than would have been possible if he had been teaching only those who intended to go on and take an MD degree.[[880]](#footnote-880) Those students patronised him by attending his lectures and later by referring patients to him.

The next chapter, Chapter 6 dealt with Scottish agricultural practices and how they were in need of reform. Again, Cullen saw this situation as an opportunity he could exploit. It appears however, that his attempts to introduce agriculture into his chemistry lectures had mixed results. While the lectures undoubtedly helped his career by gaining him the patronage of Lord Kames, most of his students did not seem to have appreciated what he was trying to do. This was because an interest in improved farming methods was confined to a few wealthy landowners. Furthermore, Cullen’s expertise was chemistry and the application of that type of cultural capital to agricultural practice was regarded as at best dubious, until the middle of the nineteenth century. The history of his agricultural lectures does suggest that he was conscious that he needed to teach students what they wanted to know, if he was to retain their patronage. Because they were not interested in learning about the topic, he dropped the subject from his courses.

Chapter 7, Cullen’s industrial chemistry, demonstrated why he was so spectacularly successful. Patronage had entered the world of trade in the early eighteenth century and as a result, Cullen was able to obtain aristocratic patronage by supplying the cultural capital needed to develop Scottish industries. [[881]](#footnote-881) Scottish land-owners and entrepreneurs were aware of the fact that their industrial base was inferior to that of England and furthermore, it was difficult to access the information they needed to effect improvements. This presented Cullen with an ideal opportunity to obtain patronage. By introducing the industrial uses of chemistry, not only into his lectures, but also to patrons outside of the universities Cullen tapped into a widespread need. Cullen was able to make contact with potential patrons from outside of the University through the institutional patronage of organisations like the Philosophy Society. Members of the Society brought him to the attention of the Duke of Argyll, the leading patron of his day, who as described in Chapter 1, was responsible for so many university appointments.

The patronage Cullen received from the Duke of Argyll played an essential part in his success. What enabled Argyll to exercise that patronage was the political situation both in Scotland and at Westminster. In Scotland, after 1745, there was no realistic prospect of the Stuarts returning to power and the economic benefits of the 1707 Act of Union were beginning to become apparent. [[882]](#footnote-882) This gave Scotland a political stability in which universities and men like Cullen, could flourish. In Westminster, politics was dominated by Robert Walpole (1676-1745) and then by William Pitt, Lord Chatham (1708-1778). Although in theory the former was a Whig and the latter a Tory, there was no clear separation between political parties. The whole of the United Kingdom was effectively a one-party state, dominated by the executive.[[883]](#footnote-883) This system worked because the number of men entitled to vote was very small.[[884]](#footnote-884) As a result, in order to retain power, the government of the day could afford to bribe voters with jobs and pensions. Scotland was managed in this way by the Duke of Argyll. [[885]](#footnote-885) The year 1832, which saw the publication of Thompson’s book, was also the year in which the First Reform Bill was passed. Reform of the electorate did away with the power of men like Argyll. Has Cullen been born in the nineteenth century, his fortunes might have been different.

In conclusion, this thesis has shown that Cullen was a man of his time. His career depended upon the patronage system which characterised eighteenth-century life. A large part of his success was probably his ability to exploit that phenomenon. His seminal insight was the realisation that he would never succeed in gaining *entrée* into the academic world as a teacher of medicine because he had never attended a European university and lacked the right connections to the right people in a teaching hospital. Consequently, he used his chemistry to establish a foot-hold in the university system. Once established in Glasgow, he was then able to exploit the patronage system until he became Professor of the Practice of Medicine in Edinburgh, then one of Europe’s most senior medical posts. Without his chemical expertise however, he would probably have finished his career where he began, as a provincial surgeon.

APPENDIX 1: **Cullen’s Chemical** **Principles [[886]](#footnote-886)**

SALTS: “Impossible to define from a single characteristic but are sapid and miscible in water”

1. They can be divided into two types, simple and compound.

2. Simple salts can be either acid, which changes syrup of violets red, or alkaline, which changes syrup of violets green.

3. Alkalis can be further subdivided into fixed with respect to heat or volatile.

4. Compound salts are formed from acid, are neutral and can be broken down.

INFLAMMATORY: “Are from heat or from contact from burning bodies. There are a great number in nature but their qualities lie in only one ingredient in their composition”

1. Oil is fluid and immiscible in water. May be animal (fats and waxes), vegetable (essential oils) or mineral (bitumen) in origin.

2. Sulphur (brimstone) is dry and immiscible in water.

3. Ardent spirit (alcohol) is fluid and miscible in water.

METALS: “Shining, heavy, opaque, fusible but not soluble in water”

1. Can be divided into metals and semi-metals.

Metals are gold, silver, mercury, lead, tin, copper and iron and are durable and malleable.

They can be further sub-divided into perfect which are gold and silver and the rest are imperfect

2. The semi-metals are zinc, antimony, bismuth, arsenick (sic) platina, cobalt and nickel and are friable.

EARTHS: “Are not miscible with water, not inflammable, always dry and solid, not fusible in fire”

1. Absorbent earths are soluble in acids and can be reduced to quicklime. Not all of them are calcareous. They are chalk, limestone and marble.

2. Crystalline earths are hard enough to strike fire from steel, also friable and not soluble in acid. They are commonly used in the manufacture of glass.

3. Argillaceous earths (from the Latin for clay) are not soluble in acids, will not strike fire from steel. They form a dry powder which becomes malleable when water is added so are the basis of pottery.

4. Talky or Arsbestos (sic) Earthy bodies which suffer no change from the action of fire.

5. Gypscous (sic) is not properly an earth. After being burnt it becomes a powder which hardens when water is added. Quicklime will not do this without sand and gravel.

WATERY: “Only one genus, water”

1. It may be either common or impregnated with some mineral substance of aerial bodies to form mineral water.

AERIAL: No definition given

1. Common air which supports life.

2. Mephitic air which destroys flame and living animals.

APPENDIX 2: *MATERIA MEDICA* CLASS LIST \*Indicates those students were doing Cullen’s chemistry course in 1760/61

**Scotland**

Anderson, James

Atkinson, Johnson

Baldock, Thomas

\*Boswell, James Ayr

Brown, John

\*Brown, Joseph

Brown, William

Buchan Gilbert

Butter William MD

\*Cairnie, John

Copland, Alexander

\*Drummond, Alexander

Dunbar, William

Ewart, James

\*Gardiner, George MD

Gardiner Michael, Renfrew

\*Hardie, John, Annandale

\*Kinloch, Charles, Angus

Lind, James

Lloyd, William

\*Mackenzie, Donald

\*Rattray, David

\*Richardson, Charles MD

Richmond John; died 1761

Rose Udnay, Aberdeenshire

\*Saunders William, Banff

\*Sholto, Archibald

\*Smith, John Hamilton

Smith, Mark, Edinburgh

Stuart, John

\*Thompson, David

Turnbull, Gilbert, Teviotdale

\*Wilson, Alexander, Aberdeen

Wood, Andrew

**England,**

Booth, James

\*Cooper, William, Shropshire

\*Crowther, James

\*Fothergill, Anthony, Durham

\*Garland Samuel, Cambridgeshire

Graham, George, Cumberland

Luscombe, Samuel, Exeter

\*Maddocks, James MD, Herts

\*Robinson, Anthony Cumberland

\*Thirlwall, William, Yorkshire

\*Wren, Thomas, MA Oxon MD

**USA**

Blair, James Virginia

\*Field James, Virginia

Gilmer, George, Virginia

Lee, Arthur, Virginia

\*Shippen, William, Pennsylvania

\*Smibert William MD, New England

**Ireland**

Butler, Edmond

\*Cook, Daniel

Harris, Richard

Fleury, John Charles MD

\*Gamble, John

Law, John MD

Saunders, Arthur

\*Usher, William

**Caribbean**

\*Burton, Thomas, Antigua

\*Cockburn, James, Jamaica

\*Thomas, Edward, St Kitts

**Other countries**

\*Clausen, Lorentz MD, Denmark

APPENDIX 3: CULLEN’S CHEMISTRY STUDENTS AND THEIR SCIENTIFIC PUBLICATIONS

The list is in alphabetical order with the year(s) in which the man attended Cullen’s course. Because Cullen usually included the man’s normal place of residence, the list has been compiled to show where the man came from. Where Cullen did not record this information, the man’s name is on a separate list at the end of this Appendix.

The ECCO database and the Oxford Dictionary of National Biography was used to investigate publications. Where the database listed more than one edition of the book, the date of the first recorded edition has been cited.

**STUDENTS FROM SCOTLAND**

Abel George, Aberdeenshire, 1762

Adie Charles, Scotland, 1764

**Aitken**, **John**, Fife, 1763

*Essays on Several Important Subjects in Surgery, chiefly on the nature and cure of fractures of the long bones of the extremities,* 1771.

*Outlines of the Theory and Cure of Fever upon plain and rational principles* 1781

*Elements of the Theory and Practice of Physic and Surgery,* 1782

*Principles of Anatomy and Physiology* 1786

*Principles of Midwifery and Puerperal Medicine* 1786

Ainslie John, Edinburgh, 1763

Alexander, William, Edinburgh, 1755, 1765

**Anderson**, **James,** Scotland 1757

*Miscellaneous Observations on Planting and Training Timber Trees: particularly calculated for the Climate of Scotland* 1777

*Essay Relating to Agriculture and Rural Affairs,* 2nd Edition 1777

*An Enquiry into the Causes that have hitherto retarded the Advancement of Agriculture in Europe* 1779

*General View of the Agriculture of Aberdeen,* 1794

*Two Letters to Sir John Sinclair on the Subject of Draining Wet and Boggy Lands* 1796

*An Essay on Quick Lime as a Cement and a Manure* 1799

**Anderson** **Patrick**, Perthshire, 1763, 1764 *Tentamen Medicum Inaugurale de Colica Spasmodica,* 1765

Anderson, Thomas, Leith, 1763

Andrews John, Linlithgow 1763

Archibald, Sholto, Shetlands, 1760

Arnot, James, Dundee , 1758

Bailie, Menzies, Scotland, 1760, 1761, 1762

Baillie John, Inverness, 1762

**Balfour** **Francis**, Fife, 1762, 1764

*Dissertatio (sic) medica inauguralis de gonorrhoea virulenta* 1767

*A Treatise on the Influence of the Moon in Fevers by a Surgeon in the Service of the East India Company* 1785

Balfour John, Edinburgh, 1765

Bannerman, Alexander, Aberdeen, 1760

Barry, James, Glasgow, 1759

Bathie, Archibald, Scotland, 1761

Begbie, James, Edinburgh 1757, 1762

Bell George, Scotland, 1762

Bennett, Robert, Teviotdale 1761, 1763

Berry Robert, Esq Scotland, 1757

Bethune George, Fife, 1759, 1760, 1761

Beveridge Andrew, Dumfries, 1764

Blair James, Aberdeen, 1758, 1762, 1765

Borland Robert, Ayrshire, 1757

Boswell James, Ayrshire, 1759, 1760, 1761

Brock John, Teviotdale, 1764

Brown Charles, Scotland, 1757

Brown John, Scotland, 1760, 1761, 1762, 1763

Bruce Robert, Stirlingshire, 1763, 1764

Buckham James MD, Scotland, 1757

Bull John, Leith, 1757

Burd, George, Scotland, 1757

Burnett Francis, Aberdeen, 1763

Burnett, William, Aberdeen 1763

**Butter** **William** **MD**, 1756, Scotland *Dissertatio Medica et Chirurgica de Arteriotmia* 1761

*A Treatise on Kincough* 1773

*An Account of Puerperal Fevers as they appeared in Derbyshire and some Counties Adjacent* 1775

*An Improved Method for Opening the Temporal Artery, also a new proposal for the extracting of the cataract* 1783

*A Treatise on the Disease Commonly Called Angina Pectoris* 1791

*A Treatise on the Venereal Rose* 1799

Cairnie, John, Scotland, 1759, 1760, 1765

Campbell, Charles Perthshire, 1762

Campbell, Duncan, Argyll, 1762

Carmichael, David, Scotland, 1757

Carmichael, James, Perth, 1759, 1760, 1763

Carmichael, James Smyth, Lanarkshire, 1762, 1763

Carmichael John, Edinburgh, 1763

Carnegie, Alexander, Angus, 1763

Carson Alexander, Nithesdale, 1763

Caverhill John, Teviotdale, 1761

Chalmers, Robert, Scotland, 1758

Chartens, William, Scotland, 1756

**Cheyne** **John** Leith, 1762, *Dissertatio Medico Inaugurale de Rachitide* 1758

Chisholm, James, Selkirk, 1762

Chrystie, David, Scotland, 1761

Clark, William, Scotland, 1756

Clerk John Drumcrief, 1764

Clow, Robert, Scotland, 1758

Colley, James, Inverness, 1765

Colvin, George, Scotland, 1758

Congleton, David, East Lothian, 1756

Copland, Alexander, Scotland, 1761, 1763, 1764

Coverhill, John, Teviotdale, 1761

Cowburgh, Thomas, Scotland, 1760

Craigie John Glasgow, 1764, 1765

Crokat, Thomas, Scotland, 1755

**Crooks**, **Alexander** **MD,** Scotland, 1757*Dissertatio Inaugurale de Arthritide,* 1758

Crosbie, Andrew, Scotland, 1758

Cullen James, Edinburgh, 1764

Cummin, Patrick, Edinburgh, 1759

Cunningham Robert, Edinburgh, 1756

Cunningham William, Edinburgh, 1762

Dalyell, Robert, Kirkcudbright, 1763

Dallas James, Edinburgh, 1762, 1763

Davidson John, Perthshire, 1763

Davidson, Ralph, Teviotdale, 1765

Dick, James, Dumfries, 1761

Doddington, James, Scotland, 1755

Douglas, Alexander MD, Scotland, 1757

Douglas Christopher, Fort William, 1763, 1764, 1765

Douglas James Wilson, Lanarkshire, 1765

Douglas, John Shotto, Scotland, 1757

Douglas Sylvester, Aberdeenshire, 1762, 1763, 1764

Drummond, Alexander, Edinburgh, 1760, 1761, 1762, 1763, 1764, 1765

Duff, Arthur, Aberdeenshire, 1765

Dunbain, John, Scotland, 1758

Dunbar Robert, Banffshire, 1765

Dunbar William, Scotland, 1762

Duncan Andrew Fife, 1764, 1765

Duncan George, Dalkeith, 1763

Duncanson, Neil, Scotland, 1757

Eckford, William, Peebles, 1758

Edmonston, Laurence, Scotland, 1761

Eliot, Simon MD, Teviotdale, 1756, 1760, 1763

Ellis, William, Aberdeenshire, 1765

Fairbairn, Alexander, Scotland, 1757

Falside James, Midlothian, 1762

Farquhar, Walter, Aberdeen 1759

Ferguson, Adam, Scotland, 1758

Ferguson Finlay, Perthshire, 1765

Ferguson, John, Scotland, 1761, 1762

Findley, John, Midlothian, 1765

Fleming John Edinburgh, 1764, 1765

**Fordyce**, **George** **MD**, Aberdeen, 1756. *Dissertation Medico Inaugurale de Catarrho* 1758

*Elements of Agriculture* 1765

*Elements of the Practice of Physics* 1771

*A Treatise on the Digestion of Food* 1791

*A Dissertation on Simple Fever* 1794

*A Second Dissertation on Fever* 1795

*A Third Dissertation on Fevers* 1798

Forbes Theodore, Leith, 1764, 1765

Fraser, James, Edinburgh, 1760

Frazer, Hugh. Inverness, 1763

**Freer**, **Adam**, Perthshire, 1764, 1765 *Dissertatio Inaugurale Medico de Syphilide Venera* 1767

Gardiner, George, Scotland, 1761

Gardener, Michael, Renfrew, 1760, 1763

Garioch Alexander, Aberdeenshire, 1763, 1765

Garioch James, Aberdeenshire, 1763

Garvey William Edinburgh, 1764

Gates, David, Scotland, 1758

Gibson David, Scotland, 1757

Gibson, James, Scotland, 1757

Gibson, John, Leith, 1760

Gillespie Urquhart, Aberdeenshire, 1763

Gilmour George, 1762, 1763, 1764

Glendenning William, Kirkcudbright, 1763, 1764

Gordon George, Banffshire, 1763

Gordon, John, Banff, 1759, 1764

Goodsir, Elliot Fife, 1762

Gowdie, Walter, Edinburgh, 1759

Graham James, Scotland, 1758

Graham, John, Stirling, 1756

Graham Thomas, Scotland, 1756

Grant Daniel, Scotland, 1760

Grant, Donald, Scotland, 1759

Grant, John, Banffshire, 1763

Grieves Charles, Peebles, 1762, 1763, 1764, 1765

Haig John, Alloa, 1763

Hain, Patrick, Scotland, 1756

Hamilton, Alexander, Angus, 1762

**Hamilton**, **Robert**, Scotland,1757*A Description of Influenza* 1782

*The Duties of a Regimental Surgeon* 1787

Hardie, John, Annandale, 1760

Haswell Patrick, Fife, 1764

Hay John, Angus, 1763

Hill Charles, Stirling 1760

Hill, John, Angus, 1761

Hogg James, East Lothian, 1762

Honeyman, Mungo, Scotland, 1756

How, John, Renfrew, 1756

Hunter Andrew, Ayrshire, 1757, 1763

Hunter, Robert, Air (sic) 1755

Hunter William, Dumfries, 1762

Hutton, Thomas, Lanark, 1761

Ilesser, John, Scotland, 1761

Irvine Patrick, Annandale, 1765

Jamieson, James, Leith, 1757

Johnson, John, Berwickshire, 1763, 1765

Johnson Richard Annandale. 1764

Johnson, Robert, Airshire, 1764

Keith, Alexander, Edinburgh, 1762

Kelly Alexander, Edinburgh, 1762, 1763

Ker, James (Air) 1756

Ker, James of Moriston, Esq, Scotland, 1758

Ker, Robert, Ayrshire, 1756, 1765

King Alexander Elgin, 1760, 1765

King, William, Scotland, 1755

Kinlock, Charles, Angus, 1760, 1761, 1762

Laing Walter, Dumfriesshire, 1765

Lauder William Edinburgh, 1764, 1765

Laurie William Edinburgh, 1764

Leishman, Peter, Scotland, 1756

Lesley, John, Scotland, 1757

Liddell Andrew Orkneys, 1764

**Lind**, **James**, Midlothian, 1755 *Dissertatio Inauguarale Medico de Morbis Veneris Localibus 1748*

Lithgow Hamilton, Scotland, 1756

Lockhart, Stephen, Lanark, 1756

Logan, James, Airshire, 1761

**Lorimer**, **John,** Scotland, 1757*Essays on Magnetism*

Lyon Alexander, Angus, 1763

Lyon, James, Scotland, 1756

Mabane, Adam, Scotland, 1757

Maxwell, Andrew, Galloway, 1759

Mackie John Dunfermline, 1765

Macalman Godrey, Argyll, 1762

Mc Arthur, John, Renfrew, 1756

Mac Caw, Anthony, Galloway, 1762

Mac Caw, James, Galloway, 1762

Mc Caskell, John, Scotland, 1761, 1762

Maclaggan Robert, Perthshire, 1762

Mc Cormack, Edward, Edinburgh, 1765

Mc Cormack, Joseph, Scotland, 1757

Mc Donald, John, Scotland, 1758

MacGlashan, Dunkeld, 1763

Mc Keller, Charles, Scotland, 1761, 1764

Mackenzie, Alexander, Scotland, 1759 1760

Mackenzie, Donald, Scotland, 1760

Mc Laughlan, John, Argyllshire, 1762

Mc Murray Peter, Kirkubright, 1764

Mc Queen, Daniel, Scotland, 1757, 1764

MacRae, George, Air, 1756

Marshall Robert, Peebles, 1763, 1764

Mason George, Selkirk, 1763

Maxwell, Andrew, Galloway 1759, 1762, 1763, 1764

Menzies Charles Perthshire, 1764

Middleton, Robert, Scotland, 1755

**Millar**, **John**, Perth, 1760 *Dissertatio Inaugurale Medico de Fluxu Lochiorum Immodica* 1757

*A Discourse on the Duty of Physicians* 1776

Milne, Edgar, Edinburgh, 1760

Milne William Banffshire, 1764

Mitchell Andrew, Edinburgh, 1765

Mitchell, William, Dundee, 1760

Moncrieff William, Perthshire, 1764, 1765

Moffatt Cumberland, Edinburgh, 1765

Moffat, William, Edinburgh 1755

Moodie Alexander, Berwickshire, 1764

Moor, Robert Aireshire (sic) 1759, 1760

Murray, Andrew, Perth, 1763

Neilson, Charles, Kirkcudbright, 1763

Ochiltree Robert, Argyll, 1763

Ogilvy, Charles, Scotland, 1756

Ogilvy, William, Scotland, 1761

Oliphant, John, Leith, 1761

Oliver Thomas, Jedburgh, 1764

Park, Patrick, Scotland, 1756

Park, Charles, Air, 1756

Parlane, Patrick, Glasgow, 1756

Paterson, George, Scotland, 1756

Paterson William, Lanarkshire, 1763

Pheydel, Thomas, Scotland, 1759

Phillips Thomas Aberdeenshire, 1764

Pinkston Fleming, Glasgow, 1764

Potts, Alexander, Scotland, 1759

Price Richard, Scotland, 1756

Primrose, Robert, Scotland, 1761

Ramsay James, Kelso, 1762

Ramsay, Robert MD, Linlithgow, 1755

Rattray, David, Scotland, 1758, 1760, 1765

Reid, Andrew, Edinburgh, 1765

Reid John, Fife, 1764

Reid, Robert, Aberdeenshire, 1765

Reid Thomas, Aberdeenshire,

Reid, William Dundee, 1757

Renwick, Michael, Dumfriesshire, 1761

Richardson, Edward MD Argyll, 1756

Richmond, John, died 1761

Robert Robertson, Dunkeld, 1764

Rogerson John, Annandale 1764

Row, John, Edinburgh, 1760

Rose, Udnay, Aberdeen, 1759

Robertson, Colin, Angus, 1757

Robertson Robert, Dunkeld, 1763, 1764

Robertson, Walter, Aberdeen, 1758, 1760

Russell, Balfour, MD Edinburgh, 1755

**Sandeman** **George**, Perth, 1765. *Dissertatio Medico Inaugurale de Rheopalmato* 1769

Saunders David, Banff, 1762, 1763, 1764

Saunders, James, Banff, 1765

**Saunders**, **William**, Banff, 1760, 1763, 1764. *Observationes de Antimonio, ejuisque usu in morbis curandis* 1773

*Catalogue of Materia Medica printed for the use of such gentlemen as attend Doctor Saunder’s lectures*

*Elements of Physic for the Use of gentlemen who attend Doctor Saunder’s lectures.* 1780

*Observations on the Superior Efficiency of the Red Bark* 1782

Scott John, Alloa 1762, 1763

Scot, Robert, Musselbrough, 1761

Sinclair William, Caithness, 1763

Simson, William, Dalkeith, 1759

Skene, George, Aberdeen, 1759

Smellie, William, Edinburgh, 1761, 1762

Smith Mark, Edinburgh, 1762, 1763, 1764

Sommers, James, Clydesdale, 1759

Sommerville, Archibald, Scotland, 1758

Spence David Edinburgh, 1763, 1764, 1765

Spence James, Scotland, 1760

Spink, Patrick, Scotland, 1757

**Stark**, **William,** Scotland, 1761, 1762*The Works of the Late William Stark consisting of clinical and anatomical observations with experiments dietetical and statistical* 1788

Stenhouse, James, Dumfries, 1761

Stuart, William, Greenock, 1765

Stevens David Aberdeenshire , 1764

**Stewart**, **Robert**, 1761, Airshire. *Dissertatio Inaugurale de Arthritides Natura et Prophylaxi* 1771

Strang Thomas, Scotland, 1762

Summers, Thomas, Scotland, 1761

Sutherland, Patrick, Orkneys, 1757

Swanston William East Lothian, 1764

**Taylor** **John** Aberdeen, 1765 *A Medical Treatise on the Virtues of St Bernard’s Well* 1790

*A Treatise on the Virtues of Fir-Tree Well* 1800

Tod, Gavin, Scotland, 1759

Thompson, James, Edinburgh, 1757, 1758

**Thomson**, **Alexander**, Fife, 1759. *An Enquiry into the Causes, Methods of Cure and Prevention of Nervous Disorders* 1781

**Thomson**, **David**, Fife, 1759, 1760, 1761, 1762, 1763. *Tractus Medicus Inauguralis de menstruis 1765*

Thomson, James, Edinburgh 1757, 1758

Townsend, Richard MD, Scotland, 1758

Turnbull, Gilbert, Teviotdale, 1761

Urquhart David, Cromarty, 1764

**Urquhart** **Robert** Edinburgh, 1764, 1765 *Dissertaio Inaugurale de Ipecacuanha* 1772

Watson, David, Angus, 1763

Wells, John, Annandale, 1760

Weir, John, Clydesdale, 1759

Weir, Phillip, Midlothian, 1760

Welch Andrew, Kirkcudbright , 1763

Whyt, Robert, Falkirk, 1759

Wilkie, John, Scotland, 1758

Williamson James, Scotland, 1762

Wilson, Alexander, Coldstream, 1763

Willison, John, Dundee, 1758

Wilson, Alexander, Aberdeen, 1760, 1761, 1765

Wilson, Alexander, Glasgow, 1760

Wilson, James, Teviotdale 1763.

Wilson, John, Edinburgh, 1755

Wilson John, Kelso, 1764

Wilson, William Greenock, 1761, 1763

Wood, Andrew, Edinburgh, 1761, 1762, 1763

Wylie, Alexander, Fife, 1765

Young, Alexander, Scotland, 1758

**Young** **James**, Angus 1765 *Tentamen Medicum Inaugurale de Chlorosi* 1768

Young Maurice, Angus, 1765

Young Walter, Angus, 1765

**STUDENTS FROM ENGLAND**

Acklans William Yorkshire, 1762

Aiken John, Warrington 1764

Akres**,** Edmund, 1758

**Arnold** **Thomas**, Leicestershire, 1762. *Dissertatio Medico Inaugurale de Pleuride* 1766

*Observations of the Nature and Kinds, Causes and Prevention of Insanity* 1782

*A case of Hydrophobia* 1793

Ashton, Ralph 1758

Atkinson, Johnson, AM Canterbury 1760

Bailey Thomas B, Lancashire, 1762

Baldwin John, 1757

Bayly, John MD 1756

Bentley, Timothy, Leicestershire, 1761, 1762

Berkley, John, Worcestershire, 1761

Bird, Adam, Northumberland, 1757

**Birdwood** **Roger** Devonshire, 1764, 1765. *Tentamen Physiologicum in de Causis Fluxus Menstrui* 1769

Birkenhout John Yorkshire, 1763, 1764

**Blagden** **Charles** Bristol, 1765. *Testamen in Causa* *Apoplexiae* 1768

*Experiments and Observations in an Heated Room* 1775

*History of Congelation of Quick Silver* 1785

*Experiments on the Cooling of Water below its Freezing Point* 1788

Blamire, William, Cumberland, 1761

Blount Thomas, Flintshire, 1764

Booth, James MD, 1759

**Bostock** **John,** 1764**.** *Testamen Medicum Inaugurale de Arthritide* 1769

Breckenden, John MD, 1757

Brooksbank, William, London, 1761

Brown, Joseph, London, 1761

Bullfinch, Thomas, 1756

Bullock William, St John’s Cambridge, 1762

**Butt**, **Martin**, Staffordshire, 1757. *Testamen Medicum Inaugurale de Spontanea Sanguis Separatione* 1760

Byecroft Henry, Liverpool, 1763

Campbell, Archibald, 1761

Churchill, Joseph, Northampton, 1756

Clarke, John, Yorkshire, 1765

Clarkson, John, Lancaster, 1761

Constable, Thomas, Berwick, 1758, 1760

Cooper, William, Shropshire, 1759, 1760

Cox Robert, Christchurch, Oxford, 1762

Crosse Richard Oxford, 1763

Crowther, James, 1759, 1760

Crozier, John, 1756

Cowling, John, Lancashire, 1765

Davison, Robert, Staffordshire, 1765

Dickson, Joshua, Cumberland, 1765

Dodsley, Alvery, Nottinghamshire, 1760

Dunne, Martin, Oriel, Oxford, 1765

Dunning John, Dorset, 1764

Dunston, Henry, 1756

**Eaton** **John** Nottinghamshire, 1764. *Dissertatio (sic) Medicum Inaugurale de Morbis Ventriculi* 1767

Edwards, John, 1761

Edwards, Joseph, 1756

**Falconer** **William**, Cheshire, 1763, 1764, 1765. *An Account of the Efficacy of Aqua Mephitica Alkalina or Solution of Fixed Alkali Salt, saturated with Fixable Air in Calculus Disorders,* 2nd Edition1787

**Farr**, **Samuel**, Bristol, 1761, 1762, 1763. *An Essay on the Medical Virtues of Acids*1769

*Enquiry into the Propriety of Blood Letting in Consumptions* 1775

Ford William Staffordshire, 1764

**Fothergill**, **Anthony** **MD**, Durham, 1760, 1761. *A New Experimental Enquiry into the Nature of the Qualities of the Cheltenham Waters* 1785

*An Essay on the Nature of the Disease Caused by the Bite of a Mad Dog* 1799

*An Essay on the Preservation of Ship Wrecked Mariners* 1799

Garencieres Theophilus, York, 1763

Garbett, Francis, 1761

**Garland**, **Samuel**, Cambridge, 1760, 1761. *Dissertation Inaugurale Medico de Medicaments Adstringents* 1763

Gilpins Joseph, Carlisle, 1764

Gould John, Devon, 1762

Gould Joseph, Derbyshire, 1762

Graham, Robert, London, 1755

Graham George, Cumberland , 1761

Graham, Thomas, 1758

**Graham** **William,** 1756*Tentamen Physiologico Medicum Inaugurale de Perspirationis Usu* 1781

Grosvenor Rupert Staffordshire, 1763

Haggart John, St John’s Cambridge, 1762

Hall Charles, Devonshire, 1763

Hall, Henry MD, 1758

Hatter Thomas, Sussex, 1762

**Haygarth** **John,** 1763, 1764**.** *Inquiry into the Prevention of Small Pox* 1784

*Sketch of a Plan to Eliminate the Casual Smallpox from GB and to introduce general inoculation.*

Herbert John Orpen, 1762

Hewert, John Berwick, 1761

Hewson**,** William**,** Northumberland, 1761

**Holdsworth** **Thomas**, Yorkshire, 1762. *Dissertio Medico Inaugarale de Ictero* 1764

Hooper Thomas, Worcestershire, 1763

Howe William Devonshire, 1764

Hulme Nathaniel, Yorkshire, 1763

Hull William Lancashire, 1764

Hutchinson, James, 1762

Hurst, Thomas, 1755

Hythe, John, Manchester, 1759

Jarvis, Maurice, St Mary’s Hall, Oxford, 1762

Jasper Porter Somersetshire, 1764

Kirsopp Mathew Northumberland, 1764

Leeds Samuel Norwich, 1764

Leighton David Northumberland, 1763

Lloyd John, Lancashire, 1756

Loftie, William, Kent, 1756

Longley Robert, London, 1765

Luscom, Samuel, Exeter, 1759

Lyde Phillip, Devonshire, 1763

Martin, Thomas, Leicestershire, 1765

Marshall John, 1764

Metcalf Francis, Yorkshire, 1764

Metcalf Thomas, St Peter’s Cambridge, 1762

Mitchelson, Thomas MD, 1757

Moodie Alexander Berwickshire, 1764

Morgan Thomas Oxford, 1765

Nabbs John, Lancashire, 1763

Nooth Mervin, Dorsetshire, 1763

Oakes John Yorkshire and Cambridge, 1764

Orred Daniel, Cheshire, 1765

Parsons, John, York, 1765

Pattison Samuel, Lincolnshire, 1762

Palmer John Bedfordshire, 1763

Parson John, Oxford, 1764

Pearson, Thomas, MA Oxon, 1757

Peele, John, 1756

Pepys Lucas, Cheshire, 1764, 1765

**Percival**, **Thomas**, Lancashire, 1761, 1764. *Essays Experimental and Medical on the Following Subjects, viz, The empiric, The dogmatic. Or the arguments for and against the use of theory.* 1767

*Experiments and Observations on water: particularly hard pump water of Manchester* 1769

*Observations* *and* *Experiments on the Poison of Lead.* 1769

Pingot Cyrus Henry, London, 1764

Porter, Jasper, 1764

Pryce, Owen, 1756

Richardson, John, Northumberland, 1756

Roberts William Isle of Wight, 1764

Robinson, Anthony, Cumberland, 1760

Rolleston, James MD, 1758

Scaife, John, Cumberland, 1763

Shepherd Arthur, Yorkshire, 1762

**Smith**, **Thomas,** Staffordshire17571761, 1763, 1764 *Testamen Physiologicum Inauguralis de Actione Musculari 1767*

Spencer Nathaniel Derbyshire, 1764

Stamper Joseph, Cumberland, 1762

Stapleton Joseph Essex, 1765

Stevens Thomas, Lincolnshire, 1764

Storey Richard, Cumberland, 1763

Symonds John Worcestershire, 1762

Taylor John, Warrington, 1765

Taylor, John, AB Oxon, 1765

Tennant John, North Yorkshire, 1763

Thirlwall, William, Yorkshire, 1760

Thombinson, Robert, 1759

**Thomson** **Benjamin**, Herefordshire, 1764. *Dissertatio Medico Inaugurale de Colico* 1770

Townsend, Joseph, Claire Hall, Cambridge, 1762

Turton, John, 1757

Trotter, John, 1755

**Vaughan**, **James** 1758**,** 1761*Dissertatio Medico Inaugurale de Polypo Cordis* 1762

*Cases and Observations on the Hydrophobia, to which is annexed an account of the Caesarean Section* 1778

Walker Richard, Durham, 1762

Walker William Yorkshire, 1764

**Wall** **John**. Oxford 1765. *Experiments on Malvern Waters* 1756

Watson William London and Cambridge, 1764

Westcott, John, Somerset, 1762

**White** **Snowdon** Derbyshire, 1765. *Tentamen Medicum Inaugulare de Ulcusculis Veneris* 1769

**White** **William**, York, 1765. *An Essay on Diseases of the Bile more particularly its calculous concretions. 1777*

*Observations on the Use of Dr James’ powder, emetic tartar and other antimonial preparations. 1774*

*Experiments and Observations on the Waters of York 1780*

Wise Arnold, Hampshire, 1762

**Withering**, **William** Shropshire, 1762, 1763, 1765. *An Account of the Scarlet Fever and Sore Throat or scarletina angiosa, particularly as it appeared in Birmingham in the year 1778.* 1779

*An Account of the Foxglove and some of its Medical Uses* 1785

*A Chemical Analysis of the Water at Caldas da Rainna* 1795

Worthington, James, Lancashire, 1761

Wren, Thomas MD, Warwickshire, 1759, 1760

Wright Baynes Yorkshire, 1765

Wright Richard Emmanuel College, Cambridge, 1762

**Wright** **Thomas**, Stafford 1765. *Tentamen Medica Inuagurale de Variolis* 1769

**STUDENTS FROM IRELAND**

**Backas**, **Charles** 1760**.** *Tentamen Medicum de Phthisi Pulmonare* 1763

Baker John, 1761

Beugo, Robert, 1757

Bonham, Francis, 1756

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Butler, Edward, 1760

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Caddell, Walter, Barbados, 1758

Clifton, Benjamin St Kitts, 1762

Cockburn, James, Jamaica, 1760

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Elcock Grant, Barbados, 1762, 1763

Forbes, Francis, Bermuda, 1760

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Perry Hugh, Barbados, 1764

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Lafont, John Abel, Denmark, 1765

Roethiger, John Andrew, Bern, 1761

Alexander William, Halifax Newfoundland, 1764

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Adie Robert 1758, 1761

Aldwell, Samuel, 1762, 1763, 1764

Armstrong Francis, 1756

Arnold Thomas, 1763, 1765

Bachas Charles 1761

Barber James, 1756

Barron Alexander, 1765

Boston William, 1764

Bridgewater Edward, 1761

Bruce George, 1765

Bruce John Esq, 1761

Buchan William, 1760

Buchanan Duncan, 1756, 1758

Burton Thomas 1761, 1762

Butler Richard, 1765

Cairn John, 1764

Campbell Islay Esq, 1758

Campbell John Esq, 1761

Clarkson John, 1763

Clifton, Benjamin 1763, 1764

Cocks Robert, 1763

Cook Daniel, 1765

Copland William Esq, 1761

Crowther James, 1763

Davis John, 1758

Dickson James, 1763

Dickson Lyonel, 1763

Digges Joseph, 1765

Drayton Charles, 1764, 1765

Drouth William, 1762, 1763, 1764

Dunning John, 1765

Edwards John 1762, 1763

Forbes Francis 1761

Forster Edward, 1764, 1765

Gamble John, 1762, 1763

Garbet Francis, 1762, 1763

Garland Samuel, 1762

Garrett Edward, 1765

Gaston Alexander, 1758

Gittens Samuel, 1756

Gould John, 1763

Golding Samuel, 1764, 1765

Graham George, 1762, 1763

Hay Alexander, 1758

Halliwell Samuel, 1762

Hutchinson James, 1763

Hutchinson John, 1763

Iveleigh Nicholas, 1764

Jardins Alexander, 1763

Jeffries, John 1762, 1763

Johnson Alexander, 1763

Johnson William Esq, 1761

Johnston Andrew 1757

Kirkpatrick Alexander 1756

Kirsop Matthew, 1765

Lashley Thomas, 1764, 1765

Lee Arthur, 1762, 1763

Leeds Samuel, 1765

Leman John, 1765

Lloyd William, 1761

Lowe Arthur, 1758

Maddox James MD 1761, 1764, 1765

Martin Samuel, 1762, 1763

Mac Culloch Robert, 1756

Mc Dermot Charles 1763

Mc Farquahar George 1761

Mac Kinlie James, 1758

Mc Kittrick James 1764

Mc Kittrick John MD 1763

Meins John 1761

Metcalf Francis 1765

Millar David, 1757

Mitchell Thomas, 1764

Morgan John 1762

Muirhead James, 1757

Murray James, 1763

Newall William, 1756

North Mervin 1765

Oakes John 1765

Palmer John Fish 1764, 1765

Parker Jasper, 1765

Percel John MD, 1762

Peyton George, 1763

Pugh John, 1763

Reeder Henry, 1765

Richardson Charles MD, 1758, 1760

Robinson Arthur, 1761

Robiris Thomas, 1758

Ross John, 1755

Russell Mr William, 1764

Rutherford Daniel, 1764, 1765

Saunders Arthur, 1761, 1762, 1763

Scott William, 1757

Sedgwick Anthony, 1762

Shiells John, 1762

Skirwin David, 1764

Smith John Hamilton, 1758, 1760

Stewart Daniel, 1762, 1763, 1764

Sticart Andrew Esq, 1761

Thomas Edward, 1761

Walwyn John, 1765

Williamson Thomas, 1763, 1764

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2. Jan Golinski, *Science as Public Culture* (Cambridge: Cambridge University Press 1992)p25 [↑](#footnote-ref-2)
3. Christopher Clayson, William Cullen in Eighteenth-Century Medicine in *William Cullen and the Eighteenth-Century Medical World* edited by A. Doig, J.P.S. Ferguson, I.A. Milne and R. Passmore (Edinburgh: Edinburgh University Press 1993) p 89 [↑](#footnote-ref-3)
4. Originally, Cullen used the word to express his theory that the nervous system explained the way the body worked. [↑](#footnote-ref-4)
5. www.cullenproject.com [↑](#footnote-ref-5)
6. John Thompson, *An Account of the Life, Lectures and Writings of William Cullen* (Edinburgh 1832).

   The fact that Thompson chose to write a life of Cullen in particular is probably a good illustration of the way individuals manipulated the patronage system. Thompson came from a relatively lowly social position but in 1806, he married Margaret Millar, daughter of John Millar (1735-1801) who was a cousin of William Cullen’s. Millar began his career as tutor to the children of Lord Kames and through Kames’ patronage, became Professor of Philosophy in Glasgow. In taking an interest in Cullen, Thompson was, in effect using his talents to boost the position of the family he had just become a part of. [↑](#footnote-ref-6)
7. Jonathon Barry, Bourgeois Collectivism? Urban Association and the Middling Sort in *The Middling Sort of People: Culture, Society and Politics in England 1550-1800* edited by Jonathon Barry and Christopher Brooks (London: Macmillan Press 1994) p95 [↑](#footnote-ref-7)
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9. Ludmilla Jordanova, Has the History of Medicine Come of Age? *Historical Journal* (1993) *36* : 437-449, p 438 [↑](#footnote-ref-9)
10. Roger Emerson, *Academic Patronage in the Scottish Enlightenment* p5 [↑](#footnote-ref-10)
11. Martin J.S. Rudwick, *Bursting the Limits of Time: The Reconstruction of Geohistory in the Age of Revolution* (Chicago London: University of Chicago Press 2005) p4 [↑](#footnote-ref-11)
12. Glasgow University Library, (GUL) Special Collections. These are filed as Series MS Cullen. [↑](#footnote-ref-12)
13. Wellcome Library, MS 1926, MS 1919, MS 1918, MS 49 [↑](#footnote-ref-13)
14. Matthew D Eddy, The Interactive Notebook: How Students Learned to Keep Notes During the Scottish Enlightenment, *Book History* (2016) *19*: 86-131 [↑](#footnote-ref-14)
15. William Wightman, William Cullen and the Teaching of Chemistry, *Annals of Science* (1956) *11*: 154-165 p162

    Wightman noted that chemistry notes from Joseph Black’s courses were changing hands for 4 or 5 guineas at a time when the course itself cost 3 guineas [↑](#footnote-ref-15)
16. James Anderson, *The Bee* (1791) p 46

    The names of the men who attended Cullen’s chemistry courses still exist in Edinburgh University Library, Special Collections. They show that many of Cullen’s students took his courses at least twice. [↑](#footnote-ref-16)
17. William P.D. Wightman, William Cullen and the Teaching of Chemistry, *Annals of Science* (1956) II p197 [↑](#footnote-ref-17)
18. Wellcome Library MS 49 [↑](#footnote-ref-18)
19. Lectures on Chemistry for Medical Students, Wellcome Library MS 1926. Lectures on Chemistry, MS 1919. [↑](#footnote-ref-19)
20. Wellcome Library MS 1918 [↑](#footnote-ref-20)
21. The lectures were originally published without Cullen’s consent. He took the student concerned to court but lost the case and agreed to publication provided that he was allowed to correct the student’s notes before they went into print. [↑](#footnote-ref-21)
22. Glasgow University Library, MS Cullen 432 [↑](#footnote-ref-22)
23. Jan Golinski, *Science as Public Culture: Chemistry and Enlightenment in Britain 1760-1820*

    Richard Sher, *Church and University in the Scottish Enlightenment: The Moderate Literati of Edinburgh* (Edinburgh: Edinburgh University Press 1985)  [↑](#footnote-ref-23)
24. T.M. Devine (editor) *Recovering Scotland’s Slavery Past: The Caribbean Connection* (Edinburgh: Edinburgh University Press 2015) [↑](#footnote-ref-24)
25. Richard B. Sheridan, The Formation of Caribbean Plantar Society in *The Oxford History of the British Empire: The Eighteenth Century* edited by P.J. Marshall (Oxford: Oxford University Press 1998)

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26. Matthew Eddy, *The Language of Mineralogy: John Walker, Chemistry and the Edinburgh Medical School 1750-1800* (Farnham Burlington: Ashgate Publications 2008)

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27. A.L. Donovan, *Philosophical Chemistry in the Scottish Enlightenment* (Edinburgh: Edinburgh University Press 1975) [↑](#footnote-ref-27)
28. Donovan discussed Cullen’s five principles, p114. After Black’s discovery of fixed air, Cullen introduced a sixth principle which was included in his later lectures. [↑](#footnote-ref-28)
29. Donovan, p31 suggested that Cullen attended Shaw’s lectures when he was in London. The state papers in the English archives in Kew show that Cullen was in Panama at the time in question. [↑](#footnote-ref-29)
30. Archibald and Nan Clow, *The Chemical Revolution: A Contribution to Social Technology* (London: Batchworth Press 1952) [↑](#footnote-ref-30)
31. L.M. Cullen and T.C. Smout, *Comparative Aspects of Scottish and Irish Economic and Social Policy 1600-1900* (Edinburgh: John Donald 1977)

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32. T.M. Devine and Rosalind Mitchison, *People and Society in Scotland: Volume 1, 1760-1830* (Edinburgh: John Donald 1988)

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33. Linda Colley, *Britons: Forging the Nation 1707-1837* (London: Pimlico Press 1992) [↑](#footnote-ref-33)
34. Mario Biagioli, Galileo’s System of Patronage *History of Science* (1990) *28*: 28-61 [↑](#footnote-ref-34)
35. In his clinical lectures Cullen taught only those aspects of the subject which were relevant to the patient he was discussing. [↑](#footnote-ref-35)
36. “Chymistry is needed in every step of the study of medicine”

    Wellcome Library, Student note book from 1762, Cullen’s lectures on Chemistry B310A4, MS 49 [↑](#footnote-ref-36)
37. Erich Weidenheimer, Patronage and Enlightened Medicine in the Eighteenth-Century British Military: The Rise and Fall of Doctor John Pringle 1707-1782 *Social History of Medicine 29*:21-43 [↑](#footnote-ref-37)
38. For example *William Cullen and the Eighteenth-Century Medical World* edited by A. Doig, J.P.S. Ferguson, I.A. Milne, R. Passmore (Edinburgh: Edinburgh University Press 1993). The book was compiled to mark the bicentenary of Cullen’s death and only one of the eleven chapters deals with his chemistry.  [↑](#footnote-ref-38)
39. Andrew Wallace Hadrill *Patronage in Ancient Society* (New York London: Routledge 1982) p1 [↑](#footnote-ref-39)
40. Jeremy Black *Eighteenth-Century Britain 1688-1783* p198 [↑](#footnote-ref-40)
41. Pierre Bourdieu, *Homo Academicus,* translated by Peter Collier(Cambridge : Polity Press and Blackwell 1988)

    In the book Bourdieu borrowed the phrase, *Conflict of the Faculties* from Kant who used it as the title of an essay on universities in eighteenth-century Germany. Kant’s description of a university in that essay would be applicable to any university at any time. Immanuel Kant, *Conflict of the Faculties,* translated by Mary J. Gregor (New York: Abaris Books 1979) p 23 [↑](#footnote-ref-41)
42. Richard Jenkins, *Pierre Bourdieu* (London New York: Routlege 1992) p11 [↑](#footnote-ref-42)
43. John B. Thompson, in the Introduction to Bourdieu’s *Language and Symbolic Power* (Cambridge: Polity Press 1999) p14 [↑](#footnote-ref-43)
44. Pierre Bourdieu, quoted by Robert Moore in the chapter, Capital in *Pierre Bourdieu: Key Concepts* edited by Michael Grenfell (London New York: Routledge 2012) p98 [↑](#footnote-ref-44)
45. Richard Jenkins, *Pierre Bourdieu* p85 [↑](#footnote-ref-45)
46. Richard Jenkins *Pierre Bourdieu* pp 10-11. Jenkins quoted Bourdieu describing his writing as “a permanent struggle against ordinary language.” [↑](#footnote-ref-46)
47. Robert Moore, Capital in *Pierre Bourdieu: Key Concepts*  p 116 [↑](#footnote-ref-47)
48. Richard Jenkins, *Pierre Bourdieu* p 85 [↑](#footnote-ref-48)
49. Lisa Rosner, *Medical Education in an Age of Improvement: Edinburgh Students and Apprentices 1760-1826* (Edinburgh: Edinburgh University Press 1991)p 26 [↑](#footnote-ref-49)
50. Lisa Rosner, pp 27- 28 [↑](#footnote-ref-50)
51. An example of a letter received by Cullen came from Benjamin Franklin who Cullen had met in 1759, Thompson, *Life* p139. The letter stated that “the bearer, Mr Morgan is a gentleman who proposes to reside in Edinburgh for the completion of his medical studies and is a young Gentleman of Philadelphia who I have long known and greatly esteem; and as I interest myself in what relates to him, I cannot but wish him the advantages of your conversation and instruction.” Morgan took Cullen’s chemistry course in 1762 and went on to become one of the founders of America’s first medical school. *Life* p 140

    Cullen, when he heard that one of his students, Alexander Coventry, was leaving for America, wrote a letter of introduction to Samuel Bard, a famous New York physician who had taken his chemistry course. L.M.A. Liggett, Extracts from the Diary of a Scotch (sic) Medical Student, *Medical Library and Historical Journal* (1904) Volume II, pp 103-112 [↑](#footnote-ref-51)
52. Pierre Bourdieu, *Homo Academicus,* p 36 [↑](#footnote-ref-52)
53. Pierre Bourdieu, *Outline* *of* a *Theory of Practice,* translated by Richard Nice (Cambridge: University of Cambridge 1977) pp 179-180 [↑](#footnote-ref-53)
54. Pierre Bourdieu, p 84 [↑](#footnote-ref-54)
55. Pierre Bourdieu, *Homo Academicus,* p10 [↑](#footnote-ref-55)
56. Pierre Bourdieu, *Homo Academicus* p88 [↑](#footnote-ref-56)
57. Pierre Bourdieu, *Outline of a Theory of Practice,*  p76

    In his Introduction to Bourdieu’s *Language and Symbolic Power,* John B. Thompson provided a much clearer definition when he stated that *habitus* was “a set of *dispositions* which incline agents to act in certain ways” (Emphasis in the original) [↑](#footnote-ref-57)
58. *Theory of Practice* p72 [↑](#footnote-ref-58)
59. *Theory of Practice* p164 [↑](#footnote-ref-59)
60. Richard Sher, *Church and University in the Scottish Enlightenment: The Moderate Literati of Edinburgh* pp 154-155 [↑](#footnote-ref-60)
61. Charles Camic *Experience and Enlightenment: Socialisation for Cultural Change in Eighteenth-Century Scotland* p26 [↑](#footnote-ref-61)
62. Cullen counted plenty of clergymen among his friends and acquaintances. His correspondence shows that he offered his advice to them free of charge. [↑](#footnote-ref-62)
63. Bourdieu, *Homo Academicus* p11

    John B. Thompson defined Bourdieu’s *Field* as “social arena within which struggles or manoeuvres take place over specific resources or stakes and access to them”. [↑](#footnote-ref-63)
64. *Homo Academicus* p11 [↑](#footnote-ref-64)
65. Pierre Bourdieu, *Homo Academicus* p87 [↑](#footnote-ref-65)
66. Pierre Bourdieu, *Homo Academicus* p56 [↑](#footnote-ref-66)
67. Pierre Bourdieu, *Homo Academicus* p90-95 [↑](#footnote-ref-67)
68. Pierre Bourdieu, *Homo Academicus* p 90-95 [↑](#footnote-ref-68)
69. Thompson, *Life* p 134 [↑](#footnote-ref-69)
70. Pierre Bourdieu, *Homo Academicus* p97 [↑](#footnote-ref-70)
71. Pierre Bourdieu, *Homo Academicus* p88 [↑](#footnote-ref-71)
72. Pierre Bourdieu, *Homo Academicus,* pp 43-50 [↑](#footnote-ref-72)
73. Bourdieu pointed out that in many cases, holders of unorthodox views are inclined to censor themselves rather than risk losing their positions. *Language and Symbolic Power* p138 [↑](#footnote-ref-73)
74. Pierre Bourdieu, *Homo Academicus* p55 [↑](#footnote-ref-74)
75. Roger Emerson, *Professors, Patronage and Politics* p7 [↑](#footnote-ref-75)
76. *Homo Academicus* p52 [↑](#footnote-ref-76)
77. *Homo Academicus* pp 105-6 [↑](#footnote-ref-77)
78. It is clear from the text that the phrase “social constraints” referred to the content of their lectures. Those teaching law and medicine had to teach a highly regulated syllabus [↑](#footnote-ref-78)
79. *Homo Academicus* page [↑](#footnote-ref-79)
80. Pierre Bourdieu, *Homo Academicus* p107 [↑](#footnote-ref-80)
81. Bourdieu, *Homo Academicus* p123. [↑](#footnote-ref-81)
82. Roger Emerson, *An Enlightened Duke: The Life of Archibald Campbell (1682-1761) Earl of Islay, 3rd Duke of Argyll* (Kilkerran: Hummingbird Press 2013) p 251 and p316 [↑](#footnote-ref-82)
83. Roger Emerson, *An Enlightened Duke,*  p316 [↑](#footnote-ref-83)
84. Roger Emerson, *An Enlightened Duke,* pp 223-226 discusses the Duke’s considerations in making an appointment.

    Glasgow University Archives (GUA) contains two letters asking the Duke to make decisions about university posts. GUA 26223, dated 1752 and GUA 30485 dated 4th January 1756, which dealt with the appointment of Joseph Black [↑](#footnote-ref-84)
85. This will be discussed in chapter 3. [↑](#footnote-ref-85)
86. Thompson, *Life* p70. [↑](#footnote-ref-86)
87. For example, Sir Lewis Namier, *The Structure of Politics at the Accession of George III* (London New York: Macmillan and Co 1957) [↑](#footnote-ref-87)
88. Basil Williams, *The Whig Supremacy 1714-1760,* Second edition (Oxford: Clarendon Press 1962) p16 [↑](#footnote-ref-88)
89. John Stuart Shaw, *The Management of Scottish Society 1707-1764* p 2 [↑](#footnote-ref-89)
90. Christopher Whately, *Scottish Society 1707-1830: Beyond Jacobitism, towards Industrialisation* (Manchester: Manchester University Press 2000) p 145

    One example of such paternalism was in time of scarcity, landlords would buy grain and sell it to their tenants at subsidised prices. T.M. Devine, *The Scottish Clearances: A History of the Dispossessed 1600-1900* (London: Allan Lane 2018) p129  [↑](#footnote-ref-90)
91. T.M. Devine, Scotland in *Cambridge Economic History of Britain, Volume 1* (Cambridge: Cambridge University Press 2008) p 393 [↑](#footnote-ref-91)
92. Larry Stewart, Public Lectures and Private Patronage *Isis* (1986) *77*: 47-58 [↑](#footnote-ref-92)
93. Stephen Shapin, Property, Patronage and the Politics of Science: The Founding of the Royal Society of Edinburgh, *British Journal for History of Science* (1974) 1-41

    The Philosophical Society of Edinburgh was founded in 1737, in order to provide a means of bringing together natural philosophers and aristocrats. It subsequently became the Royal Society. [↑](#footnote-ref-93)
94. Mario Biagioli, Galileo’s System of Patronage *History of Science* (1990) *28*: 28-61 [↑](#footnote-ref-94)
95. Thomas Gisborne, *An Inquiry into the duties of men in the higher and middle classes of society in Great Britain* (London 1795) p117 [↑](#footnote-ref-95)
96. Christopher Brookes, Professions, Ideology and the Middling Sort in *The Middling Sort of People* p 114 [↑](#footnote-ref-96)
97. Christopher Brookes, Apprenticeship and Social Mobility in *The Middling Sort of People* p 68 [↑](#footnote-ref-97)
98. Jeremy Black, *Eighteenth-Century Britain 1688-1873* p 92 [↑](#footnote-ref-98)
99. Jonathon Barry in Introduction to *The Middling Sort of People: Culture,* p 2 [↑](#footnote-ref-99)
100. Christopher Brooks, Apprenticeship, Social Mobility and the Middling Sort, 1550-1800 in *The Middling Sort of People,* p52 [↑](#footnote-ref-100)
101. Roy Lewis and Angus Maude, *The English Middle Class* (London: Phoenix House 1949) page 13 [↑](#footnote-ref-101)
102. Rosemary O’ Day, *The Professions in Early Modern England* (Harlow: Pearson Education 2000) p224 [↑](#footnote-ref-102)
103. Christopher Brooks, Social Mobility and the Middling Sort, p 69 [↑](#footnote-ref-103)
104. Rosemary O’ Day, *The Professions in Early Modern England,* p 225 [↑](#footnote-ref-104)
105. Guenter Risse, *Hospital Life in Enlightenment Scotland: Care and Teaching at the Royal Infirmary of Edinburgh,* (Cambridge: Cambridge University Press 1986) p19 [↑](#footnote-ref-105)
106. Thompson, *Life* page 15 [↑](#footnote-ref-106)
107. Jonathon Barry, Professions, Ideology and the Middling Sort, *The Middling Sort of People* p125

     Guenter Risse, *Hospital Life in Enlightenment Scotland* p 17 [↑](#footnote-ref-107)
108. Guenter Risse, *Hospital Life in Enlightenment Scotland,* p 245 [↑](#footnote-ref-108)
109. Quoted by Guenter Risse in *Hospital Life in Enlightenment Scotland* p 247 [↑](#footnote-ref-109)
110. Guenter Risse, *Hospital Life in Enlightened Scotland* p 247 [↑](#footnote-ref-110)
111. John Morrell, The University of Edinburgh in the Late Eighteenth Century, *Isis* (1971) *62*: 158-171. According to Morrell, at least 5 professors of Medicine received no salary at all during the eighteenth century. He did not name them. [↑](#footnote-ref-111)
112. This will be discussed in Chapter 2 [↑](#footnote-ref-112)
113. John Morrell, *History of Science* (1974) *12*: 128 [↑](#footnote-ref-113)
114. John Morrell, Reflections on the History of Scottish Science, *History of Science* (1974) *12*: 128- p161 [↑](#footnote-ref-114)
115. Jan Golinski, *Science as Public Culture* p17 [↑](#footnote-ref-115)
116. Thompson *Life* p 156 [↑](#footnote-ref-116)
117. Thompson, *Life* p155, italics in the original [↑](#footnote-ref-117)
118. Richard B. Sher, *Church and University in the Scottish Enlightenment: The Moderate Literati of Edinburgh* p24 [↑](#footnote-ref-118)
119. Charles Camic, *Experience and Enlightenment: Socialisation for Cultural Change* p200 [↑](#footnote-ref-119)
120. Thompson, *Life* page 16 [↑](#footnote-ref-120)
121. Richard Sher, *Church and University in the Scottish Enlightenment* p27 [↑](#footnote-ref-121)
122. Roger Emerson, The Philosophical Society of Edinburgh, *British Journal for the History of Science,* (1985) 18: 255-303, p 272 for Cullen’s induction of his son into the society.

     Stephen Shapin, Property, Patronage and Society, *British Journal for the History of Science* (1974) 7: 1-41.

     Page 14 describes the appointment of a Professor of Natural History to Edinburgh University. Cullen’s first thought had been to try and get his son, Henry appointed. When he realised that it was too late to do the necessary lobbying, he then gave his support to John Walker.  [↑](#footnote-ref-122)
123. Derek J. de Solla Price and Donald Beaver, Collaboration in an Invisible College, *American Psychologist* (1966) *21:* 1011-1018 [↑](#footnote-ref-123)
124. David A. Kronick, The Commerce of Letters: Networks and “Invisible Colleges” in the Seventeenth and Eighteenth Centuries *The Library Quarterly: Information: Community: Policy* (2001) *71*:28-43, p28 [↑](#footnote-ref-124)
125. Andrea Rusnock, Correspondence Networks and the Royal Society *British Journal for the History of Science* (1999) *32*: 155-169 p156 [↑](#footnote-ref-125)
126. David A. Kronick, The Commerce of Letters, *Library Quarterly* p 29 [↑](#footnote-ref-126)
127. It should be noted that although such associations often termed themselves “literary” the word is misleading if interpreted in twenty-first century terms because the separation between arts and sciences did not exist at that time. The sciences were divided into distinct disciplines long before learning as a whole separated itself into arts and sciences. This took place in the early nineteenth century. The Royal Society of Edinburgh, founded in 1783 had a literary section for many years. See McElroy p3 [↑](#footnote-ref-127)
128. Albert Hume, *The Learned Societies* p1 [↑](#footnote-ref-128)
129. D.D. McElroy, *The Literary Clubs and Societies of Edinburgh* (Unpublished PhD thesis, University of Edinburgh 1952) p18 [↑](#footnote-ref-129)
130. Albert Hume, *The Learned Societies and Printing Clubs of England* (London: G. Willis 1853) p 17 [↑](#footnote-ref-130)
131. Information taken from D.D. McElroy, *The Literary Clubs and Societies of Eighteenth-Century Scotland.* Mc Elroy’s thesis contains an appendix with the membership lists of the various societies. [↑](#footnote-ref-131)
132. Roger Emerson, The Philosophical Society of Edinburgh 1737-1745, *British Journal for the History of Science* (1979) *12*: 154-191, p159 [↑](#footnote-ref-132)
133. Stephen Shapin, Property, Patronage and Politics: The Foundation of the Royal Society of Edinburgh, *British Journal for the History of Science* (1974) *7*: 1-41 [↑](#footnote-ref-133)
134. Roger Emerson, The Philosophical Society of Edinburgh p 159 [↑](#footnote-ref-134)
135. Roger Emerson, The Philosophical Society of Edinburgh, p160 [↑](#footnote-ref-135)
136. Albert Hume, *The Learned Societies* page 15 [↑](#footnote-ref-136)
137. Henry Grey Graham, *Scottish Men of Letters of the Eighteenth Century* published 1901 and quoted by D.D. McElroy in *The Literary Clubs and Societies in Eighteenth-Century Scotland*, page 215 [↑](#footnote-ref-137)
138. Roger Emerson, *Essays on David Hume, Medical Men and the Scottish Enlightenment* (London: Ashgate 2009) Emerson quoted T.M. Devine who estimated that 2,000 men left Scotland every year. [↑](#footnote-ref-138)
139. Charles Camic *Experience and Enlightenment* p 209 [↑](#footnote-ref-139)
140. Quoted by Linda Colley, *Britons: Forging the Nation 1707-1837* p123 [↑](#footnote-ref-140)
141. Charles Camic, *Experience and Enlightenment* p142  [↑](#footnote-ref-141)
142. Linda Colley, *Britons: Forging the Nation 1707-1837,* p128 [↑](#footnote-ref-142)
143. Linda Colley, *Britons* page 129 [↑](#footnote-ref-143)
144. Lord Bute seems to have been responsible for ensuring that many Scotsmen obtained crown appointments in the government institutions of Florida and Edmund Burke accused Warren Hastings of doing the same thing in the East India Company. [↑](#footnote-ref-144)
145. T.M. Devine, *To the Ends of the Earth: Scotland’s Global Diaspora 1750-2010* (London: Penguin Books 2011) p 21. Devine was from quoting G.K. Mc Kilvary’s PhD thesis, *East India Patronage and the Political Management of Scotland 1720-1774* Open University 1989 [↑](#footnote-ref-145)
146. William Mackintosh, *An Essay on Ways and Means for Inclosing (sic) Fallowing and Planting etc* (Edinburgh 1729) page xii Mackintosh cited Pericles and Warwick who had been a key player in the wars of the Roses. [↑](#footnote-ref-146)
147. Roger Emerson, *An Enlightened Duke,* p249 [↑](#footnote-ref-147)
148. Christopher Lawrence, Cullen, Brown and the Poverty of Essentialism in *Brunonianism in Britain and Europe* edited by W.F. Bynum and Roy Porter, (Wellcome Institute for the History of Medicine: London 1988) p4.

     Brown decided that Cullen was primarily responsible for his failure to be offered a medical chair and that Cullen had “black-balled” his membership of the prestigious Philosophical Society. How Cullen became acquainted with Brown is not known but he had not only employed Brown as Latin tutor to his children but had allowed him to attend his classes without payment when Brown decided to take up medicine as a profession. [↑](#footnote-ref-148)
149. Pierre Bourdieu, *Homo Academicus* p175 [↑](#footnote-ref-149)
150. Brown’s ideas of disease causation differed from what was generally accepted at the time because he denied that the body had any intrinsic healing power or that there was such a thing as a specific disease. Instead he suggested that the body had a fund of natural energy. If that energy was excessive then *sthenia* was the result. If the body lacked energy then the illness was *asthenia*. The treatment for both conditions was almost identical, consisting of opium and alcohol. [↑](#footnote-ref-150)
151. James Mackintosh, *Life of the Right Honourable Sir James Mackintosh, Volume 1* p24. Book referred to in D.D. McEvoy’s thesis. [↑](#footnote-ref-151)
152. Pierre Bourdieu, *Homo Academicus,* p 56 [↑](#footnote-ref-152)
153. Jeremy Black, *Eighteenth-Century Britain* p198

     C. Innes, *Sketches of Early Scotch (sic) History and Social Progress* (Edinburgh 1861) pp 467-468.

     Innes quoted the example of John Clephane MD, a friend of David Hume. After completing his university studies, Clephane began his career as a tutor on a grand tour and on his return home became a senior medical officer in the army – without any medical experience. [↑](#footnote-ref-153)
154. Jeremy Black, *Eighteenth-Century Britain* p199 [↑](#footnote-ref-154)
155. Alexander Grant, *The Story of Edinburgh University* (London: Longman, Greene and Co 1884) page 320  [↑](#footnote-ref-155)
156. L.S. Jacyna, *Philosophical Whigs: Medicine, Science and Citizenship in Edinburgh 1789-1848* (London New York: Routledge 1994) p6 [↑](#footnote-ref-156)
157. Ludmilla Jordanova, Has the History of Medicine Come of Age? *Historical Review* (1993) *36:* 437-449 p 439 [↑](#footnote-ref-157)
158. Christopher Brooks, Apprenticeship, Social Mobility and the Middling Sort, 1550-1800 in *The Middling Sort of People 1550-1800*  p52 [↑](#footnote-ref-158)
159. Emma Rothschild, *The Inner Life of Empires* (Princetown: Princetown University Press 2011) p15 [↑](#footnote-ref-159)
160. NRS, Reference number RH8/340. Deposition by James Muirhead with the consent of William Cullen of Sauchies. (Sauchies is an alternative spelling of Saughs which is the word Thompson used in his *Life*) In the document William Cullen senior was acting for both his father and grandfather who were resident there. So it seems probable that William Cullen senior was born there. [↑](#footnote-ref-160)
161. List of Writers to the Signet 1890 is available online at <http://www.archive.org/stream/history> [↑](#footnote-ref-161)
162. *Life,* p1 [↑](#footnote-ref-162)
163. John Donald, *The Management of Scottish Society* (Edinburgh 1983) p23  [↑](#footnote-ref-163)
164. Robertoun is an alternative spelling of Roberton. As Cullen’s mother’s was a Hume, it raises the possibility that Cullen’s friendship with David Hume was based on family ties [↑](#footnote-ref-164)
165. DNB [↑](#footnote-ref-165)
166. DNB [↑](#footnote-ref-166)
167. Until the early twentieth century, it was not unusual to give a child the same name as an earlier sibling who had died before the birth of the child in question. The most likely explanation for the baptismal record is that *the* William Cullen had an older brother also named William, who died in infancy. My thanks to Doctor David Shuttleton for pointing this out. [↑](#footnote-ref-167)
168. GUL, Cullen papers 608/8

     William Cullen, *A Treatise on the Materia Medica* was published in Dublin in 1789. In it Cullen described himself as “being in the 77th year of my age” [↑](#footnote-ref-168)
169. Where records exist they show that Cullen’s mother had a pregnancy almost every year – William, in 1710; Charles in 1711; Charlotte, September 1718; Daniel, November 1719; James, September 1721 and Archibald, February 1725.

     There is a gap in the records between 1711 and 1718. If *the* William Cullen was born in 1713, then it seems likely that the 3 remaining siblings were born between 1714 and 1717. [↑](#footnote-ref-169)
170. Letter from Millar, GUL Cullen MS/490 [↑](#footnote-ref-170)
171. *Life,* page 68 [↑](#footnote-ref-171)
172. *Life*  page 69 [↑](#footnote-ref-172)
173. NAS reference numbers CS271/22018 and CS271/37055 [↑](#footnote-ref-173)
174. NAS 271/47435 [↑](#footnote-ref-174)
175. NAS CS 236/C/1/42 Naismith and Naismyth are alternative spellings of the same name. [↑](#footnote-ref-175)
176. NAS CS 121/21. The document was a petition sent to a judge asking him to appoint a factor to run the estates of the Laird of Cleland who had become bankrupt. The Laird’s creditors had forced the sale of his estate to recover their assets. The estate was bought by the Laird of Wishaw who should have paid the interest on the Laird of Cleland’s debt to his creditors. Cullen was appointed to ensure that the money went to the creditors and was not “squandered away and consumed.”

     In the early eighteenth century (before the current banking system developed) individuals or organisations who wanted to invest money entered into private contracts called bonds. The individual who borrowed the money paid interest on it as well as an incremental return on the capital thus forming a regular income for the holders of the bond. The bond issued to the Laird of Cleland was funded by money owned by widows and also the funds used to run the hospital in Hamilton. [↑](#footnote-ref-176)
177. NAS GD85/364 [↑](#footnote-ref-177)
178. GUL MS Cullen 608/8 [↑](#footnote-ref-178)
179. *Life* p1 [↑](#footnote-ref-179)
180. GUL, MS Cullen 490 [↑](#footnote-ref-180)
181. NAS CC10/5/10 [↑](#footnote-ref-181)
182. GUL, MS Cullen 608/8

     Thompson, *Life* pp 17-18 [↑](#footnote-ref-182)
183. *Life* p 1 [↑](#footnote-ref-183)
184. NAS CC10/5/10 [↑](#footnote-ref-184)
185. NAS GD85/247 [↑](#footnote-ref-185)
186. NAS GD85/336 [↑](#footnote-ref-186)
187. NAS GD85/357 [↑](#footnote-ref-187)
188. NAS GD85/363, GD85/357 and GD85/358 [↑](#footnote-ref-188)
189. Christopher Brooks, Apprenticeship and Social Mobility in *The Middling Sort,* p 77 [↑](#footnote-ref-189)
190. GUL, Cullen papers MS/490 [↑](#footnote-ref-190)
191. Rosemary O’ Day, *The Professions in Early Modern England,* p 224. [↑](#footnote-ref-191)
192. *Life* p2 [↑](#footnote-ref-192)
193. John Gibson, *History of Glasgow* quoted by Fenwick Beekman in William Hunter’s Education in Glasgow 1731-36, *Bulletin of the History of Medicine* (1944) Volume XV, p 287 [↑](#footnote-ref-193)
194. *Life* p2 [↑](#footnote-ref-194)
195. John Kerr, *Scottish Education: School and university* (Cambridge: Cambridge University Press 1910) p118 [↑](#footnote-ref-195)
196. Charles Camic, *Experience and Enlightenment* p164 [↑](#footnote-ref-196)
197. *Life* page 3 [↑](#footnote-ref-197)
198. Henry L. Fulton, Smollett’s Apprenticeship in Glasgow, 1736-1739, *Studies in Scottish Literature* 1980 (Volume number not given) p178.

     Fulton discussed not only Smollett’s training but that of John Moore who was trained in Stirling and who left to become a surgeon’s mate with the army in Flanders, (1747) Although officially the period of training was 5 years, Fulton cited a decree from the Faculty of Physicians and Surgeons of Glasgow which reduced this to 3 years, arguing that the decree was legalising what was standard practice. [↑](#footnote-ref-198)
199. If Cullen was in his second year at university in 1727, he should have finished studying there in 1728. Assuming that he did so and was in London in late 1729, (as Thompson stated) he could not possibly have done much more than one year’s apprenticeship. [↑](#footnote-ref-199)
200. James Lucas, *A Candid Enquiry into the Education, Training and Offices of a Surgeon-Apothecary* (London 1800) p51 [↑](#footnote-ref-200)
201. Pamphlet quoted by Rosalin M. Stott, *The Incorporation of Surgeons and Medical Education 1695-1755, Unpublished PhD thesis, University of Edinburgh 1984* p 155 [↑](#footnote-ref-201)
202. Helen Dingwall, *Physicians, Surgeons and Apothecaries: Medicine in Seventeenth Century Edinburgh* (Edinburgh: East Lothian Press 1995) p70 [↑](#footnote-ref-202)
203. Linda Colley, *Britons: Forging the Nation 1707-1837* p64 [↑](#footnote-ref-203)
204. For example James Boswell was the son of a High Court Judge in Edinburgh and he needed the patronage of Doctor Johnson to succeed. DNB [↑](#footnote-ref-204)
205. Thompson, *Life* page 4 [↑](#footnote-ref-205)
206. John Burton Cleland, *Ancient Family of Cleland* (London: 1905) p66.

     DNB entry for William Cleland.

     *The Correspondence of Alexander Pope,* edited by George Sherburn (Oxford: Clarendon Press 1956) Cleland’s frequent visits to Pope are mentioned in a letter to Hugh Bethel dated 28th July 1731 [↑](#footnote-ref-206)
207. Richard B. Sheridan in *The Oxford History of the British Empire: The Eighteenth Century* edited by P.J. Marshall (Oxford: Oxford University Press 1998) p405

     James Horn, The British Diaspora, in *Oxford History of the British Empire,* p41 [↑](#footnote-ref-207)
208. Ships surgeons were only paid for the time they spent on board ship, if the ship’s departure was delayed then the surgeon was not earning. Ship’s surgeons also had to supply their own medicine chests which may explain why Cullen chose to work for an apothecary. C.R.B. Barrett, *The History of the Society of Apothecaries of London,* (London: Eliot Stock 1904) page 119 [↑](#footnote-ref-208)
209. *Life,* pages 6-7 [↑](#footnote-ref-209)
210. Anna Simmons, Medicines, Monopolies and Mortars: The Chemical Laboratory and Pharmaceutical Trade at the Society of Apothecaries in the Eighteenth Century. *Ambix* (2006) *53*: 221-236 p224 [↑](#footnote-ref-210)
211. National Archives (Kew) SP 36/19/2 dated July 1730; SP 36/23/1, dated May 1731 [↑](#footnote-ref-211)
212. P.J. and R.V. Wallis, *Eighteenth-Century Medics* (Newcastle-upon-Tyne: Project for Historical Biography 1988) [↑](#footnote-ref-212)
213. The Piazza: The Social Decline of the Piazza, *Survey of London: Volume 36,* pp 82-84. The survey is now produced by a team of academics attached to UCL. It quotes a London magistrate who, in 1776, described Covent Garden as “the great square of Venus.” [↑](#footnote-ref-213)
214. *Life* p5 [↑](#footnote-ref-214)
215. Richard B. Sheridan, *Doctors and Slaves: A Demographic History of Slavery in the West Indies* (Cambridge: Cambridge University Press 1985) p 42 [↑](#footnote-ref-215)
216. Quoted by Richard Sheridan in *Doctors and Slaves* p 43

     Although Sheridan clearly has read the letters, the archivist in the Public Records Office in Edinburgh cannot trace the reference number he cited or the letters themselves. [↑](#footnote-ref-216)
217. Charles Leslie, *A New History of Jamaica from the Earliest Accounts to the Taking of Portobello* (London 1740) p 46 [↑](#footnote-ref-217)
218. Thompson, *Life,* p6 [↑](#footnote-ref-218)
219. T.M. Devine, *Recovering Scotland’s Slavery Past: The Caribbean Connection*  p 28 [↑](#footnote-ref-219)
220. John Sperling, *The South Sea Company: An Historical Essay and Bibliographical Finding List* (Harvard: Harvard University Press 1962)p 2 [↑](#footnote-ref-220)
221. John Campbell, *The Spanish Empire in America,* 2nd Edition (London 1744) page 214. The First Edition was entitled *A Concise History of South America.*  [↑](#footnote-ref-221)
222. John G. Sperling, *The South Sea Company:* p ix [↑](#footnote-ref-222)
223. Vera Lee Brown, The South Sea Company and the Contraband Trade, *American Historical Review* (1926) *31*: 662-678 p663 [↑](#footnote-ref-223)
224. Sperling, *The South Sea Company* p13

     National Archives, Kew SP 36/10/203 gives details of the ships hired by the South Sea Company. It includes the Prince William which was detailed to go to Cartagena and Portobello.

     Kew, SP 36/19/29 dated 10th June 1730 confirms the right of South Sea Company factors to reside in Portobello. [↑](#footnote-ref-224)
225. As a result of that hostility, the famous Captain Jenkins had his ear sliced off by an exasperated Spanish customs official. This led, a few years later, to what was termed the War of Jenkin’s Ear. Lawrence James, *The Rise and Fall of the British Empire* (London: Abacus Press 1994) page 59

     Richard B. Sheridan, The Formation of Caribbean Plantar Society in *The Oxford History of the British Empire,* Volume II, p 410 [↑](#footnote-ref-225)
226. Sheridan page 411. Between 1716 and 1731, one hundred and eighty British ships were illegally confiscated by the Spanish in the Caribbean, using the Assiento as an excuse.

     Lawrence James, page 59. [↑](#footnote-ref-226)
227. Sperling, pages 41-42. The ships included a few vessels belonging to the South Sea Company. [↑](#footnote-ref-227)
228. National Archives, Kew SP 36/10/203 [↑](#footnote-ref-228)
229. Kew SP 36/20/199. The *Prince William* had a crew of 180 men, carried 40 guns and before she sailed, Captain Cleland sought permission from the Navy to seize pirates. [↑](#footnote-ref-229)
230. Kew, SP 36/19/2 dated 1730 [↑](#footnote-ref-230)
231. Kew, ADM 106/819/256 It was dated 9th November 1730. The paper stated that Captain Cleland was on his was to Cartagena and Portobello. Deptford was a naval dockyard and someone wrote a comment on the paper querying who was going to pay for the repair. [↑](#footnote-ref-231)
232. Kew SP 36/23/1 [↑](#footnote-ref-232)
233. The list of crew members no longer exists, so it is impossible to be absolutely certain that Cullen was on board. [↑](#footnote-ref-233)
234. David Templeman, *An Impartial Enquiry into the transactions of the late Governors of the South Sea Company* (London 1735) The pamphlet warned the public of the fraudulent practices of the various members of the South Sea Company, including Captain Cleland.

     Anonymous pamphlet, *An Address to the Proprietors of the South Sea Company,* pp 6-9 [↑](#footnote-ref-234)
235. *An Address to the proprietors of the South Sea Company,* p8 [↑](#footnote-ref-235)
236. Kew, Chancery Court records, South Sea Company v Cleland C11/2076/34 dated 1739; C11/2065 dated 1736 and CC11/2098/12 dated 1743 [↑](#footnote-ref-236)
237. *Life* pp 6-7 [↑](#footnote-ref-237)
238. John Burton Cleland, *The Ancient Family of Cleland* (London 1905) page 66

     Another possible reason for Cullen to dissociate himself from the family was that the son of Cullen’s original patron, William Cleland (who had arranged his appointment as a ship’s surgeon) had a son, John Cleland (1710-1789) who was imprisoned for debt in the 1740s. While in prison he wrote what was alleged to be the world’s best pornographic novel, entitled *Memoires of a Woman of Pleasure*. [↑](#footnote-ref-238)
239. Thompson, *Life* page 7 [↑](#footnote-ref-239)
240. MS Cullen 608/8 [↑](#footnote-ref-240)
241. Cullen papers MS/490 [↑](#footnote-ref-241)
242. *Life* p8 [↑](#footnote-ref-242)
243. Thompson *Life,* p 523 contains a letter entitled *Doctor Fothergill’s Account of the Edinburgh School of Medicine*  [↑](#footnote-ref-243)
244. Thompson, *Life* pp 10-11 [↑](#footnote-ref-244)
245. Withers was a physician from York who had trained in Edinburgh when Cullen was teaching there. [↑](#footnote-ref-245)
246. Thomas Withers, *Treatise on the Errors and Defects of Medical Education* (London 1794) page 45 [↑](#footnote-ref-246)
247. Thomas Withers, pp 32-45 [↑](#footnote-ref-247)
248. John Gregory, *The Duties and Qualifications of a Physician* p 86 [↑](#footnote-ref-248)
249. Thompson, *Life* p 11 [↑](#footnote-ref-249)
250. N.D. Jewson, Medical Knowledge and the Patronage System in Eighteenth-Century England, *Sociology* (1974) *8*: 369-385 p 376 [↑](#footnote-ref-250)
251. Ursula Mulcahy, How did Eighteenth-Century Scottish Surgeons Earn a Living, *Social History of Medicine* accepted for publication 14.04.2019 [↑](#footnote-ref-251)
252. Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations* (London: Routledge 1946) p 87  [↑](#footnote-ref-252)
253. Thompson, *Life* page 12. Thompson does not give a date. [↑](#footnote-ref-253)
254. N. D. Jewson, Medical Knowledge and the Patronage System in Eighteenth-Century England, *Sociology* (1974) 8: 369-385, p373 [↑](#footnote-ref-254)
255. Irvine Loudon, *Medical Care and the General Practitioner 1750-1850* (Oxford: Clarendon Press 1986) page 114

     Jewson overlooked the fact that patients admitted to teaching hospitals were there because they could not afford medical care. [↑](#footnote-ref-255)
256. Johanna Geyer-Kordesch and Fiona McDonald, *Physicians and Surgeons in Glasgow: The History of the Royal College of Physicians and Surgeons 1599-1853* (London Rio-Grande: Hambledon Press 1999) p 181 [↑](#footnote-ref-256)
257. Johanna Geyer-Kordesch, Fiona Macdonald, p 181 [↑](#footnote-ref-257)
258. Thompson, *Life* p13. Thompson says that Hunter “went to reside with Dr Cullen” in 1737. He does not state whether he was formally apprenticed to him. [↑](#footnote-ref-258)
259. *Life,* page 15 [↑](#footnote-ref-259)
260. The certificate states “Quem Juvenis Egregius Guilliamus Cullen A M, nostra alumnus postquam arti medicatum in nostrua tum in Edinburgh academia … (A.M = MA) [↑](#footnote-ref-260)
261. James Coutts, *The University of Glasgow 1451-1909* (Glasgow: James Maclehose and Sons 1909) page 208

     A regulation introduced in 1727 stated that candidates for a degree did not have to matriculate, but had to show evidence that they “had a competent knowledge” of Logic, Moral Philosophy, Natural Philosophy, Latin and Greek. [↑](#footnote-ref-261)
262. Although was appointed Professor of Anatomy he never taught the subject but seems to have had an extensive medical practice. [↑](#footnote-ref-262)
263. Cullen’s chances of getting Brisbane’s post may not have been as rosy as Thompson supposed. Brisbane’s successor was Robert Hamilton (1714-1756) who had been teaching anatomy *in lieu* of Brisbane. He had the support of his fellow teachers in the university and the physicians in Edinburgh and some of the Squadrone faction. Roger Emerson, *Academic Patronage in Enlightenment Scotland: Glasgow, Edinburgh and St Andrews*  pp 107-8 [↑](#footnote-ref-263)
264. GUL MS Cullen 490 [↑](#footnote-ref-264)
265. Thompson, *Life* p30 recounts the difficulties Cullen had in setting up a chemical laboratory in Glasgow. He had to send to London for the equipment. [↑](#footnote-ref-265)
266. GUL MS Cullen 34

     Cullen’s account book for the years 1737-1741 still exists in the Royal College of Physicians, Edinburgh MS Cullen 34 Ab 4.55. It confirms what Cullen’s daughter asserted. [↑](#footnote-ref-266)
267. GUL MS Cullen 608/15 [↑](#footnote-ref-267)
268. GUL MS Cullen 608/8 [↑](#footnote-ref-268)
269. Thompson, *Life* p 19 [↑](#footnote-ref-269)
270. John Thompson, *Life* p19 [↑](#footnote-ref-270)
271. GUL, Cullen Papers MS 490 [↑](#footnote-ref-271)
272. The Duke of Hamilton’s name was recorded on several occasions in minutes of Faculty meetings between 1735 and 1745 so he did have some influence over University affairs. They included “a presentation by the Duke in favour of George Ellies to be one of his Grace’s bursars”. Glasgow University Archive (GUA) 26648. [↑](#footnote-ref-272)
273. GUL Cullen papers MS 608/8

     James Robarton, Lord Belday (1590-1664), started his career as Professor of Philosophy in Glasgow in 1618, became rector there in 1646 and afterwards a law lord. DNB

     Cullen’s mother was descended from one of his younger sons. Thompson, *Life* p1 [↑](#footnote-ref-273)
274. Ronald Sunter, *Patronage and Politics in Scotland 1707-1832* (Edinburgh: John Donald 1986) p 62 [↑](#footnote-ref-274)
275. Roger Emerson, *Academic Patronage in the Scottish Enlightenment* p 99

     Another relative, Mungo Graham (1670-1754) had been Rector of Glasgow University from 1718 to 1720  [↑](#footnote-ref-275)
276. DNB [↑](#footnote-ref-276)
277. Roger Emerson, *An Enlightened Duke: The Life of Archibald Campbell, Earl of Islay, 3rd Duke of Argyll* p251 [↑](#footnote-ref-277)
278. Roger Emerson, *An Enlightened Duke:* p 249 [↑](#footnote-ref-278)
279. *Life* page 17 [↑](#footnote-ref-279)
280. GUA 26648, [↑](#footnote-ref-280)
281. J.D. Mackie, *The University of Glasgow: A Short History* (Jackson, Son and Co: Glasgow 1954) p 169

     Mackie had been Professor of History in Glasgow. [↑](#footnote-ref-281)
282. Mackie *The University of Glasgow* p 170 [↑](#footnote-ref-282)
283. Mackie, *The University of Glasgow,* p 170 [↑](#footnote-ref-283)
284. Glasgow University Archives (GUA) 26648 is a record of Faculty meetings. One June 24th 1747 they record that John Carrick was paid £4-4s to cover the expenses of the anatomy class. When Crawford became ill and was unable to teach chemistry, Cullen took over the teaching of chemistry but not anatomy. [↑](#footnote-ref-284)
285. Thompson, *Life* p19.

     Mr Hamilton was a patient of Cullen’s. His name appears in Cullen’s account book held by the Royal College of Physicians in Edinburgh Ab 4.55 MS Cullen 34 [↑](#footnote-ref-285)
286. Wishaw is only a few miles from Hamilton. [↑](#footnote-ref-286)
287. DNB [↑](#footnote-ref-287)
288. Published in *The Works of the Rev. William Thom, Late Minster of Govan* (Glasgow 1799) pp 264-304. The reason for the late publication date is that after his death, Thom’s work were gathered together and published in one volume. [↑](#footnote-ref-288)
289. William Thom, *Works of Rev Thom* Defects of a University Education and its unsuitableness for a Commercial People pp 264-5. [↑](#footnote-ref-289)
290. M.D. Eddy, TheChildWriter*:* GraphicLiteracyandtheScottishEducationSystem1700*-*1820: *History of Education* (2016) *45:* 695-718 [↑](#footnote-ref-290)
291. Peter Jones, The Polite Academy and the Presbyterians in *New Perspectives on the Politics and Culture of Early Modern Scotland* edited by John Dwyer, Roger A. Mason and Alexander Murdoch (Edinburgh: John Donald Press 1982) p152 [↑](#footnote-ref-291)
292. Peter Jones, The Polite Academy p172 [↑](#footnote-ref-292)
293. J.D. Mackie, *The University of Glasgow* p186. [↑](#footnote-ref-293)
294. With the regenting system, the same lecturer taught the same group of boys all the way through their university course. Abandoning the system meant that lecturers taught only one subject and, as a result, acquired a greater knowledge of it.

     After the Professor of Divinity, seniority depended upon the order of appointment. James Coutts, *A History of the University of Glasgow* p208 [↑](#footnote-ref-294)
295. Coutts *A History of the University of Glasgow* p213 [↑](#footnote-ref-295)
296. Andrew Kent, *An Eighteenth Century Lectureship in Chemistry* (Glasgow: Glasgow University Press 1950) p50 [↑](#footnote-ref-296)
297. J.D. Mackie, *The University of Glasgow* p189 [↑](#footnote-ref-297)
298. Mackie *The University of Glasgow* p 188 [↑](#footnote-ref-298)
299. Mackie p168 [↑](#footnote-ref-299)
300. See minutes 1735-1745, GUA 26648 [↑](#footnote-ref-300)
301. Thompson, *Life* page 70 [↑](#footnote-ref-301)
302. Glasgow University Archives (GUA) 30297 [↑](#footnote-ref-302)
303. English National Archives, Kew, ref SP 36/20. Unfortunately, the Privy Council minutes for the period in question are missing [↑](#footnote-ref-303)
304. Thompson, *Life* p 545

     Hunter had obtained the information by getting a Doctor Stewart to discuss the situation with the Duke. [↑](#footnote-ref-304)
305. Thompson, *Life* p 97 [↑](#footnote-ref-305)
306. Glasgow University Archives (GUA) 30492, underlined in the original [↑](#footnote-ref-306)
307. Ruart had been given leave to absence and sent to London to supervise an action being taken by the University in the High Court there. He made a routine, courtesy call on the Duke and was evidently very dismayed to find that “the Duke was exceedingly angry that no resignation had been given in.” [↑](#footnote-ref-307)
308. Thompson, *Life* pp 144-5 [↑](#footnote-ref-308)
309. Thompson *Life* pp117-118 [↑](#footnote-ref-309)
310. DNB and Thompson, *Life* p101 [↑](#footnote-ref-310)
311. Thompson, *Life* p 27 [↑](#footnote-ref-311)
312. Thompson, *Life* pp 118-119 [↑](#footnote-ref-312)
313. Roger A. Mason and Alexander Murdoch, Moderates, Managers and Popular Politics in mid-eighteenth-century Edinburgh in *New Perspectives on the Politics and Culture of Early Modern Scotland* edited by John Dwyer, Roger A. Mason and Alexander Murdoch (Edinburgh: John Donald 1982) p180 [↑](#footnote-ref-313)
314. Roger A. Mason and Alexander Murdoch, Moderates, Managers and Popular Politics, p180 [↑](#footnote-ref-314)
315. DNB [↑](#footnote-ref-315)
316. Thompson, *Life* p151 Thompson does not name them. [↑](#footnote-ref-316)
317. DNB [↑](#footnote-ref-317)
318. Thompson, *Life* p145  [↑](#footnote-ref-318)
319. Thompson, *Life* p152 [↑](#footnote-ref-319)
320. Thompson, *Life* p153 [↑](#footnote-ref-320)
321. Thompson, *Life* p161 [↑](#footnote-ref-321)
322. John Gregory, *The Duties and Qualifications of a Physician* 1772. [↑](#footnote-ref-322)
323. GUL, MS Cullen 1166. The letter was dated 12th April 1766 [↑](#footnote-ref-323)
324. GUL, MS Cullen 1149, letter from William Hunter to Cullen dated 20th April 1765

     One of the initials is LB-- Lord Bute? [↑](#footnote-ref-324)
325. DNB [↑](#footnote-ref-325)
326. The Master of the Ordinance was a senior army position. The individual holding the position was responsible for supplies and transport of the army but was not under the direct command of the Military. [↑](#footnote-ref-326)
327. National Archives, Kew, SP54/46/f173

     The letter also included the information that Gregory’s salary of £100 Sterling had been divided between himself as Professor of the Practice of Medicine and the Professors of Chemistry and the Theory of Medicine, i.e. Joseph Black and Cullen. [↑](#footnote-ref-327)
328. Kew, SP57/36/f363 [↑](#footnote-ref-328)
329. DNB [↑](#footnote-ref-329)
330. MS 608/8 [↑](#footnote-ref-330)
331. L.S.Jacyna, *Philosophical Whigs* p3 [↑](#footnote-ref-331)
332. Thomas Kuhn, *The Essential Tension: Selected Essays in Scientific Tradition and Change* (Chicago London: University of Chicago Press 1977) p 46 [↑](#footnote-ref-332)
333. Jan Golinski, *Science as Public Culture: Chemistry and Enlightenment in Britain 1760-1820* p 8 [↑](#footnote-ref-333)
334. J.R.R. Christie, Cullen and the Practice of Chemistry in *William Cullen and the Eighteenth-Century Medical World* p102 [↑](#footnote-ref-334)
335. Arthur Donovan *Philosophical Chemistry in the Scottish Enlightenment* p3 [↑](#footnote-ref-335)
336. John Robinson quoted by John Christie in The Origins and Development of the Scottish Scientific Community, *History of Science* (1974) *12*:122-141, p125 [↑](#footnote-ref-336)
337. Thompson, *Life* p28

     Cullen continued to lecture on Botany in Latin, Thompson, p 33 [↑](#footnote-ref-337)
338. Thompson, *Life,* p25 [↑](#footnote-ref-338)
339. DNB [↑](#footnote-ref-339)
340. William Cullen, *A Treatise on the Materia Medica* p 41

     In his lectures on m*ateria medica,* Cullen began in the conventional way by discussing the history of the topic. While doing so, he evaluated the work of other chemists. Lewis was the only chemist whose work he praised unreservedly. [↑](#footnote-ref-340)
341. William Lewis, *Commercium Philosophico-Technium or the Philosophy of the Commercial Arts* (London 1763)p xii [↑](#footnote-ref-341)
342. Thompson, *Life* p40 [↑](#footnote-ref-342)
343. John C. Powers, *Inventing Chemistry* p39 [↑](#footnote-ref-343)
344. A.L. Donovan, *Philosophical Chemistry in the Scottish Enlightenment* page 37 [↑](#footnote-ref-344)
345. James Lind *Sketches for a Medical Education* 1800, p 2

     This James Lind was a younger cousin of the man who made his name by researching scurvy in sailors. [↑](#footnote-ref-345)
346. James Lucas, *A Candid Inquiry into the Education, Qualifications and Offices of a Surgeon-Apothecary* (London 1800) p66 [↑](#footnote-ref-346)
347. Jan Golinski, *Science as Public Culture,* p 17 [↑](#footnote-ref-347)
348. The lists for Glasgow no longer exist but the Edinburgh lists are held by the University Library there, ref number EUA INI/ACU/C2/1. [↑](#footnote-ref-348)
349. DNB [↑](#footnote-ref-349)
350. Quoted by Edward Andrew in The Senecan Moment: Patronage and Philosophy in the Eighteenth Century, *Journal of the History of Ideas* (2004) 277-299, p 277 [↑](#footnote-ref-350)
351. Samuel Bard quoted by Lisa Rosner, *Medical Education in an Age of Improvement* p58 [↑](#footnote-ref-351)
352. L.M.A. Liggett, Extracts from the Journal of a Scotch (sic) Medical Student of the Eighteenth Century, *Medical Library and Historic Journal* (1904) *2*: 103-112, p 106 [↑](#footnote-ref-352)
353. Lisa Rosner, *Medical Education in an Age of Improvement* pp 96-97 [↑](#footnote-ref-353)
354. James Anderson, *The Bee 1791,* p 46 [↑](#footnote-ref-354)
355. Ursula Mulcahy, How did Eighteenth-Century Scottish Surgeons Earn a Living. [↑](#footnote-ref-355)
356. Quoted by P. O’ Brien, *Warrington Academy 1757-1786: Its Predecessors and its Successors* (Wigan: Owl Books 1989) p135 [↑](#footnote-ref-356)
357. Quotation from Reverend William Turner (a Unitarian minister and the founder of the Newcastle-upon-Tyne Literary and Philosophical Society) quoted by S. Harbottle *The Reverend William Turner: Dissent and Reform in Georgian Newcastle-upon-Tyne* (Newcastle-upon-Tyne: Northern Universities Press for the Literary and Philosophical Society 1997 ) p 8 [↑](#footnote-ref-357)
358. Roy Forster, *Modern Ireland 1600-1972* (London: Allen Lane Penguin Press 1988) p 124 [↑](#footnote-ref-358)
359. Angela McCarthy and John McKenzie, Introduction to *Global Migration: The Scottish Diaspora Since 1600* (Edinburgh: Edinburgh University Press 2017) p 10 [↑](#footnote-ref-359)
360. Roy Forster, *Modern Ireland* p158

     There were very few Gaelic names on the lists which makes it unlikely that they were Catholics. [↑](#footnote-ref-360)
361. Elizabeth Fee, *Lancet,* (2015) *385* (9981): 1940-1941 [↑](#footnote-ref-361)
362. John C. Powers, *Inventing Chemistry* p 42 [↑](#footnote-ref-362)
363. J. Johnson, *A Guide for Gentlemen Studying Medicine at the University of Edinburgh,* (London 1792) p 57 [↑](#footnote-ref-363)
364. One man who Cullen named as James Ker of Moriston Esq was Scottish. Cullen did not give his normal place of residence, but Moriston is in the Great Glen. Possibly Cullen did not record where a man came from because he already knew who they were. [↑](#footnote-ref-364)
365. Colin Russell, *Science and Social Change 1700-1900* (Hong Kong: Macmillan Press) pages 76-80. Russell cites several examples of eighteenth century scientists who were able to do chemistry because they were supported by the aristocracy. [↑](#footnote-ref-365)
366. Matthew Eddy, *The Language of Mineralogy* pp 22-23 [↑](#footnote-ref-366)
367. GUL MS Cullen 574/12 [↑](#footnote-ref-367)
368. MS 1918 page 2

     In the lecture Cullen stated, “Professors of every science by endeavouring to prove that [their] science as ancient as possible when they think that its antiquity will make it more esteemed … The Chemists have not been behind hand in this endeavour.” [↑](#footnote-ref-368)
369. Wellcome MS 1918 p 1 [↑](#footnote-ref-369)
370. J.J.R. Christie, The Historiography of Chemistry, *Ambix* (1994) *20*: 4- page 13

     Cullen cited the Biblical account (Genesis, Chapter 8, verses 20-27) of Noah’s drunkenness as the first recorded use of a chemical process.

     MS 1918 p 2 [↑](#footnote-ref-370)
371. MS 1918 p 6 [↑](#footnote-ref-371)
372. MS 1918 p 6 [↑](#footnote-ref-372)
373. MS 1918 p 6 [↑](#footnote-ref-373)
374. MS 1918 p 6 [↑](#footnote-ref-374)
375. MS 1918 p 9 [↑](#footnote-ref-375)
376. MS 1918 p 11 [↑](#footnote-ref-376)
377. MS 1918 15 [↑](#footnote-ref-377)
378. John C. Powers, *Inventing Chemistry: Herman Boerhaave and the Reform of the Chemical Arts* (Chicago: University of Chicago Press 2012)p 45 [↑](#footnote-ref-378)
379. MS 1918 p19 [↑](#footnote-ref-379)
380. MS 1918 p19 [↑](#footnote-ref-380)
381. MS 1918 p20 [↑](#footnote-ref-381)
382. MS 1918 p20 [↑](#footnote-ref-382)
383. MS 1918 p21. The book he was referring to was *The Sceptical Chemist* [↑](#footnote-ref-383)
384. MS 1918 p21

     This may be a reference to the Newtonian manuscripts which show his connection to alchemy. [↑](#footnote-ref-384)
385. J.R.R. Christie, J.V. Golinski, The Historiography of Chemistry, *History of Science* (1982) *20*:235-266, p245 [↑](#footnote-ref-385)
386. Matthew Eddy, *The Language of Mineralogy,* page 256 [↑](#footnote-ref-386)
387. Cullen died bankrupt and his extensive library had to be sold off to help pay his debts. As an expensive catalogue was produced, (a copy of which is held in the Royal College of Physicians of Edinburgh), we know which books he owned at the time of his death. While owning a book does not necessarily mean that it was read, it does imply that the owner valued the book. The library contained the 1657 edition of Agricola’s book, *De Res Metallica* [↑](#footnote-ref-387)
388. MS 1918 p21

     See note 387

     Cullen possessed Glauber’s *Opera Omnia* of 1661 as well as an English translation of 1689

     He also had Kunckel’s *Ars Vitriana* 1689; *Observationes Chymicae* 1678; *An Experimental Confirmation of Chemical Philosophy* 1705 and *Laboratory Chemicum* 1738 (published posthumously)

     Kunchel believed in the transmutation of metals which may be why Cullen objected to his theories [↑](#footnote-ref-388)
389. MS 1918 p23 [↑](#footnote-ref-389)
390. MS 1918 p23

     Cullen owned Hoffman’s *Die Chymie* 1757 and *Chymisher Manufacturier* 1758 [↑](#footnote-ref-390)
391. MS 1918 p24.

     See note 387, Cullen owned Neuman’s *Chymia* 1749, *Sal Ammoniac et Farmicis* 1737, *Lectiones Publicae de Subjectis Diabetes* 1736 and *Chemical Works with Notes by Lewis,* 1759

     It is not clear who Margraave was. It may be a misspelling of Marggraf. If so, there are two possibilities, Hemming Christian Marggraf (1689-1754) and his son, Andreas Sigismund Marggraf (1709-1782). As MS 1926 p8, also mentions Mr Margrave working on phosphorus in Berlin, it is likely to be Andreas Sigismund Marggraf who isolated the substance from urine. [↑](#footnote-ref-391)
392. MS 1918, p24

     Herman Boerhaave (1668-1735) Cullen owned *Elemems Chymicum* 1732 and 19 other volumes of work by or about Boerhaave including Burton’s *Life.* [↑](#footnote-ref-392)
393. MS 1918 p24 [↑](#footnote-ref-393)
394. MS 1918 p22 [↑](#footnote-ref-394)
395. MS 1918 p23

     See note 387, Cullen owned Duhamel’s *Treatise on Agriculture* 1759; Nicholas Lemery’s *Cours de Chemie* 1716, *Traite de l’Antimone* 1707; Macquer’s *Elements of Chemistry* 1758, *Dictionnaire de Chymie* 1767 [↑](#footnote-ref-395)
396. Fredric Holmes, *Eighteenth-Century Chemistry as an Investigative Enterprise* (Berkley: Office for the History of Science and Technology 1989) pp 63-64 [↑](#footnote-ref-396)
397. For a discussion of the fashion for science, see Roy Porter, *Enlightenment* (London: Penguin Books 2000) Chapter 6, The Culture of Science, pp 130-155 [↑](#footnote-ref-397)
398. Roy Porter, *Enlightenment,* p132 [↑](#footnote-ref-398)
399. Richard Yeo, *Science in the Public Sphere: Natural Knowledge in British Culture, 1800-1860* (Aldershot, USA, Singapore Sidney: Ashgate Publications) p260  [↑](#footnote-ref-399)
400. See foot note 387 [↑](#footnote-ref-400)
401. Robert E. Schofield, *Mechanism and Materialism: British Natural Philosophy in an Age of Reason* (New Jersey: Princetown University Press 1970) p94 [↑](#footnote-ref-401)
402. M. Peltonen in Introduction to *The Cambridge Companion to Francis Bacon* edited by Edward Markku and M. Peltonen (Cambridge: Cambridge University Press 1996) p1 [↑](#footnote-ref-402)
403. Barry Gower, *Scientific Knowledge: An Historical and Philosophical Introduction* (London New York: Routlege 1997) pages 41 [↑](#footnote-ref-403)
404. Richard Yeo, *Science in the Public Sphere* p260 [↑](#footnote-ref-404)
405. Barry Gower, *Scientific Method* pp53-54 [↑](#footnote-ref-405)
406. Barry Gower, *Scientific Method,* p51 [↑](#footnote-ref-406)
407. Barry Gower, *Scientific Knowledge* p47 [↑](#footnote-ref-407)
408. Barry Gower, *Scientific Knowledge* p66 [↑](#footnote-ref-408)
409. Stephen Gaukroger, *Francis Bacon and the Transformation of Early Modern Philosophy* (Cambridge: Cambridge University Press 2001) p6 [↑](#footnote-ref-409)
410. William Eamon, *Science and the Secrets of Nature* (New Jersey: Princeton University Press 1994) p4.

     Eamon pointed out that as many artisans were illiterate they had no option but to pass on information by demonstration and word of mouth. [↑](#footnote-ref-410)
411. Stephen Gaukroger, *Francis Bacon and the Transformation of Early Modern Philosophy* p96 [↑](#footnote-ref-411)
412. B. Martin “Sir Isaac Newton was infallible in everything he proved and demonstrated” quoted by J.L. Heilbron in *Elements of Early Modern Physics* (Berkeley LA London: University of California Press 1982) p47 [↑](#footnote-ref-412)
413. Stephen Gaukroger, *The Collapse of Mechanism and the Rise of Sensibility: Science and the Shaping of Modernity 1680-1760* (Oxford: Clarendon Press 2012) p58 [↑](#footnote-ref-413)
414. Timothy Venter and Ezio Vailati in Samuel Clarke, *Stanford Encyclopaedia of Philosophy* on-line, consulted 11.5.2019 [↑](#footnote-ref-414)
415. All theories on the nature of matter by Newton’s day suggested that it was particulate. It was Newton’s concept of force that made his theory so different. [↑](#footnote-ref-415)
416. Isaac Newton, *Opticks,* 1730 edition, p381. “The Bounds of moral philosophy will be enlarged by natural philosophy.” [↑](#footnote-ref-416)
417. Robert E. Schofield, *Mechanics and Materialism* p93 [↑](#footnote-ref-417)
418. Peter J. Bowler and Iwan Rhys Morus, *Making Modern Science: A Historical Survey* (Chicago London: University of Chicago Press 2005) p50 [↑](#footnote-ref-418)
419. Henry Pemberton, *A View of Sir Isaac’s Newton’s Philosophy,* (London 1728)

     Scottish Universities were the first to accept Newtonian mechanics. David Gregory (1659-1708) taught the subject at Edinburgh University. [↑](#footnote-ref-419)
420. Isaac Newton, *Opticks,* 1730 edition p380

     Newton’s scientific methodology was based on three rules. In ascertaining the cause of any phenomenon, “no more causes than were true and sufficient” were to be accepted. The same effects were to be attributed to the same causes and finally “in experimental philosophy we are to look upon propositions collected by general induction of the phenomena as accurately or very nearly true, notwithstanding any contrary hypothesis.” [↑](#footnote-ref-420)
421. GUL Ms Cullen 436 [↑](#footnote-ref-421)
422. Wellcome, MS 49 p 4 [↑](#footnote-ref-422)
423. MS 49 p 4

     The Oxford English Dictionary defines a fact as “a true statement” and “that which is known (or firmly believed) to be true.” [↑](#footnote-ref-423)
424. Francis Bacon, *The Advancement of Learning* edited by Robert Kitchen (London: Heron Books) p97

     “The handling of final causes mixed with the rest of physical inquiries hath intercepted the severe and diligent inquiry of all real and physical causes” [↑](#footnote-ref-424)
425. GUL Ms Cullen 436 [↑](#footnote-ref-425)
426. John Hedley Brooke, *Science and Religion: Some Historical Perspectives* (Cambridge: Cambridge University Press 1991) p19 [↑](#footnote-ref-426)
427. Wellcome Library, Shelf mark B310 A4, Ms 49 p34

     Such was Newton’s fame that Cullen did not feel the need to name him.

     The idea that natural philosophers should only investigate efficient causes was put forward by Francis Bacon in *The Advancement of Learning,* edited by G.W. Kitchin (Heron Books, no publication date given) p97 [↑](#footnote-ref-427)
428. John Hedley Brook, *Science and Religion 2nd Edition* Cambridge: Cambridge University Press 2014) p183-184 [↑](#footnote-ref-428)
429. Larry Laudan, Thomas Reid and the Newtonian Turn of British Methodological Thought in *The Methodological Heritage of Newton* edited by Robert E. Butts and John Davis (Oxford: Blackwell Press 1970, p104 [↑](#footnote-ref-429)
430. The usual translation is “I will not feign an hypothesis.” [↑](#footnote-ref-430)
431. N.R. Hanson, Hypothesis Fingo in *The Methodological Heritage of Newton* p33 [↑](#footnote-ref-431)
432. Quoted by Ernan McMullan, in The Impact of Newton’s *Principia* in *Philosophy of Science* (2001) *68*: 279-310 p291 [↑](#footnote-ref-432)
433. GUL, Ms Cullen 436 [↑](#footnote-ref-433)
434. J.J. Thompson, Quoted by Robert E. Schofield in *Mechanism and Materialism: British Natural Philosophy in an Age of Reason* (New Jersey: Princetown University Press)p4 [↑](#footnote-ref-434)
435. Hasok Chang, *Inventing Temperature: Measurement and Scientific Progress* (Oxford: Oxford University Press 2004) p 221 [↑](#footnote-ref-435)
436. Robert Schofield, *Mechanism and Materialism* p206 [↑](#footnote-ref-436)
437. Roger Scruton, *A Short History of Modern Philosophy* (London New York: Routledge 2002) p108 [↑](#footnote-ref-437)
438. Stephen Gaukroger, *The Collapse of Mechanism* p153 [↑](#footnote-ref-438)
439. Quoted by Arnold Thackery, Matter in a Nut Shell, *Ambix* (1968) *15*: 29-33, p48 [↑](#footnote-ref-439)
440. John Locke, *An* *Essay Concerning Human Understanding* edited and abridged by John W. Yolton (London Vermont: Everyman, Dent 1993) p303 [↑](#footnote-ref-440)
441. Quoted by Arnold Thackery, Matter in a Nut Shell, p31 [↑](#footnote-ref-441)
442. Robert E. Schofield, *Mechanics and Materialism*  pp108-109 [↑](#footnote-ref-442)
443. Robert E. Schofield, *Mechanics and Materialism,* p28 [↑](#footnote-ref-443)
444. Robert E. Schofield, *Mechanics and Materialism* p95 [↑](#footnote-ref-444)
445. Peter J. Bowler and Iwan Rhys Morus *Making Modern Science: A Historical Survey* p34. [↑](#footnote-ref-445)
446. Peter J. Bowler and Iwan Rhys Morus, *Making Modern Science* p58 [↑](#footnote-ref-446)
447. Wellcome Library, MS 49 p1 [↑](#footnote-ref-447)
448. Isaac Newton, *Opticks,* page 369, “There are Agents in Nature able to make the Particles of the Bodies stick together by Strong Attractions and it is the Business of Natural Philosophy to find them out.”

     Page 376, “It seems to me farther, that these Particles (of which substances are composed) have not only a *vis inertia* … but also move by certain active Principles, such as Gravity and *that* *which* *causes* *Fermentation* *and* *Cohesion* *of* *Bodies*. “ (Emphasis mine)  [↑](#footnote-ref-448)
449. MS 49 p5  [↑](#footnote-ref-449)
450. Aristotle, *Physics,* translated by Robin Waterfield (Oxford: University Press (World’s Classics) 1999) p9

     “In any subject which has principles, causes and elements and understanding stems from a grasp of these, for we think we know a thing only when we have grasped its first causes and principles and have traced it back to its elements … elements and principles only become intelligible later, when one separates them. ” [↑](#footnote-ref-450)
451. MS 49 p5 [↑](#footnote-ref-451)
452. MS 49, p32 [↑](#footnote-ref-452)
453. Robert Boyle, *Selected Philosophical Papers of Robert Boyle* edited by M.A. Stewart (Manchester: Manchester University Press 1979) p20 “Individual particles of matter are “endowed each with its peculiar bulk and shape.” [↑](#footnote-ref-453)
454. MS 49 p72 [↑](#footnote-ref-454)
455. MS 49 p37 [↑](#footnote-ref-455)
456. MS 49 p37

     Georges Louis Leclerc, Count of Buffon (1707-1788) thought they were produced by the same force.

     Quoted by Arnold Thackery, *An Essay on Newtonian Matter theory and the Development of Chemistry* (Harvard: Harvard University Press 1970) p155

     Cullen possessed Buffon’s book, *Histoire Naturelle Generale et Particuliere avec la Description du Cabinet du Roy,* 1750 [↑](#footnote-ref-456)
457. MS 49 p37 [↑](#footnote-ref-457)
458. Robert E. Schofield, *Mechanism and Materialism* p157 [↑](#footnote-ref-458)
459. MS 1918 p52 [↑](#footnote-ref-459)
460. Robert E. Schofield, *Mechanism and Materialism* p212 [↑](#footnote-ref-460)
461. MS 49 p5 [↑](#footnote-ref-461)
462. See note 387 [↑](#footnote-ref-462)
463. Georg Stahl, translated by Peter Shaw, *Philosophical Principles of Universal Chemistry or the foundation of a scientific manner of Inquiry into and Preparation of the Natural and Artificial Bodies for the Use of Life,* (1730) p viii [↑](#footnote-ref-463)
464. Peter Schofield, *Mechanics and Materialism* pp 212-213 [↑](#footnote-ref-464)
465. Georg Stahl, *Philosophical Principles* p4 [↑](#footnote-ref-465)
466. MS 49 p6 [↑](#footnote-ref-466)
467. The situation was not quite straightforward because aggregates could be composed of substances which were themselves mixts. [↑](#footnote-ref-467)
468. Ms 49 p2 [↑](#footnote-ref-468)
469. MS 49 p14 [↑](#footnote-ref-469)
470. J.R.R. Christie, Cullen and the Practice of Chemistry in *William Cullen and the Eighteenth-Century Medical World* edited by A. Doig, J.P.S. Ferguson, I.A. Milne and R. Passmore p102  [↑](#footnote-ref-470)
471. MS 49 p50 [↑](#footnote-ref-471)
472. Isaac Newton, *Opticks,* 1730 edition,p370

     Newton believed that there was a force which held the particles of matter together “but as in Algebra where Affirmative Qualities vanish and cease, there Negative ones begin” [↑](#footnote-ref-472)
473. MS 49 p50 [↑](#footnote-ref-473)
474. Quoted by Peter Shaw in *Elements of Chemistry* p207 [↑](#footnote-ref-474)
475. Hasok Chang, *The Nature of Heat* p167 [↑](#footnote-ref-475)
476. MS 49 v 77 [↑](#footnote-ref-476)
477. MS 49 v 81 and MS 49n v 71 [↑](#footnote-ref-477)
478. Alistair Duncan, *Laws and Order in Eighteenth-Century Chemistry* (Oxford: Clarendon Press 1996) p57

     John C. Powers, *Inventing Chemistry* p128 [↑](#footnote-ref-478)
479. A substance in solution remained unchanged, unlike a substance forming mixt which did change in solution. [↑](#footnote-ref-479)
480. MS 49 p 71. Who the chemists were and their reasons for making the statements are not given in the notes. It appears to have been a minority opinion. [↑](#footnote-ref-480)
481. MS 49 f 78 [↑](#footnote-ref-481)
482. John Locke, *An Essay Concerning Human Understanding* p45 [↑](#footnote-ref-482)
483. John C. Powers, *Inventing Chemistry* p5 [↑](#footnote-ref-483)
484. Roy Porter, *Enlightenment* p130 [↑](#footnote-ref-484)
485. Peter J. Bowler and Iwan Rhys Morus, *Making Modern Science* p58 [↑](#footnote-ref-485)
486. Bourdieu, *Homo Academicus* p107 [↑](#footnote-ref-486)
487. Thompson, *Life,* p40 [↑](#footnote-ref-487)
488. Thompson, *Life* p156 [↑](#footnote-ref-488)
489. Mi Gyung Kim, *Affinity, That Elusive Dream* (Cambridge Mass, London: MIT Press 2003) p4 [↑](#footnote-ref-489)
490. William Lewis, *Commercium Philosphico-Technium.*

     Cullen praised Lewis in his *Treatise on Materia Medica, Part 1,* page 41 [↑](#footnote-ref-490)
491. M.D. Eddy, Seymour H. Mauskopf, William R. Newman, An Introduction to Chemical Knowledge in the Early Modern World, *Osiris* (2014) *29*: 1-15, page 6 [↑](#footnote-ref-491)
492. Wellcome Institute, MS 49, f 2 [↑](#footnote-ref-492)
493. J. Johnson, *Guide for Gentlemen Studying Medicine* p24 [↑](#footnote-ref-493)
494. Roger Emerson, *An Enlightened Duke* p147 [↑](#footnote-ref-494)
495. GUL MS Cullen 256

     Reading the document makes it clear that Cullen was actually complaining that the members of the class had neglected the practical side of his course. [↑](#footnote-ref-495)
496. Ursula Klein and Wolfgang Lefevre, *Materials in Eighteenth-Century Chemistry,* (Cambridge Mass: MIT Press 2007) p29 [↑](#footnote-ref-496)
497. Georg Stahl’s book, *Philosophical Principles of Universal Chemistry* 1730, p38 contains what it describes as the common instruments of operations, but this was in an account of the underlying theory of why chemical reactions occur.

     Peter Shaw’s *Chemical Lectures* does not give any details either.

     *Doctor Boerhaave’s Elements of Chemistry faithfully abridg’d from the late genuine edition,* 1734 defines chemical apparatus as “those hollow bodies that contain certain things to be chemically treated” p205. He does discuss the different types of vessels and their properties but throughout the text, he seems to assume that the reader will be familiar with the use of the apparatus he is describing.  [↑](#footnote-ref-497)
498. Ursula Klein and Wolfgang Lefevre, *Materials in Eighteenth-Century Chemistry* p33 [↑](#footnote-ref-498)
499. Gwen Averley, The “Social Chemists”; English Chemical Societies in the Eighteenth and Early Nineteenth Centuries, *Ambix* (1986) *33*: 99-128, p99 [↑](#footnote-ref-499)
500. MS 49, f 101 [↑](#footnote-ref-500)
501. MS 49 f 80-81 [↑](#footnote-ref-501)
502. William Cullen, *Nosology 1800 edition,* p ix [↑](#footnote-ref-502)
503. Georg Stahl, *Philosophical Principles,* p4 [↑](#footnote-ref-503)
504. M.D. Eddy, *The Language of Mineralogy* p14.Fixed air is now known to be carbon dioxide [↑](#footnote-ref-504)
505. Thompson, *Life* p36. [↑](#footnote-ref-505)
506. Peter Dear, *The Intelligibility of Nature: Science Makes Sense of the World* (Chicago: University of Chicago Press 2007) p39. [↑](#footnote-ref-506)
507. Professor Robinson in his memoir of Joseph Black quoted by Thompson, *Life* page 46 [↑](#footnote-ref-507)
508. Richard Yeo, *Encyclopaedic Visions: Dictionaries and Enlightenment Culture* (Cambridge: Cambridge University Press 2001) p70 [↑](#footnote-ref-508)
509. Cullen believed that the term Principles applied to the basic units of matter which could be obtained by breaking down a substance into its chemical components. [↑](#footnote-ref-509)
510. M.D. Eddy, *The Language of Mineralogy* p64 [↑](#footnote-ref-510)
511. Lawrence Principe, *The Secrets of Alchemy* (Chicago London: University of Chicago Press 2007) p13 [↑](#footnote-ref-511)
512. Wellcome MS 49, pp22-24 [↑](#footnote-ref-512)
513. William D. Wightman, William Cullen and the Teaching of Chemistry, *Annals of Science* (1955) *11*: 154-165, p162

     Cullen’s course fee was 3 guineas. [↑](#footnote-ref-513)
514. The modern term is potassium tartrate, used as a food additive. Its chemical formula is K2C4H4O6 [↑](#footnote-ref-514)
515. MS 1919 after p 92 [↑](#footnote-ref-515)
516. Stephen Shapin, The House of Experiment in Eighteenth-Century England, *Isis* (1988) *79*:373-404, p175 [↑](#footnote-ref-516)
517. John C. Power, *Inventing Chemistry* page 131 [↑](#footnote-ref-517)
518. Wellcome MS 49 p 3 [↑](#footnote-ref-518)
519. Georgette Taylor, *Variations on a Theme: Patterns of Divergence Among Eighteenth-Century Affinity Tables* Unpublished PhD thesis, University of London 2006 p54

     Wellcome MS 49 p 40  [↑](#footnote-ref-519)
520. Georgette Taylor, *Variations on a Theme,* p18 [↑](#footnote-ref-520)
521. Wellcome, MS 49 f 37 [↑](#footnote-ref-521)
522. MS 49 f 39 [↑](#footnote-ref-522)
523. Wellcome Library [↑](#footnote-ref-523)
524. MS 49 p 46 [↑](#footnote-ref-524)
525. MS 49 p 73 [↑](#footnote-ref-525)
526. Georgette Taylor, *Variation on a Theme* p73 [↑](#footnote-ref-526)
527. Ursula Klein and Wolfgang Lefevre, *Materials in Eighteenth-Century Chemistry* pp 56-57 [↑](#footnote-ref-527)
528. Thompson, *Life* pp 570-571 [↑](#footnote-ref-528)
529. MS 1919 f 2 [↑](#footnote-ref-529)
530. Michael Finn, editor, *Scottish Population History: From the Seventeenth Century to the 1930s* (Cambridge: Cambridge University Press 1977) pp 289-295 [↑](#footnote-ref-530)
531. William Cullen, *First Lines in the Practice of Medicine, Volume 1* (Edinburgh: William Creech 1778) p109 [↑](#footnote-ref-531)
532. Wellcome MS 1926 pp 14-17 [↑](#footnote-ref-532)
533. William Cullen, *First Lines in the Practice of Medicine, Volume 1* p163 [↑](#footnote-ref-533)
534. MS 1919 and William Cullen, *Treatise of the Materia Medica* p233

     MS 49 page 12. “Compound salts can be broken down and always have an acid as one of their constituent parts.” The term neutral was not introduced until the middle of the century. [↑](#footnote-ref-534)
535. MS 1926 f 57 Glauber’s salt is sodium sulphate [↑](#footnote-ref-535)
536. William Cullen, *A Treatise on the Materia Medica, Part 2* (1789) page 337 [↑](#footnote-ref-536)
537. William Cullen, *First Lines* p107 [↑](#footnote-ref-537)
538. See the case book of a practitioner from Dalkeith held by the National Library of Scotland, MS 3447 [↑](#footnote-ref-538)
539. William Cullen, *First Lines* pp 121-123 [↑](#footnote-ref-539)
540. *Sal digestivum sylvi* is now known as potassium chloride. It was produced by distilling an alkali with muriatic acid.

     William Cullen, *A treatise of the Materia Medica* p393 [↑](#footnote-ref-540)
541. William Cullen, *A Treatise of the Materia Medica, Part 2,* p227 [↑](#footnote-ref-541)
542. James Lind *An Essay on the Most Effectual means of Preserving the Health of Seamen in the Royal Navy,* 1757 [↑](#footnote-ref-542)
543. William Cullen, *A Treatise of the Materia Medica* pp 271-272 “Supposed to be powerful attenuants but this does not appear to me to be on very just grounds” [↑](#footnote-ref-543)
544. MS 1926 p 38 [↑](#footnote-ref-544)
545. Matthew Eddy, *The Language of Mineralogy* pp 68-74 [↑](#footnote-ref-545)
546. Matthew Eddy, *The Language of Mineralogy* p68 [↑](#footnote-ref-546)
547. See list in Appendix 2 [↑](#footnote-ref-547)
548. William Withering, *A Chemical Analysis of the Water at Caldas da Rainna* 1795 [↑](#footnote-ref-548)
549. Thomas Percival, *Experiments and Observations on Water: especially the hard pump water of Manchester* 1769, p38 [↑](#footnote-ref-549)
550. MS 1926, p 41 [↑](#footnote-ref-550)
551. *Sal ammonium* was obtained by distilling the hooves and horns of oxen then neutralising the carbonate component with muriatic acid. [↑](#footnote-ref-551)
552. William Cullen, *A Treatise of the Materia Medica, Part 2* p262 [↑](#footnote-ref-552)
553. It features in the account books of not only William Cullen but also David Wishart, NRS CS96/1301 and in many of the accounts sent by surgeons to their patients. NRS, GD5/440 and GD150/3294. Also National Library of Scotland, (NLS) MS 14663 [↑](#footnote-ref-553)
554. John Maxson Stillman, *The Story of Alchemy and Early Chemistry* (New York: Dover Press 1923) p302, Stillman recounts how the earliest chemical books were written in German in the sixteenth century and gave detailed directions for the separation of metals from their ores using nitric acid and *aqua regia,* which was a mixture of hydrochloric and nitrous acid.  [↑](#footnote-ref-554)
555. T.C. Smout, Lead Mining in Scotland in *Scottish Business History* edited by Peter L. Payne (London New York: Routledge 1967) p104 [↑](#footnote-ref-555)
556. Clows, *The Chemical Revolution,* p68 [↑](#footnote-ref-556)
557. Roger Emerson, *An Enlightened Duke,* p235

     “Production (of linen) rose at least seven-fold between 1730 and 1790. The numbers fully or partially employed increased so that by the 1790s, over one sixth of the country’s working population was at least partially employed in the trade.” [↑](#footnote-ref-557)
558. MS 1926, f 26

     MS 1919 f 78

     One method was to extract it from tartar (now known as potassium bicarbonate) that was obtained from wine lees. It was cheaper to import it from France than purify it in the UK.

     It could also be produced from nitre which was free of earth and vitriolated tartar [↑](#footnote-ref-558)
559. GUL MS Cullen 61 [↑](#footnote-ref-559)
560. MS 1926, f 40 [↑](#footnote-ref-560)
561. A.B. Shaw, The Norwich School of Lithotomy, *Medical History* (1970) *14*:221-259, p222.

     Of the 6 patients admitted to the Edinburgh Infirmary for lithotomy between June 1783 and June 1785, only 2 survived [↑](#footnote-ref-561)
562. T. Percival and E. Percival, *The Works, Literary, Moral and Medical of Thomas Percival: to which are Prefixed Memoirs of his Life, Writings and a Selection of his Literary Correspondence* (London 1807) p182 [↑](#footnote-ref-562)
563. William Cullen, *Treatise on Materia Medica* page 286 [↑](#footnote-ref-563)
564. MS 1926 f 27 In modern chemical terms, caustic potash or potassium hydroxide is formed [↑](#footnote-ref-564)
565. MS 1926 f 28 [↑](#footnote-ref-565)
566. Potassium nitrate [↑](#footnote-ref-566)
567. In one, late, manuscript, MS 1919 Cullen referred to his production of alkali from nitre and commented “In my late attempts however to establish this Manufacture I have with so many doubts about the proposed manner of performing it that I find I can deliver nothing certain upon the subject.” (As the page numbers in the notebook finish at 92 an exact reference is not possible.) [↑](#footnote-ref-567)
568. MS 1919 no folio number [↑](#footnote-ref-568)
569. MS 1919 no folio number [↑](#footnote-ref-569)
570. MS 49 pp 18 and 121 [↑](#footnote-ref-570)
571. William P.D. Wightman, William Cullen and the Teaching of Chemistry II *Annals of Science 12*: 192-205, p192 [↑](#footnote-ref-571)
572. Thompson, *Life* p157 [↑](#footnote-ref-572)
573. John Thompson, *Life,* page 141 [↑](#footnote-ref-573)
574. In his clinical lectures Cullen taught only those aspects of the subject which were relevant to the patient he was discussing. [↑](#footnote-ref-574)
575. Thompson, *Life,* p104 [↑](#footnote-ref-575)
576. Thompson, *Life* p112 [↑](#footnote-ref-576)
577. *The History and Statutes of the Royal Infirmary of Edinburgh, 1749 edition.*

     P14 lists the Hospital’s managers. Membership of the management committee was compulsory for the Town’s Provost, the Dean of Guilds as well as the President and Vice President of the Royal College of Physicians and certain senior clergy. The list of managers cited in the book also included George Drummond.  [↑](#footnote-ref-577)
578. The book was originally published in 1771. This chapter uses the 1789 version, published in Dublin as it is available as a paperback. [↑](#footnote-ref-578)
579. Thompson, *Life,* p143

     When Cullen heard that the student had published the notes taken at his lectures, he took the student to court. Although Cullen lost his case against the student, he agreed to the publication of the notes, provided he was allowed to correct them before they were printed again. [↑](#footnote-ref-579)
580. Guenter Risse, *Hospital Life in Enlightenment Scotland* p178 [↑](#footnote-ref-580)
581. Although it could be argued that medicine is based on the science of physiology, that branch of science was regarded as part of anatomy in the eighteenth century. [↑](#footnote-ref-581)
582. William Cullen, *A Treatise of the Materia Medica in 2 volumes,* (Dublin 1789) Vol. 1, p1 [↑](#footnote-ref-582)
583. Charles Alston, *Lectures on Materia Medica* p63 [↑](#footnote-ref-583)
584. Francois Boissier de Sauvages, *Nosologie Methodique* (Paris: Herissant et fils 1771) p71

     Sauvages cited theories by Galen (129-c200), Paracelsus (1493-1542), Daniel Sennert (1572-1636), Thomas Sydenham (1624-1689), Jean Ribit de la Riviere (1571-1605) Herman Boerhaave (1668-1738), Friedrich Hoffman (1660-1742) and Archibald Pitcairne (1652-1713).

     The Latin version of Sauvage’s book, the first nosology to be published, appeared in 1763, and was widely accepted almost immediately. Julian Martin, Sauvages’ Nosology: Medical Enlightenment at Monpelier in *The Medical Enlightenment of the Eighteenth Century* edited by Andrew Cunningham and Roger French (Cambridge: Cambridge University Press 1990) p 127. Although Cullen was to advocate the use of nosology as a diagnostic tool, Sauvage’s work was obviously unavailable to him when he gave his *Materia Medica* course. [↑](#footnote-ref-584)
585. For example Cullen believed that fevers were due to over stimulation of the heart and blood vessels. As a result he recommended an “antiphlogistic regime, proper to be employed in almost every case of continued fever” *First Lines in the Practice of Physic Volume 1* (Edinburgh 1778)*,* pp 102-103.

     For a full discussion on Cullen’s ideas about the causes of fever see W.F. Bynum, Cullen and the Study of Fevers in Britain 1760-1820 in *Theories of Fever from Antiquity to the Enlightenment* edited by W.F. Bynum and V. Nutton (London: Wellcome Institute for Medicine 1981) pp 135-147 [↑](#footnote-ref-585)
586. William Cullen, *First Lines in the Practice of Physic* (Edinburgh 1778) p 2

     Cullen also believed that there were remote causes of disease which were predispositions to develop a condition. Removing a remote cause might prevent the disease but would not cure a patient once the condition was established. [↑](#footnote-ref-586)
587. William Cullen, *First Lines in the Practice of Physic, Volume 1,* p35 [↑](#footnote-ref-587)
588. Matriculation records for the University of Edinburgh are very incomplete until 1762. The University of Edinburgh Special Collections, however, does have Cullen’s list of his chemistry and *materia medica* students from 1755 to 1765. It would be of interest to investigate what other courses Cullen’s *materia medica* students had taken but unfortunately the information no longer exists. [↑](#footnote-ref-588)
589. Thompson, *Life,* p104. While the physicians of Edinburgh gave medical advice and treatment free of charge to the patients in the Infirmary, it appears that only Cullen and Rutherford actually taught the students clinical medicine there in the 1750s. [↑](#footnote-ref-589)
590. Charles Alston, *Lectures in Materia Medica* (London 17) p63 [↑](#footnote-ref-590)
591. Guenter Risse, *Hospital Life in Enlightened Scotland,* p2. Organised clinical teaching began in Edinburgh in 1748. [↑](#footnote-ref-591)
592. Thompson, *Life* pp 473-481

     When the Duke of Buccleugh was made an Honorary Fellow of the College of Physicians in 1774, Cullen saw an opportunity to present his thoughts on medical education to the government of the day. He wrote a memorandum to Buccleugh in which he stated that a degree in medicine should only be given to those who had followed a set course of study which included lectures on *materia medica*. In reply to Cullen, Adam Smith also wrote to Buccleugh arguing that if students were forced to attend certain courses, the lecturers had no incentive to keep their work up-to-date. [↑](#footnote-ref-592)
593. Lisa Rosner*, Medical Education in an Age of Improvement* pp 62-64 [↑](#footnote-ref-593)
594. J. Johnson, *A Guide for Gentlemen Studying Medicine at the University of Edinburgh* (London 1792) [↑](#footnote-ref-594)
595. Lisa Rosner page 106

     See also discussion in Chapter 3 [↑](#footnote-ref-595)
596. For a discussion of the value of University Degrees in Medicine see Thompson, *Life* pp 468-481 which quotes letters between Cullen and Adam Smith. [↑](#footnote-ref-596)
597. Lisa Rosner, p12. Students were usually between 16 and 23 years of age. [↑](#footnote-ref-597)
598. William Cullen, *Treatise on the Materia Medica, Vol 1,* page 128. Emphasis mine. Giving a list of terms was a common eighteenth-century practice but in this case, Cullen does make it clear that his course was directed mainly at inexperienced practitioners. [↑](#footnote-ref-598)
599. *Treatise Part 1* p25 [↑](#footnote-ref-599)
600. For example, Charles Alston *Lectures in Materia Medica* (1770) discusses medicines according to their origins starting with metals. Others, in print in the early eighteenth century include John Ball, *Pharmacopoeia Domestica,* (London 1750); Bates *Dispensatory* (London 1747) *British Dispensatory* (London 1747); Thomas Fuller, *Dispensatory* (London 1740); William Lewis 1746  [↑](#footnote-ref-600)
601. “Chymistry is needed in every step of the study of medicine”

     Wellcome Library, Student note book from 1762, Cullen’s lectures on Chemistry B310A4, MS 49 [↑](#footnote-ref-601)
602. William Cullen *Treatise on Materia Medica Part 1*  p 127 [↑](#footnote-ref-602)
603. *Treatise Part 1,* p 45 [↑](#footnote-ref-603)
604. *Treatise* part 1 p29 [↑](#footnote-ref-604)
605. Lisa Rosner, *Medical Education in an Age of Improvement* p 69 [↑](#footnote-ref-605)
606. L.M.A. Liggett, Extracts from the Journal of a Scotch (sic) Medical Student p 107 [↑](#footnote-ref-606)
607. J. Johnson, *A Guide* p25 [↑](#footnote-ref-607)
608. *Treatise, Part 1* pp 23-24.

     The theory postulated that corpuscles were the basic building blocks of all matter. Newton believed that all corpuscles were identical and that it was the pores between them that gave substances their different characteristics. Robert Boyle and Rene Descartes (1596-1650) believed that the differences between substances could be explained by the different shapes and sizes of the corpuscles. For example, water molecules were spherical so they did not coalesce and hence water was fluid. [↑](#footnote-ref-608)
609. Thompson, *Life* p 119 [↑](#footnote-ref-609)
610. *Treatise Part 1* p24

     *Treatise, Part 2,* pp 264-265, [↑](#footnote-ref-610)
611. *Treatise,* p 24. “Demum omnia quoque examinae virtutis medicamenta, non tam in partes fluids, eum crasin ac intemperium corriendo quam motus in solidas, et nervosas … [↑](#footnote-ref-611)
612. William Cullen, *Institutes of Medicine* (1785) p12 and p24 [↑](#footnote-ref-612)
613. Cullen, *Institutes* page 27 and *Treatise, Part 2* p149 [↑](#footnote-ref-613)
614. *Treatise, Part 2* p92 [↑](#footnote-ref-614)
615. *Treatise, Part 1* page 30 [↑](#footnote-ref-615)
616. *Treatise Part 1* page 114 [↑](#footnote-ref-616)
617. *Treatise, Part 1,* p36 [↑](#footnote-ref-617)
618. *Treatise, Part 1,* p *41*

     Cullen actually referred to the late Doctor Lewis but as William Lewis (1708-1781) was a Fellow of the Royal Society who had written and researched extensively on drugs, he seems to be the only possible man Cullen could be referring to. [↑](#footnote-ref-618)
619. *Treatise Part 1* p42 [↑](#footnote-ref-619)
620. Thompson, *Life* p 119

     Michael Barfoot, Old Spasm: The Medical Theory and Practice of William Cullen, *Proceedings of the Scottish Society for the History of Medicine* (1984-85) *5:* 31-37 p36 [↑](#footnote-ref-620)
621. William Cullen, *Treatise, Part 1,* p x [↑](#footnote-ref-621)
622. Michael Barfoot, Old Spasm p 31

     L.M.A. Liggett, Journal of a Scotch (sic) Medical Student, Alexander Coventry commented that “Some may ridicule his spasms” [↑](#footnote-ref-622)
623. Wellcome Collection MS MSL 22. Lettsom did not go to Edinburgh until 1766 but the notes are evidently a copy of Cullen’s course. In them, Lettsom makes several, less than complimentary, comments about Cullen’s chemical theories. [↑](#footnote-ref-623)
624. *Treatise Part 1,* p42 [↑](#footnote-ref-624)
625. Roy Porter, The Eighteenth Century in *The Western Medical Tradition 800 BC to 1800* edited by Lawrence I Conrad, Michael Neve, Vivian Nutton, Roy Porter and Andrew Wear p413.  [↑](#footnote-ref-625)
626. In Great Britain and Ireland, either a university degree or a licence from one of the Royal Colleges is needed before an individual can become a registered medical practitioner. Until the 1858 Medical Act, such a qualification was not compulsory. Deborah Brunton, The Emergence of a Modern Profession in *Medicine Transformed: Health, Disease and Society in Europe 1800-1930,* edited by Deborah Brunton(Manchester: Open University Press 2004) p122 [↑](#footnote-ref-626)
627. Ginnie Smith, Prescribing the Rules of Self-Help in *Patients and Practitioners: Lay Perceptions of Medicine in Pre-Industrial Society* edited by Roy Porter (Cambridge: Cambridge University Press 1985) p250 [↑](#footnote-ref-627)
628. Book published in London 1740 [↑](#footnote-ref-628)
629. Roy Porter, Lay Medical Knowledge in the Eighteenth Century: Evidence from the Gentleman’s Magazine, *Medical History* (1985) *29*: 138-68, p139 [↑](#footnote-ref-629)
630. Emma Spary, *Eating the Enlightenment: Food and the Sciences in France* (Chicago: University of Chicago Press 2012) p254 [↑](#footnote-ref-630)
631. Andrew Wear, Medical Ethics in Early Modern England in *Doctors and Ethics: The Earlier Historical Setting of Professional Ethics*  edited by A Wear, Johanna Geyer-Kordesch and Roger French (Amsterdam: Rodopi 1993) [↑](#footnote-ref-631)
632. William Cullen, *Treatise, Part 1* p48. Emphasis in the original. For a full discussion of Cullen’s ideas, see W.F. Bynum, Cullen and the Nervous System in William Cullen and the Eighteenth-Century Medical World.  [↑](#footnote-ref-632)
633. A menstruum was essentially a solute i.e. something in which a substance could dissolve. [↑](#footnote-ref-633)
634. Guenter Risse, Medicine in an Age of Enlightenment in *Medicine in Society* edited by Andrew Wear (Cambridge: Cambridge University Press 1996) p150 [↑](#footnote-ref-634)
635. Risse, Medicine in an Age of Enlightenment, p151 [↑](#footnote-ref-635)
636. [www.cullenproject.ac.uk](http://www.cullenproject.ac.uk) Consulted December 6th 2015 [↑](#footnote-ref-636)
637. P.H. Niebyl, The Non-Naturals, *Bulletin of the History of Medicine* (1971) *45*: 486-492, p486 [↑](#footnote-ref-637)
638. Guenter B. Risse, *Hospital Life in Enlightenment Scotland*  p14 [↑](#footnote-ref-638)
639. *Treatise, Part 1* p90 [↑](#footnote-ref-639)
640. Quoted by Anna Marie Roos, in *The Salt of the Earth: Natural Philosophy, Medicine and Chymistry in England 1650-1750* (Leiden Boston: Brill 2007) p 150

     In his paper on Cullen and the Nervous System in *William Cullen and the Eighteenth-Century Medical World,* W.F. Bynum p 158, suggested that most of Cullen’s experimental evidence on muscular reaction was taken from Thomas Smith’s MD thesis entitled *De Actione Musculari*. However, that was not published until 1767, so could not have influenced Cullen when he was giving his *Materia Medica* course. [↑](#footnote-ref-640)
641. *Materia Medica, part 1* p107 [↑](#footnote-ref-641)
642. Cullen used smell and taste as a means of deciding whether a substance was acid or alkaline. Wellcome Collection MS 1926 p1 [↑](#footnote-ref-642)
643. *Materia Medica* p111 [↑](#footnote-ref-643)
644. Frederick L. Holmes, *Eighteenth-Century Chemistry as an Investigative Enterprise* p61 [↑](#footnote-ref-644)
645. *Materia Medica part 1,* p111 [↑](#footnote-ref-645)
646. *Materia Medica, Part 1* p114 [↑](#footnote-ref-646)
647. *Treatise, Part 2* p88 [↑](#footnote-ref-647)
648. Charles Alston, *Lectures on Materia Medica: containing the Natural History of Drugs, their Virtues and Doses: also directions for the Study of Materia Medica* (London 1770) p i

     John Hope had been appointed Professor of *Materia Medica* under the patronage of Lord Bute. See Roger Emerson, Lord Bute and the Scottish Universities 1760-1792 in *Lord Bute: Essays in Re-Interpretation* edited by Karl W. Schweitzer (Leicester: Leicester University Press 1988) p152 [↑](#footnote-ref-648)
649. A “simple” was a drug used on its own and not in combination with others. A good example of the latter was Theriac which had started as an antidote to snake bite in Roman times and by the eighteenth century was being prescribed as a tonic. It could contain several dozen ingredients. Cullen prescribed it for both the Duke of Hamilton and his horses. [↑](#footnote-ref-649)
650. Charles Alston, *Materia Medica* p 18 [↑](#footnote-ref-650)
651. Matthew D Eddy, The Sparkling Nectar of Spas: The Medical Commercial Relevance of Spring Water in *Materials and Expertise in Early Modern Europe: Between Market and Library* (Chicago: University of Chicago Press 2010) p202 [↑](#footnote-ref-651)
652. Alston talked of the “power” of a disease to kill, p 7

     p74, nitrous oxide increases the power of the menstruum

     p 81 the power of exciting salivation [↑](#footnote-ref-652)
653. Alston, p19 [↑](#footnote-ref-653)
654. Alston p20 [↑](#footnote-ref-654)
655. Alston, p22 [↑](#footnote-ref-655)
656. Andreas Holger Maehle, *Drugs on Trial: Experimental Pharmacology and Therapeutics in the Eighteenth Century,* (Amsterdam Atlanta: Rodopi 1999) pp 147-151 [↑](#footnote-ref-656)
657. David L. Cowen, *Pharmacopoeias and Related Literature in Britain and America, 1617-1847* (Aldershot Burlington USA Singapore Sydney: Ashgate Publications 2001) p35 [↑](#footnote-ref-657)
658. Charles Alston, *A Treatise on Quick Lime and Lime Water* (London 1754)

     Charles Alston, *Materia Medica* p62 [↑](#footnote-ref-658)
659. *Treatise* p41 [↑](#footnote-ref-659)
660. William Brown did the *Materia Medica* course and referred a patient to Cullen. The letter was dated April 26th 1775, reference ID 1137 [www.cullenproject.com](http://www.cullenproject.com) consulted January 12th 2016 [↑](#footnote-ref-660)
661. James E. Handley, *Scottish Farming in the Eighteenth Century* (London: Faber and Faber 1953) see Chapter V, The Awakening pp 109-116 [↑](#footnote-ref-661)
662. Thompson, *Life* p25 [↑](#footnote-ref-662)
663. Jan Golinski, *Science as Public Culture* p15 [↑](#footnote-ref-663)
664. GUL MS Cullen 430/4

     “As the course was intended to teach the Elements of a Chemistry applicable to the Arts in general, Agriculture claimed a place and though I was not well prepared on that subject yet, I thought it was proper to make a beginning and at least open Young Gentlemen’s views a little on this subject.” [↑](#footnote-ref-664)
665. GUL MS Cullen 432. The draft of the lectures held in GUL is undated so it is impossible to tell if it is identical to one referred to in the letter to Kames.

     Charles Withers, in his paper, William Cullen’s Agricultural Lectures and Writings and the Development of Agricultural Science in Eighteenth-Century Scotland in *Agricultural History Review* (1989) *37*: 144-156, noted that the draft in GUL is identical to one in John Walker’s archive, in Walker’s handwriting, dated 1768. In addition to that document, GUL has another file (MS Cullen 436) containing numerous scraps of paper with Cullen’s thoughts on agriculture. They appear to be the rough notes from which Cullen compiled the final draft.

     Kames was not the only one to read his agricultural lectures. GUL MS Cullen 65 is a letter to Cullen dated 1750, from Arthur Martine. In his letter Martine tells Cullen that he has read his lectures “with great pleasure.” [↑](#footnote-ref-665)
666. Charles J. Withers, William Cullen’s Lectures on Agriculture *Agricultural History Review* (1989) *37:* 144-156.  [↑](#footnote-ref-666)
667. T.M. Devine, *Scottish Clearances* p125 [↑](#footnote-ref-667)
668. T.C. Smout, A New Look at Scottish Improvers, *Scottish Historical Review* (2012) *91*: 125-149, p131 [↑](#footnote-ref-668)
669. I.H. Adams, The Agents of Agricultural Change in *The Making of the Scottish Countryside* edited by M.L. Parry and T.R. Slater (London Montreal : Croom Helm and McGill) p155 [↑](#footnote-ref-669)
670. Justus von Liebig, *Letters on Modern Agriculture,* edited by John Blythe(London 1859) p4 [↑](#footnote-ref-670)
671. T.C. Smout, Famine and Famine Relief in Scotland in *Comparative Aspects of Scottish and Irish Economic and Social Policy 1600-1900* p25 [↑](#footnote-ref-671)
672. L.M. Cullen and T.C. Smout, *Comparative Aspects of Scottish and Irish Economic and Social Policy 1600-1900* (Edinburgh: John Donald and Co 1977) p3 [↑](#footnote-ref-672)
673. Cullen and Smout, *Comparative Aspects* p25.

     As a magistrate William Cullen was involved in the suppression of a food riot in Hamilton. Thompson, *Life* p15 [↑](#footnote-ref-673)
674. I.H. Adams, The Agents of Agricultural Change, p155 [↑](#footnote-ref-674)
675. I.H. Adams, p155 [↑](#footnote-ref-675)
676. Fredrik Albritton Jonsson, *Enlightenment’s Frontier: The Scottish Highlands and the Origins of Environmentalism* (New haven London: Yale University Press 2013)p12. [↑](#footnote-ref-676)
677. The language spoken in the Scottish Lowlands is now recognised as a separate language, “Scots” but during the eighteenth century, it was felt by many to be an inferior form of English and men like David Hume went to considerable lengths to rid their speech and writings of its characteristic forms. [↑](#footnote-ref-677)
678. For a description of this system and how it worked see Piers Dixon, Field Systems, Rig and Other Cultivation Remains in Scotland: The Field Evidence in *The History of Soils and Field Systems* edited by S. Foster and T.C. Smout (Aberdeen: Scottish Cultural Press 1994)*;* J.E. Handley, *Scottish Farming in the Eighteenth Century* pp37-52; Henry Hamilton, *Economic History of Scotland in the Eighteenth Century* (Oxford: Clarendon Press 1979)pp37-41 [↑](#footnote-ref-678)
679. Devine and Mitchison, *People and Society in Scotland, Volume 1* p60 [↑](#footnote-ref-679)
680. T. M. Devine, *The Scottish Clearances,* p134 [↑](#footnote-ref-680)
681. For a description of the social structure of the agricultural industry, see Devine and Mitchison, *People and Society in Scotland,* p54-57 [↑](#footnote-ref-681)
682. T.M. Devine and Rosalind Mitchison, *People and Society in Scotland* p53 and p80 [↑](#footnote-ref-682)
683. William Mackintosh, *An essay on ways and means for inclosing, fallowing, planting etc* page xxiv [↑](#footnote-ref-683)
684. L. Timperley, The Pattern of Landholding in Eighteenth-Century Scotland, in *The Making of the Scottish Countryside* page 137 [↑](#footnote-ref-684)
685. Devine and Mitchison page 116 [↑](#footnote-ref-685)
686. R.H. Campbell, Scottish Improvers and the Course of Agrarian Change in the Eighteenth Century in *Comparative Aspects* page 207 [↑](#footnote-ref-686)
687. James E. Handley, *Scottish Farming in the Eighteenth Century* p111 [↑](#footnote-ref-687)
688. Hadley, Chapter VII, The Pioneers, pp 144- 189 [↑](#footnote-ref-688)
689. T.M. Devine, *The Scottish Clearances* p87 [↑](#footnote-ref-689)
690. Ian Simpson Ross, *Lord Kames and the Scotland of his Day* (Oxford: Clarendon Press 1972) p316 [↑](#footnote-ref-690)
691. Fredrik Albritton Jonsson, *Enlightenments Frontier* p29 [↑](#footnote-ref-691)
692. Ross, p315 [↑](#footnote-ref-692)
693. Fredrik Albritton Jonsson, *Enlightenments Frontier* p28  [↑](#footnote-ref-693)
694. Heather Holmes, The Circulation of Scottish Agricultural Books during the Eighteenth Century, *Agricultural History Review,* (2006) *54*: 45-78, p47 [↑](#footnote-ref-694)
695. Robert Maxwell, *Select Transactions of the Honourable the Society of the Improvers of the Agriculture in Scotland* (Edinburgh 1743) p xvi

     There was a copy of the book in Cullen’s library [↑](#footnote-ref-695)
696. T.M. Devine and Rosalind Mitchison, *People and Society in Scotland, Volume 1,* p 80

     Henry Home, Lord Kames, *The Gentleman Farmer* p x [↑](#footnote-ref-696)
697. Henry Hamilton, *An Economic History of Scotland in the Eighteenth Century* p70

     See also T.C. Smout, A New Look at Scottish Improvers, *Scottish Historical Review* (2012) *91*:125-149, p131 [↑](#footnote-ref-697)
698. Robert Maxwell, *Select Transactions* page xiii [↑](#footnote-ref-698)
699. GUL MS Cullen 436 [↑](#footnote-ref-699)
700. GUL MS Cullen 430/1 [↑](#footnote-ref-700)
701. Cullen did not give the man’s full name. Tourniquet’s research was written up in a book, *Histoire des Plantes qui naissant aux environs de Paris, avec leur usage dans la medicine.* The book was translated and published in London in 1732 [↑](#footnote-ref-701)
702. MS Cullen 430/1 [↑](#footnote-ref-702)
703. In his letter to Kames, Cullen discussed the problems he would face in carrying out the experiments. “Where shall I find a place to put a hundred different heaps under cover? How shall I find time to give them the necessary attention? Assistants are difficulty got (sic) and even the expense will be considerable. These considerations however shall not deter me from the attempt in some measure. I mention them only that they may be an excuse with you if I do not attempt my Plan to its full extent” He then went on to ask Kames opinion as to which of the experiments he had described were the most important. [↑](#footnote-ref-703)
704. Charles Withers, William Cullen’s Agricultural Lectures and Writings and the Development of Agricultural Science in Eighteenth-Century Scotland, *Agricultural History Review* 37: 144-156, the actual content of the lectures is discussed pp 151-152 [↑](#footnote-ref-704)
705. GUL MS Cullen 430/4 [↑](#footnote-ref-705)
706. Although the Cullen’s lectures were published as a book which was entitled *Nine Lectures on Agriculture,* the handwritten notes only contain seven lectures. I have not managed to get hold of a copy of the book but it seems reasonable to suggest that as the last two lectures are rather long, the book’s editors decided to split each of them into two separate lectures.  [↑](#footnote-ref-706)
707. GUL MS Cullen 432 [↑](#footnote-ref-707)
708. Robert A. Dodgson, Budgeting for Survival: Nutrient Flow and Traditional Highland Farming in *The History of Soils and Field Systems* p83  [↑](#footnote-ref-708)
709. Cullen seems to have changed his views on the subject.

     GUL MS Cullen 436 contains a scrap of paper on which he had written, “Roots of plants have no elective attractions, they take in promiscuously the noxious and the salutary. All the salutary can be assimilated, the noxious cannot. Because neither file is dated, it is impossible to trace the development of his ideas. [↑](#footnote-ref-709)
710. Dictionary of Scientific Biography

     As Cullen went to Edinburgh in 1755-56 this raises the possibility that the draft of his agricultural lectures (GUL MS Cullen 432) had been corrected just before Cullen left Glasgow. Bonnet was a corresponding member of the Royal Society of London from 1743 which is another possible source of Cullen’s information. [↑](#footnote-ref-710)
711. The Oxford English Dictionary defines “tillering” as the multiplication of stalks. [↑](#footnote-ref-711)
712. Not only did Cullen fail to mention Hales in his lectures, Hales’ book was not in Cullen’s Library. [↑](#footnote-ref-712)
713. The O.E.D. defines mucilage as a “viscid preparation from seeds, roots or other parts of certain plants by soaking or by heating them in water.” [↑](#footnote-ref-713)
714. Cullen, *Materia Medica, Part 2,* p282 contains a section entitled *Mucilaginosa* [↑](#footnote-ref-714)
715. For a description of the problems see J.H. Hadley, *Scottish Farming in the Eighteenth-Century* p210 [↑](#footnote-ref-715)
716. See Robert Maxwell, *Select Transactions of the Honourable the Society of the Improvers of Agriculture* (Edinburgh 1743).This was a selection of queries that various landowners had put to the Society about land improvement together with the Society’s answers. The way the various fields are described uses the same terms as Cullen. [↑](#footnote-ref-716)
717. GUL MS Cullen 432

     Selenite (modern term, calcium sulphate) is a form of gypsum.

     Cullen described it as being formed from a calcareous earth by vitriolic acid in the air. [↑](#footnote-ref-717)
718. Wellcome Institute, MS 49 p5. Cullen described the Saline Principle as containing substances which were “impossible to define from a single characteristic but sapid and miscible in water.” [↑](#footnote-ref-718)
719. Cullen’s description, “They are from heat or contact with burning bodies. There are a great number in nature but their qualities lie in only one ingredient in their composition.” (phlogiston) [↑](#footnote-ref-719)
720. Wellcome Institute, William Cullen, *Lectures on Chemistry* MS 49 p14 [↑](#footnote-ref-720)
721. It was thought to take place in the human body as well as in the soil. [↑](#footnote-ref-721)
722. Peter Shaw, *Chemical Lectures, Publicky read at London 1731-32* (London 1755) Glossary of Technical Terms, page xii, Lixiviation was boiling the substance to be analysed in water. [↑](#footnote-ref-722)
723. The rationale was that any clay present in the soil would dissolve in the water. Once the sand was allowed to settle in the container, then the water containing the clay could be poured off, separating the two components. The relative proportion of sand and clay could then be calculated. [↑](#footnote-ref-723)
724. H.A. Webber, The Relation of Chemistry to Agriculture, *Science* (1907) : 689-694

     P689 “The effects of manure were known to farmers before chemistry had pointed out that carbon, hydrogen, oxygen nitrogen, phosphorus, sulphur, potassium, calcium, magnesium and iron were essential for vegetable growth” [↑](#footnote-ref-724)
725. James Anderson, *Essays on Agriculture and Rural Affairs 3rd Edition, Part 2* (Edinburgh 1784) pp 318-319 [↑](#footnote-ref-725)
726. J.E. Handley, *Scottish Farming in the Eighteenth Century* p43 [↑](#footnote-ref-726)
727. Donald Woodward, Gooding the Earth: Manuring Practices in Britain 1500-1800 in *The History of Soils and Field Systems* p102 [↑](#footnote-ref-727)
728. William Cullen, *Treatise on the Materia Medica, Part 1* p240 [↑](#footnote-ref-728)
729. It is now known that legume trap nitrogen in their roots. [↑](#footnote-ref-729)
730. Henry Hamilton, *An Economic History of Scotland in the Eighteenth Century* p64 [↑](#footnote-ref-730)
731. Acids “were always hurtful to vegetation,” alkaline ashes acted, not as a fertiliser, but to dissolve mucilage.” Soot had the same effect as alkaline ashes. Common salt had no effect on sterile soil. Nitre was a good fertiliser and quick lime was also beneficial. It acted through its solubility in water. It had to be applied regularly because “the more recent the application, the better.” “If long exposed to air, it returned to the state of a calcareous earth.” [↑](#footnote-ref-731)
732. DNB

     Tull published *Horse-Hoeing Husbandry* in 1731 with a second edition in 1743, so both editions would have been available to Cullen when he was preparing his lectures. [↑](#footnote-ref-732)
733. Marle was “calcareous matter that has not crystallised because it is mixed with clay or sand.”

     M.D. Eddy, The Aberdeen Agricola: Chemical Principles and Practice in James Anderson’s Georgics and Geology in *New Narratives in Eighteenth- Century Chemistry* edited by Lawrence M. Principe (Dordrecht: Springer 2007) p 15.  [↑](#footnote-ref-733)
734. Quoted by Justus von Liebig, in *Letters on Modern Agriculture* (London 1859) p6 [↑](#footnote-ref-734)
735. DNB

     Justus von Liebig, *Letters on Modern Agriculture,* p2 [↑](#footnote-ref-735)
736. For the details of Liebig’s work, see <https://www.britannica/biography/Justus-Freiherr-von-Liebig> (consulted 6th June 2019) [↑](#footnote-ref-736)
737. Henry Home, Lord Kames, *The Gentleman Farmer* p vii [↑](#footnote-ref-737)
738. GUL MS Cullen 436 is a sheet of paper on which is written what appears to be chapter headings for a book. [↑](#footnote-ref-738)
739. Thompson, *Life* p 67

     Sebastian A.J. Keible, Leigh Shaw-Taylor, Early Modern Rural By-Employments: A Re-Examination of the Probate Evidence, *Agricultural Historical Review* (2013) *61*:244-281, p258

     In later life, Cullen bought his own farm at Ormston but that was in 1778. [↑](#footnote-ref-739)
740. Charles Daubeny, On the Scientific Principles by which the Application of Manures ought to be Regulated, *Journal of the Royal Agricultural Society* (1842) *2:* 232-272 p240 [↑](#footnote-ref-740)
741. DNB [↑](#footnote-ref-741)
742. James Anderson, *Essays on Agriculture and Rural Affairs 4th Edition.* pp 507-510 [↑](#footnote-ref-742)
743. James Anderson, *Essays on Agriculture* p 490 [↑](#footnote-ref-743)
744. Kames, *Gentleman Farmer* page 290

     What he was referring to was the fact that chemical analysis of certain crops had shown they contained salts and oily substances. As a result, some farmers advocated using salt and oil as fertilisers. [↑](#footnote-ref-744)
745. Kames, *Gentleman Farmer,* p314

     Stephen Hale’s book *Vegetable Statics* was regarded as authoritative at the time. [↑](#footnote-ref-745)
746. Kames, *Gentleman Farmer,* p324 [↑](#footnote-ref-746)
747. Kames, *Gentleman Farmer,* p291 [↑](#footnote-ref-747)
748. Quotation from Cullen’s letter to Kames, GUL MS Kames 430/4 [↑](#footnote-ref-748)
749. John Morrell, The University of Edinburgh in the Eighteenth Century, *Isis,* (1971) *62*: 158-171. See diagram on page 165 which gives a list of professorial salaries. The Professors of Medical Theory, Medical Practice and Chemistry received nothing for their services. [↑](#footnote-ref-749)
750. Henry Hamilton, *An Economic History of Scotland in the Eighteenth Century* p58 [↑](#footnote-ref-750)
751. Fredrik Albritton Jonsson, *Enlightenment’s Frontier* p50 [↑](#footnote-ref-751)
752. M.D. Eddy, *The History of Mineralogy* pp 27-34 [↑](#footnote-ref-752)
753. Ian Simpson Ross, *Lord* *Kames and the Scotland of his Day* (Oxford: Clarendon Press 1952) p75 [↑](#footnote-ref-753)
754. Thompson, *Life* p60 [↑](#footnote-ref-754)
755. Joel Mokyr, President’s Address, The Intellectual Origins of Economic Growth, *Journal Of Economic History* (2005) *65*: 285-351, p287

     Useful knowledge in this chapter will refer to the Baconian concept. [↑](#footnote-ref-755)
756. Joel Mokyr, The Intellectual Origins of Economic Growth, p290 [↑](#footnote-ref-756)
757. Roger Emerson, *An Enlightened Duke* p226 [↑](#footnote-ref-757)
758. Roy Porter, *The Making of Geology: Earth Sciences in Britain 1660-1815* (Cambridge: Cambridge University Press 1977) p150 [↑](#footnote-ref-758)
759. GUL MS Cullen 256. It must have been the last lecture in a series because Cullen’s final sentence begins, “I am now to conclude my lectures.” [↑](#footnote-ref-759)
760. GUL MS Cullen 256 [↑](#footnote-ref-760)
761. The five classes were saline, inflammatory, metallic, earthy, and watery. After Joseph Black’s discovery of fixed air (carbon dioxide), the subject of his dissertation of 1756, Cullen added a sixth class, aerial. As Cullen referred to five classes in his lecture, it must have been delivered early in his career. [↑](#footnote-ref-761)
762. Matthew Eddy, *The Language of Mineralogy* p130 [↑](#footnote-ref-762)
763. Matthew Eddy, *The Language of Mineralogy* p131 [↑](#footnote-ref-763)
764. Matthew Eddy, *The language of Mineralogy* p 56 [↑](#footnote-ref-764)
765. Anna Simmons, p225 [↑](#footnote-ref-765)
766. Thompson, *Life* p30 [↑](#footnote-ref-766)
767. Thompson *Life* p539

     Cullen’s library did contain copies of the books concerned so he must have acquired them from another source. Reaumur (1683-1757) was a French chemist who devised a thermometer which used alcohol. [↑](#footnote-ref-767)
768. Glasgow University Library (GUL) Special Collections MS Cullen 91. Moore did not give the titles of the books. [↑](#footnote-ref-768)
769. GUL, Special Collections contains 5 letters from booksellers [↑](#footnote-ref-769)
770. Rachel Laudan, *From Mineralogy to Geology: The Foundations of a Science 1650-1830* (Chicago London: University of Chicago Press 1987) pp55-56  [↑](#footnote-ref-770)
771. John Maxson Stillman, *The Story of Alchemy and Early Chemistry* (New York: Dover Press 1923) p302 [↑](#footnote-ref-771)
772. Martin J.R. Rudwick, *Bursting the Limits if Time,* p30 [↑](#footnote-ref-772)
773. Matthew Eddy, *The Language of Mineralogy* p56 [↑](#footnote-ref-773)
774. After Cullen’s death, Walker purchased his collection of minerals for the Edinburgh Natural History Museum, Matthew Eddy, *The Language of Mineralogy* p94 [↑](#footnote-ref-774)
775. Rachel Laudan, *From Mineralogy to Geology* p49 [↑](#footnote-ref-775)
776. GUL MS Cullen 264 [↑](#footnote-ref-776)
777. GUL MS Cullen 264 [↑](#footnote-ref-777)
778. Roy Porter, *The Making of Geology* p 151 [↑](#footnote-ref-778)
779. Thompson, *Life* p153 [↑](#footnote-ref-779)
780. Robert G.W. Anderson, Introduction to *The Correspondence of Joseph Black, Volume I* (Farnham Burlington: Ashgate Publications 2012) pages 37-38. Anderson remarks that Black continued to conduct chemical experiments for others until 1782. [↑](#footnote-ref-780)
781. Stephen Shapin, Property, Patronage and the Politics of Science: The Founding of the Royal Society of Edinburgh *British Journal for the History of Science* (1974) *7* : 1-41 [↑](#footnote-ref-781)
782. Matthew Eddy, *The Language of Mineralogy* p 111 [↑](#footnote-ref-782)
783. Roger Emerson, *Academic Patronage in the Scottish Enlightenment* pp 306-7 [↑](#footnote-ref-783)
784. For a full discussion of Walker’s mineralogical system, see Chapter 5, The Ordering of the Earth: The Chemical Foundations of Geology in Matthew Eddy, *The Language of Mineralogy* pp 155-187 [↑](#footnote-ref-784)
785. For the development of the various Literary and Philosophical Societies and their connection to mineralogy and geology see Simon J. Kneil, *The Culture of English Geology 1815-1851* (Aldershott, Burlington Singapore Sydney: Ashgate 2000) p50 [↑](#footnote-ref-785)
786. The separation of Humanities from the Sciences did not occur until the nineteenth century. [↑](#footnote-ref-786)
787. The rules of the Newcastle-upon-Tyne Society are set out in the First Annual Report, held in the Society’s Archives. They show that the annual membership subscription was a guinea (well above what an artisan could afford) and members had to be proposed by three existing members. In other words, they needed patronage to become members. [↑](#footnote-ref-787)
788. DNB.

     Thomas Percival attended Cullen’s chemistry classes in 1761, 1763 and 1764, John Clark in 1765 [↑](#footnote-ref-788)
789. DNB [↑](#footnote-ref-789)
790. R.S. Watson, *History of the Literary and Philosophical Society of Newcastle-upon-Tyne 1793-1896* (London: Walter Scott 1897) p34

     Medical Schools were the only places where “speculative philosophy” was taught. [↑](#footnote-ref-790)
791. Bruce Lenman, *An Economic History of Scotland 1660-1976* (London: B.T. Batsford and Son 1977) p97 [↑](#footnote-ref-791)
792. Christopher A. Whately, *The Industrial Revolution in Scotland* (Cambridge: Cambridge University Press 1997) p58  [↑](#footnote-ref-792)
793. T.C. Smout, Lead Mining in *Studies in Scottish Business History* edited by Peter L. Payne (London New York: Routledge and Co 1967) p102 [↑](#footnote-ref-793)
794. Matthew Eddy, *The Language of Mineralogy* p 56 [↑](#footnote-ref-794)
795. Roger Emerson, The Philosophical Society of Edinburgh, *British Journal for the History of Science* (1985) 18: 255-298 p256 [↑](#footnote-ref-795)
796. Quoted by Stephen Shapin in Property, Patronage and the Politics of Science, *British Journal for History of Science* (1974) *vii* 1-41, p9 [↑](#footnote-ref-796)
797. Roger Emerson, The Philosophical Society of Edinburgh 1768-1783 *BJHS* p286 [↑](#footnote-ref-797)
798. Roger Emerson, *Academic Patronage in the Scottish Enlightenment,* p121 [↑](#footnote-ref-798)
799. Hugh Miller, *Edinburgh and its Neighbourhood Geological and Historical with the Geology of the Bass Rock* (Edinburgh: Adam and Charles Black 1864) p83. The book was a collection of his writings published by his wife after his death.  [↑](#footnote-ref-799)
800. Henry Hamilton, *An Economic History of Scotland in the Eighteenth Century* p 282 [↑](#footnote-ref-800)
801. T.C. Smout in Lead Mining in Scotland p104 [↑](#footnote-ref-801)
802. John Walker, A Mineralogical Journey from Edinburgh to Elliock in *Essays on Natural History and the Rural Economy* (Edinburgh University Press 1808) pp 385-390 [↑](#footnote-ref-802)
803. Roy Porter, *The Making of Geology* p60 [↑](#footnote-ref-803)
804. Matthew Eddy, *The Language of Mineralogy* p2 [↑](#footnote-ref-804)
805. Ian H. Adams, *Scottish Geographical Magazine* (1965) *81*: 153-162 [↑](#footnote-ref-805)
806. Archibald Cochrane, Earl of Dundonald, *Thoughts on the Manufacture and Trade of Salt and on the Herring Fisheries* (Edinburgh 1784)p11 [↑](#footnote-ref-806)
807. Archibald Cochrane, p5 [↑](#footnote-ref-807)
808. For a discussion see Clows pp 46-49 [↑](#footnote-ref-808)
809. Clows p48 [↑](#footnote-ref-809)
810. These were known as magnesia salita and magnesia vitriolata, Archibald Cochrane, p16 [↑](#footnote-ref-810)
811. Roger Emerson, *An Enlightened Duke* pp 233-235

     The Board will be referred to in the rest of the chapter as the Board for the Improvement of Fisheries and Manufactures [↑](#footnote-ref-811)
812. Clows *The Chemical Revolution* p41 [↑](#footnote-ref-812)
813. Clows, p50 [↑](#footnote-ref-813)
814. Cochrane p9 [↑](#footnote-ref-814)
815. Salt pans were the large iron vessels which contained the salt while it was being evaporated. [↑](#footnote-ref-815)
816. Thompson, *Life,* p60 [↑](#footnote-ref-816)
817. Roger Emerson, *An Enlightened Duke* p143 [↑](#footnote-ref-817)
818. Roger Emerson, *An Enlightened Duke,* p232. Argyll had been in Scotland during the severe famine in the 1690s and had seen the social and economic devastation it caused. [↑](#footnote-ref-818)
819. Thompson, *Life* p70

     Roger Emerson, *An Enlightened Duke,* p144.

     Lind had undertaken experiments for the Duke in an attempt to produce alkali from limestone. [↑](#footnote-ref-819)
820. GUL MS Cullen 60 and 61 [↑](#footnote-ref-820)
821. William Brownrigg, *The Making of Common Salt* p263-4

     Brownrigg suggested adding muriatic acid in order to prevent the alkali breaking down the sodium chloride. The logic being that the acid would neutralise the alkali. [↑](#footnote-ref-821)
822. GUL Special collections, MS Cullen 60 and 61. [↑](#footnote-ref-822)
823. GUL MS Cullen 60 and 61 [↑](#footnote-ref-823)
824. GUL MS Cullen 60 [↑](#footnote-ref-824)
825. GUL MS Cullen, 60

     Cullen wrote 3 drafts of the letter [↑](#footnote-ref-825)
826. Margaret C. Jacob, *Scientific Culture and the Making of the Industrial West* (New York Oxford: Oxford University Press 1997) pp 117-118 [↑](#footnote-ref-826)
827. It is interesting to note that none of the students’ notebooks contains any reference to salt manufacture. [↑](#footnote-ref-827)
828. Jan Golinski, *Science as Public Culture* page 35 [↑](#footnote-ref-828)
829. Thompson, *Life* page 75.

     Also GUL MS Cullen 60 and 61. Both manuscripts seem to be drafts of a letter sent to the Duke in 1751

     See also A.L. Donovan, *Philosophical Chemistry in the Scottish Enlightenment* p84 [↑](#footnote-ref-829)
830. Clows, p173 [↑](#footnote-ref-830)
831. Roger Emerson, *An Enlightened Duke* p 235 [↑](#footnote-ref-831)
832. Alistair Durie, *The Scottish Linen Industry* p 9 [↑](#footnote-ref-832)
833. Alistair Durie, *The Scottish Linen Industry in the Eighteenth Century* (Edinburgh: John Donald and Son 1979) p5

     Cullen’s description of the way alkali was produced is given in Chapter 4 [↑](#footnote-ref-833)
834. Alistair Durie, *The Scottish Linen Industry,* p9 [↑](#footnote-ref-834)
835. Clows, *The Chemical Revolution* pp 65-68 [↑](#footnote-ref-835)
836. Clows p 66 [↑](#footnote-ref-836)
837. Wellcome Institute MS 1926 p 23 [↑](#footnote-ref-837)
838. Clows p 66. [↑](#footnote-ref-838)
839. Thompson, *Life* p76 [↑](#footnote-ref-839)
840. Roger Emerson, *An Enlightened Duke* p 147 [↑](#footnote-ref-840)
841. Roger Emerson, *An Enlightened Duke,* p 139 [↑](#footnote-ref-841)
842. GUL, MS Cullen 60 and 61 contain drafts of letter to the Duke. The fact that Cullen needed to write two long drafts before he sent the letter suggests that he attached great importance to it. [↑](#footnote-ref-842)
843. John Mitchell, An Account of the Various Kinds of Pot-Ash *Philosophical Transactions of the Royal Society of London* (1748) *45*: 541-563 [↑](#footnote-ref-843)
844. Salt in this context must be the chemical term for alkali and not just sodium chloride [↑](#footnote-ref-844)
845. Gmelin was the son of a Tubingen professor, a doctor and a chemist who went to St Petersburg to teach and undertook a journey to the Kamchatka peninsula to collect botanical specimens. [↑](#footnote-ref-845)
846. Thompson, *Life* p77 [↑](#footnote-ref-846)
847. Thompson, *Life* p79 [↑](#footnote-ref-847)
848. Thompson, *Life* page 78 [↑](#footnote-ref-848)
849. DNB [↑](#footnote-ref-849)
850. Thompson, *Life* page 79 [↑](#footnote-ref-850)
851. Ian Simpson Ross, *Lord Kames and the Scotland of his Day* p315.

     The government returned the estates at the end of the century. In the meantime, the confiscations enabled men like Kames and Deskford to use their ideas to try and improve the lands concerned. [↑](#footnote-ref-851)
852. Ian D. Whyte, *Scotland’s Society and Economy in Transition 1500-1760* (Basingstoke London: Macmillan Press 1997)p113.

     Forty one estates were annexed, 13 of these passed to the Crown and were managed by Board for the Annexed Estates. In Whyte’s opinion, “Much of the well intentioned paternalism had little effect.” [↑](#footnote-ref-852)
853. DNB Cullen [↑](#footnote-ref-853)
854. Thompson, *Life* p76. [↑](#footnote-ref-854)
855. Clows, p 69, cited the opinion of Ebenezer McCulloch who also investigated kelp and concluded it was only suitable for glass making.

     Durie, *The Linen Industry in Eighteenth-Century Scotland,* p 84.

     With the benefit of hindsight, Durie concluded that the practical results were negligible because “kelp stained the linen yellow” and fern ash was “too dirty unless burned twice, when it became too expensive.” [↑](#footnote-ref-855)
856. Thompson, *Life* pp 76-77 [↑](#footnote-ref-856)
857. Margaret C. Jacob, *Scientific* *Culture* *and* *the* *Making* *of* *the* *Industrial* *West*, (New York, Oxford: Oxford University Press 1997) p170 [↑](#footnote-ref-857)
858. Margaret C. Jacobs, *Scientific Culture and the Making of the Industrial West* p170 [↑](#footnote-ref-858)
859. Roger Emerson, *An Enlightened Duke* p155-162 [↑](#footnote-ref-859)
860. Thompson, *Life* pp 86-90 [↑](#footnote-ref-860)
861. Thompson, *Life,* p 90 [↑](#footnote-ref-861)
862. Peter J. Bowler and Iwan Reece Morgan *Making Modern Science* p 329 [↑](#footnote-ref-862)
863. A good example was William Whewell (1794-1866), who held the Chair of Mineralogy in Cambridge from 1829 to 1832 and then transferred to the Chair of Moral Philosophy at the same university, which he held from 1838 to 1855. [www.britannica.com/biography/William-Whewell](http://www.britannica.com/biography/William-Whewell) (Consulted August 10th 2019) [↑](#footnote-ref-863)
864. Charles Camic, *Experience and Enlightenment* p165 [↑](#footnote-ref-864)
865. Roger Emerson, The Contexts of the Scottish Enlightenment in *Cambridge Companion to the Scottish Enlightenment,* edited by Alexander Brodie (Cambridge: Cambridge University Press 2003) p10 [↑](#footnote-ref-865)
866. David Hume, *Essays Moral and Political* edited by Eugene F. Millar (Indianapolis: Liberty Classics 1987) p 127 [↑](#footnote-ref-866)
867. Steven Shapin in *Cambridge History of Science* p165 [↑](#footnote-ref-867)
868. Stephen Shapin, *Cambridge History of Science* p160. Inverted commas in the original. [↑](#footnote-ref-868)
869. Steven Shapin and Arnold Thackery, Prosography as a Research Tool in the History of British Science: History of the British Scientific Community 1700-1900, *History of Science* (1974) *12*: 1-28, p1 [↑](#footnote-ref-869)
870. James Anderson, *The Bee 1791,* January 12th page 45 Emphasis in the original [↑](#footnote-ref-870)
871. Guenter Risse, *Hospital Life in Enlightened Scotland* p244 [↑](#footnote-ref-871)
872. Lisa Rosner, *Medical Education in an Age of Improvement* p58 [↑](#footnote-ref-872)
873. Pierre Bourdieu, *Homo Academicus* pp58-59 [↑](#footnote-ref-873)
874. Mathematics was well taught in Glasgow. [↑](#footnote-ref-874)
875. Thompson, *Life* p545 [↑](#footnote-ref-875)
876. William Lewis, *Commercium Philosophico-Technium or the Philosophy of Commerce of Arts* (London 1763) p xiv [↑](#footnote-ref-876)
877. Simon Schaffer and Steven Shapin, *Leviathan and the Air Pump: Hobbes, Boyle and the Experimental Life* (Princetown N.J.: Princetown University Press 1985) p131 and p261 [↑](#footnote-ref-877)
878. William Lewis, *Commercium Philkosophico-Technium,* p iii [↑](#footnote-ref-878)
879. Rosemary O’ Day, *The Professions in Early Modern England,* p 224 [↑](#footnote-ref-879)
880. For a discussion of the varying types of medical students and their educational needs see J. Johnson, *A Guide for Gentlemen studying Medicine at the University of Edinburgh* (1792) pp 54-67 [↑](#footnote-ref-880)
881. Larry Stewart, Public Lectures and Private Patronage *Isis* (1986) *77*: 47-58 [↑](#footnote-ref-881)
882. Linda Colley, *Britons,* p56 [↑](#footnote-ref-882)
883. J.A. Sharpe, *Early Modern England: A Social History 1550-1760* (London: Arnold 1997) p352 [↑](#footnote-ref-883)
884. During the eighteenth century, the number of men entitled to vote in Scotland was approximately 3,100 or 0.2% of the population. The number of voters in the whole of Scotland was smaller than the number of voters in the city of Dublin. T. M. Devine, *The Scottish Clearances,* p122 [↑](#footnote-ref-884)
885. Roger Emerson, *An Enlightened Duke,* p348 [↑](#footnote-ref-885)
886. Wellcome, MS 49 pp 8-25 [↑](#footnote-ref-886)