

Science and patronage in early modern England – a preliminary study.

Stephen Pumfrey and Frances Dawbarn (University of Lancaster, U.K.)

(Currently copyright of the authors. Not to be cited without permission. A version to be published in *History of Science* vol. 41 [1993].)

1. Introduction.

In the last fifteen years our understanding of the development of late Renaissance and early modern science has been transformed by the application of patronage studies to the production of natural knowledge. As historians of other forms of cultural production, from high art to popular theatre, from confessional apologetics to country houses, had long been aware, patronage was ubiquitous in sixteenth and seventeenth century Europe.¹ Courtly, aristocratic, ecclesiastical and, increasingly, mercantile patrons provided most of the positions for men (and some women) with intellectual and practical skills but limited socio-economic autonomy. These clients' careers, the cultural and material goods they produced, even the nature of the professions they pursued, depended upon the complex sets of interests that structured the field of patron-client relations. Such also was the dependence of most English makers of natural knowledge during the period of this study, 1570-1625. It was especially true of those working outside universities, ranging from elevated court physicians and philosophers through projectors and private tutors to more humble mathematical and mechanical practitioners.

The sociological turn in the history of science transformed the significance of patronage. If the disciplinary frameworks, material practices and intellectual content of forms of natural knowledge were strongly shaped by the cultural and institutional contexts in which they were developed then, potentially, early modern systems of patronage not only sustained but also

¹ There is an extensive literature on patronage other than of natural knowledge. The most influential for this study include: Stephen Greenblatt, *Renaissance self-fashioning from More to Shakespeare* (Chicago, 1980); Robert C. Evans, *Ben Jonson and the poetics of patronage* (London, 1989); Linda Levy-Peck, *Court patronage and corruption in early Stuart England* (London, 1993); Iain Fenlon, *Music and patronage in sixteenth century Mantua* (Cambridge, 1982); Rona Goffen, *Piety and patronage in Renaissance Venice: Bellini, Titian, and the Franciscans* (New Haven, Connecticut, 1986); Pauline Croft (ed.), *Patronage, culture and power: The early Cecils* (New Haven and London, 2002); Bram Kempers (trans. Beverley Jackson), *Painting, power and patronage: the rise of the professional artist in the Italian Renaissance* (London, 1992); Guy Fitch Lytle and Stephen Orgel, *Patronage in the Renaissance* (Princeton, 1991); Eleanor Rosenberg, *Leicester: patron of letters* (New York, 1976); Graham Parry, *The golden age restor'd: The culture of the Stuart court, 1603-1642* (Manchester, 1981); Jonathan P. Wainwright, *Musical patronage in seventeenth century England: Christopher, first baron Hatton (1605-1670)* (Aldershot, 1997); Rosemary O'Day, *The English clergy: The emergence and consolidation of a profession 1558-1642* (Leicester, 1979); Claire Cross (ed.), *Patronage and recruitment in the Tudor and early Stuart church* (York, 1996); Natalie Zemon-Davis, *The gift in sixteenth century France* (Oxford, 2000).

controlled innovation. Recent studies such as Westman's and Biagioli's on new courtly astronomers like Galileo, Findlen's on naturalists like Aldrovandi and Kircher, and Moran's on chemical philosophers like Hartmann, have actualised the potential.²

Of course, historians of English science knew from the biographies of actors like John Dee and William Harvey that they depended, at least for their financial and material support, upon patronage just as much as Kepler, Galileo or della Porta.³ They also knew that, as in other countries, Oxford and Cambridge universities, the traditional sites of knowledge making in natural philosophy and its related disciplines, were challenged and even surpassed by new, primarily courtly sites where the operation of patronage was more visible.⁴

Nevertheless, until this study of Elizabethan and Jacobean patronage, England has not received the attention given to other European courts in Italy, Germany, France or even Denmark. Whilst the products were not so spectacular, England was emerging from its position as a cultural backwater in natural knowledge, although its influence grew most after the deaths of James I and Francis Bacon in 1625 and 1626. England fostered numerous individuals with an international reputation. The best known were John Dee, Thomas Digges, Thomas Harriot, William Gilbert, Edward Wright, Francis Bacon, William Harvey, Theodore Mayerne, Cornelis Drebbel and Isaac Casaubon. The last three names prove that leading foreign experts were once again accepting English patronage, even if Kepler declined James I's invitation.⁵ It produced Allen Debus's 'English Paracelsians' and other proponents of heterodox medical philosophy and practice.⁶ Moreover, London, with its burgeoning international role as a trading and military centre, hosted a large community of practitioners of mathematical, mechanical and other 'arts', and a larger audience of private patrons and a paying public for their work. Gresham College, founded in 1597 but planned earlier, partially answered calls and proposals for new institutional initiatives, such as

² See p. 7 below.

³ Nicholas Clulee, *John Dee's natural philosophy: between science and religion* (London, 1988); Peter J. French, *John Dee: The world of an Elizabethan magus* (London, 1972); Geoffrey Keynes, *The life of William Harvey* (Oxford, 1966) is the fullest recent biography; Max Caspar (trans. C. Doris Hellman), *Kepler* (London and New York, 1959); Pietro Redondi (trans. Raymond Rosenthal), *Galileo heretic* (Princeton, 1987); Mario Biagioli, *Galileo, courtier: The practice of science in the culture of absolutism* (Chicago, 1993); Paula Findlen, *Possessing nature: museums, collecting and scientific culture in early modern Italy* (Berkeley, California, 1994).

⁴ The argument for traditionalism was made by W. T. Costello, *The Scholastic Curriculum at Early Seventeenth-Century Cambridge* (Cambridge, Mass., 1958). Costello's picture of stasis has been challenged recently, notably in Mordechai Feingold, *The Mathematicians' Apprenticeship: Science, Universities and Society in England; 1560-1640* (Cambridge, 1984), by Lesley Cormack, *Charting an empire: geography at the English universities, 1580-1620* (Chicago, 1997) and, for a later period by Barbara Shapiro, "The Universities and Science in Seventeenth-Century England", *Journal of British Studies*, 10, 1971, 47-82. The issue is discussed in section 6 below.

⁵ Caspar, *Kepler* (ref. 3), 252; *Encyclopedia Britannica* (London, 1911), s.v. "Kepler, Johannes".

⁶ Allen Debus, *The English Paracelsians* (New York, 1966); Frances Dawbarn, 'Conflict in early modern London: the College of Physicians and courtly patronage', unpublished Ph.D. dissertation, Lancaster University, 2000.

Humphrey Gilbert's plan for 'The Queen's Academy', which he presented to Elizabeth in 1573.⁷ Besides this well-documented activity, a host of forgotten petitioners also put their talents at the disposal of English aristocrats and courtiers. Moreover, as Bennett, Johnston and others have shown, individuals such as Robert Norman, William Bedwell and Thomas Hood typified instrumental and quantitative approaches that shaped England's influential development of experimental mechanical philosophy.⁸

Even Johnston, however, is pessimistic about the value of studying English courtly patronage. Writing specifically of English mathematical practitioners, he asked where they could work. On the continent

royal courts provided an important answer. But England did not have a court culture which could offer substantial support to the activities of a mathematician. There was no equivalent to the courts of William IV of Hesse-Cassel or Rudolph II of Prague[.]⁹

In this paper we develop a distinction between what we call, a little anachronistically, utilitarian and ostentatious patronage of natural knowledge. The problem, we suggest, is that Wilhelm's and Rudolph's courts offered particular kinds of ostentatious patronage, producing particular kinds of natural knowledge. That patronage style and its products were, by definition, visible, lavish, innovative and often controversial. Galileo's services to Cosimo de Medici can be seen as classically ostentatious, certainly in comparison to those he provided for the Venetian state.¹⁰ Our research confirms that there was indeed "no equivalent" to such courts and, that "substantial support", at least on Wilhelm IV's extraordinarily munificent scale, was lacking in England.

Like Galileo, John Dee aspired to patronage for more than utilitarian services. Indeed, he argued for the broader philosophical importance of mathematics in his extraordinary preface to

⁷ Francis Ames-Lewis, *Sir Thomas Gresham and Gresham College: Studies in the intellectual history of London in the sixteenth and seventeenth centuries* (Aldershot, 1999); Humphrey Gilbert 'The erection of an Academy in London for the education of her Majesties Wards and others the youth of nobility and gentlemen', BL MS. Lansd. 98, ff.2-9. See also Sir Humphrey Gilbert, *Queen Elizabeth's Academy* (ed. F.J. Furnivall) (London, 1869).

⁸ Stephen Johnston, "Mathematical Practitioners and Instruments in Elizabethan England", *Annals of Science*, xxxviii (1991), 319-433; J.A. Bennett, "The Mechanics' Philosophy and the Mechanical Philosophy", *History of Science*, xxiv (1986), 1-27.

J.A. Bennett, "Geometry and Surveying in Early Seventeenth-Century England", *Annals of Science*, xxxviii (1991), 345-354; A.J. Turner, "Mathematical Instruments and the education of gentlemen", *Annals of Science*, xxx (1973), 51-88.

⁹ Johnston, (ref.8), 243.

Henry Billingsley's edition of Euclid's *Elements*, published in 1570 - one reason we have for beginning this study in that year.¹¹ By 1577 he had been patronised by several nobles for work in practical mathematics, but none had shown interest in his philosophical work. He appended an anonymous 'Necessary Address' to a tract on navigation. In it, he wrote of himself, Dr Dee "had found a constant and assistant CHRISTIAN ALEXANDER, BRYTAN should not have now bin destitute of a CHRISTIAN ARISTOTLE".¹² He wanted a grand patron for his grand projects, and he was disillusioned that the Queen of England (or "Brytan" - a political entity he helped Elizabeth to fashion) did not help him. In 1584 he emigrated, having become a client of Prince Albrecht Laski of Poland, before moving on to the true Alexander of occultism, Emperor Rudolph II in Prague.¹³

We contend, however, that early modern England was by no means devoid of highly significant patronage. Rather, England exemplifies the historical significance of another, more utilitarian system. Developing Bruce Moran's suggestion, we hypothesise that English patronage developed to suit the needs of consolidating, imperialising, primarily North European, independent nation states.¹⁴ We also suggest that specific circumstances, of intellectual geography, court structure, economic and political concerns and religious history, combined to give English patronage, and much of the natural knowledge it supported, a specific character. It was more empirical and utilitarian, less philosophical and ostentatious than in many European states. Not so visible or spectacular, nor so well connected to multiple sources and styles of patronage, it was nevertheless ubiquitous, inescapable and determining.

This article has two main purposes. One is to share the results of our preliminary empirical research into the patronage of Elizabethan and Jacobean science. The second is to make some tentative suggestions about how and why English patronage shaped natural knowledge in different ways from those in the well-known continental case studies. For example, we believe that patronage helps to explain why none of the surprisingly numerous Copernicans in Elizabethan England went on to contribute significantly to the creation of a new physical astronomy. We also suggest that Bacon's proposals for a new, institutionalised natural philosophy can partially be read as a codification of existing patronage practices.

¹⁰ Biagioli, *Galileo, courtier* (ref.3).

¹¹ *The Elements of Geometrie... now first translated into the English tongue, by H. Billingsley [with a preface by...] M. J. Dee, specifying the chiefe Mathematicale sciences, what they are, etc* (London, 1570).

¹² J. H. Crossley (ed.), *Autobiographical Tracts of John Dee* (Manchester, 1851), 50-67, .50.

¹³ I. Seymour, "The political magic of John Dee", *History Today*, Jan. 1989, pp. 29-35; Nicholas Clulee (ref.3), 196-8.

¹⁴ See Bruce Moran, "Patronage" in Wilbur Applebaum (ed.), *Encyclopedia of the Scientific Revolution: From Copernicus to Newton* (New York, 2000), 484-8.

2. The current state of patronage studies.

The importance of courtly sites to the evolution of post-scholastic forms of natural knowledge during 'the scientific revolution' has been superbly established by several historians. Few of their conclusions, however, transfer easily to the English context.

A powerful case was first made in 1980 with Robert S. Westman's 'The Astronomer's Role in the Sixteenth Century: A Preliminary Study'.¹⁵ Westman proposed that courts emerged as crucial alternative sites, where traditional disciplinary boundaries could be challenged and transgressed, specifically in the creation of a new, physical astronomy. Universities maintained the traditional disciplinary divide between the high status natural philosophical practice of cosmology, which dealt with causal explanations of the heavens, and the lower status, non-causal practice of mathematical astronomers. Such institutional divisions and values were less evident in courts. The system of court patronage brought clients from different disciplines into working relationships. It permitted clients to negotiate new roles. Some courts also encouraged innovative, even radical work, as signs of their cultural independence and dynamism.

Consequently, some court astronomers, protected by their patrons, were able to fashion a new role which included making knowledge claims (even Copernican ones) about the physics of the heavens. In the case of England, if F.R. Johnson exaggerated the number of Copernicans,¹⁶ there was still a considerable number, disproportionate to its international standing. Among the handful of proponents of the Earth's motion before 1601 were Thomas Digges, Thomas Harriot, William Gilbert and Edward Wright. Dubious claims have also been made for others such as Robert Recorde.¹⁷ All worked outside Oxbridge and depended upon patronage, yet none contributed significantly to the new physical astronomy, despite a relative lack of religious opposition. In this case at least, the English court does not seem to have supported disciplinary innovation.¹⁸

If Westman proposed a totalising model of the role of court patronage in the emergence of physical astronomy then Mario Biagioli provided a micrological account of the most famous new

¹⁵ Robert S. Westman, 'The Astronomer's role in the sixteenth century: a preliminary study', *History of Science*, xviii (1980), 105-47.

¹⁶ Francis R. Johnson, *Astronomical thought in Renaissance England: A study of the English scientific writings from 1500-1645* (New York, 1937).

¹⁷ Westman, 'Astronomer's role' (ref. 13), 106 stated that '[b]etween 1543 and 1600 I can find no more than ten thinkers who choose to adopt the main claimMS. of heliocentric theory.' In n. 6 he lists Thomas Digges and Thomas Harriot, and the 'weak or inconclusive' case of Recorde. Gilbert does not count because, whilst he almost certainly accepted the Earth's motion, he did not accept Copernicus' astronomical arguments. The biggest group was of Germans, with Italy second equal to England but, as we argue, England did not share the patronage systemMS. of Germany and Italy.

¹⁸ See section 4 below.

astronomer, Galileo. In *Galileo, Courtier* Biagioli interpreted both Galileo's career and work as the response of a client to the opportunities and constraints of his various patronage and court contexts. Even allowing for criticisms of excessive reductionism, Biagioli conclusively demonstrated the explanatory power of patronage in the construction of early modern science.¹⁹

The closest parallels to Galileo in England were Thomas Digges and Thomas Harriot, who has indeed been called 'the English Galileo'.²⁰ We shall see that Digges' and Harriot's careers and output are just as open as Galileo's to being read in terms of patronage culture. Yet neither they, nor any other Englishman, with the exception of Robert Fludd (a client of James I) succeeded in using the patronage system to create what we call ostentatious natural philosophy.²¹ There was never any concerted courtly support for new philosophy of the kind that Shackelford has identified for Danish Paracelsism.²² Nor is there any English equivalent to J.J. Becher who, as Pamela Smith has demonstrated for a slightly later period, succeeded in manipulating the patronage system to alter the Holy Roman Imperial Court's interest in alchemy from occultism to a 'modernised' business.²³

Another pioneer, Bruce Moran, has demonstrated the importance of 'prince-practitioners' - hands-on patrons - to the development of new disciplines such as observational astronomy and chemical philosophy in German courts such as Hesse-Cassel.²⁴ The early Copernican Christoph Rothmann worked alongside Wilhelm IV in Hesse, whilst the iatrochemist Georg Hartmann of Marburg was personally selected by Wilhelm's son Prince Maurice.²⁵ Elizabethan England's closest approximation to a prince-practitioner was Henry Percy, 9th Earl of Northumberland, whose genuine personal interest in mathematics, occult and other natural philosophy translated into his patronage of Harriot and others. But Percy was a rare exception; moreover, for much of

¹⁹ Biagioli (ref. 3). The most critical opinion is Michael J. Shank, "How Shall We Practice History? The Case of Mario Biagioli's Galileo, Courtier," *Early Science and Medicine* i (1996), 106-150.

²⁰ The identity was developed by Jean Jacquot in his 'Harriot, Hill, Warner and the new philosophy' in J.W. Shirley (ed.), *Thomas Harriot. Renaissance scientist* (Oxford, 1974), 107-28, e.g. 107, 115. The question is still debated. A paper by Matthias Schemmel, 'Was Thomas Harriot an English Galileo', was included in the programme of the Durham Thomas Harriot Seminar, 16-18 December, 2002.

²¹ The Dutch recipient of James' patronage, Cornelis Drebbel, is another example. See section 5 below.

²² Joel Shackelford, "Paracelsianism and patronage in early modern Denmark", in *Patronage and institutions: science, technology and medicine at the European court, 1500-1750*, Bruce T. Moran (ed.) (Suffolk, 1991).

²³ Pamela H. Smith, *The business of alchemy: science and culture in the Holy Roman Empire* (Princeton, 1994).

²⁴ See for example Bruce T. Moran, "German Prince-Practitioners: Aspects in the Development of Courtly Science, Technology, and Procedures in the Renaissance," *Technology and Culture*, xxii (1981), 253-274.

²⁵ Bruce T. Moran, "Privilege, Communication and Chemistry: the Hermetic-Alchemical Circle of Moritz of Hessen-Kessel", *Ambix*, 32 (1985), 110-126; *The alchemical world of the German court: occult philosophy and chemical medicine in the circle of Moritz of Hessen* (Stuttgart, 1991); "Wilhelm of Hesse-Kassel: Informal Communication and the Aristocratic Context of Discovery", *Scientific discovery: case Studies*, Thomas Nickels (ed.) (Dordrecht, 1978), 67-96; Percy, Ninth earl of Northumberland (G.B. Harrison, ed.), *Advice to his son* (London, 1930); G.R. Batho, "The library of the 'Wizard' earl: Henry Percy ninth earl of Northumberland (1564-1632)" *The Library*, 5th series, xv. no. 1 (1960), 246-261; John William Shirley, "The scientific experiments of Sir Walter Raleigh, The Wizard Earl, and the three magi in the Tower 1603-1617", *Ambix*, iv (1945-51), 52-66.

his life he was a marginal, oppositional figure, imprisoned on suspicion of treason from 1606 to 1621, whose patronage power was thereby limited.²⁶

Our last relevant example is Paula Findlen's *Possessing Nature*.²⁷ Findlen has shown the intimate connections between the new culture of natural history, of collecting, taxonomising and displaying nature, to patronage. In the case of Aldrovandi, this natural history depended upon patrons' interests in the self-aggrandising benefits, both political and scholarly, of possessing such collections, as well as the immense patronly resources and contacts necessary to assembling them.

There is little evidence that English patrons shared these ostentatious interests. For them, possessing nature primarily meant the utilitarian concerns of mapping territory, making inventories of natural resources and exploiting them. Moreover, the English patronage system did not offer clients the richness of material and social resources to undertake projects such as Aldrovandi's. John Gerard's failure, despite the backing of his patron Cecil, to create a physic garden for Cambridge University is a modest case in point.²⁸

Our study of English patronage of natural knowledge suggests that, while the ubiquity of its patronage system was comparable to that of other European monarchies, it is not another example of the primarily Italian and German princely courts that have attracted scholarly attention.

2.1 The patronage of natural knowledge: systems and interests in early modern Europe.

Patronage was, primarily, a political system, and scientific patronage operated by similar rules. A client could increase his status and power either by acquiring a patron at the top of the hierarchy, or by building up a portfolio of lesser patrons. To be identified with a single, powerful patron brought great rewards, but also dangers. After Cecil's death, Francis Bacon was temporarily tainted by his association with Essex (and later his role in Essex's fall from Elizabeth's favour) whilst Harriot suffered from the successive disgraces of Raleigh (also associated with Essex) and Percy. Multiple patrons allowed a client to survive such vicissitudes. The mathematician John Blagrove wisely cultivated several patrons.²⁹

²⁶ Gordon R. Batho. "Thomas Harriot and the Northumberland Household" in Robert Fox (ed.), *Thomas Harriot. An Elizabethan man of science* (Aldershot, 2000), 28-47; John W. Shirley, "Sir Walter Raleigh and Thomas Harriot" in John W. Shirley (ed.), *Thomas Harriot, Renaissance scientist* (Oxford, 1974), 16-35.

²⁷ Findlen, *Possessing Nature* (ref. 3).

²⁸ See section 3.3 below.

²⁹ Lisa Jardine and Alan Stewart, *Hostage to fortune: The troubled life of Francis Bacon, 1561-1626* (London, 1998); Steven A. Walton, *Thomas Harriot's ballistics and the patronage of military science* (University of Durham, 1991);

Like other forms, scientific patronage also worked indirectly and discreetly, often through patronage brokers. A key broker in Elizabethan England was Michael Hickes, secretary to William Cecil. In James's reign, Adam Newton advanced many, especially himself, using the brokerage that flowed from his position as tutor to Henry, Prince of Wales.³⁰ Gabriel Harvey, an Earl of Leicester client and briefly his secretary, had especially good contacts with London's mathematical practitioners.³¹

Patronage, then, formed an elaborate network linking many social groups and levels. Like a successful bureaucrat, a successful practitioner of natural knowledge, especially one engaged in complex projects, was at the centre of a rich web of patron-client relations. They ensured that a variety of intellectual, social and material needs were continuously met despite the uncertain nature of court patronage. Probably the most richly connected client was the Bolognese naturalist Ulisse Aldrovandi. The multiple networks which Findlen shows that Aldrovandi exploited allows us to classify the diverse systems of patronage available to many European practitioners.

One purpose of the following classification is to indicate the limited resources and sources of patronage available to English practitioners compared with those in other European states. Patronage networks facilitated the connections available to clients, to multiple sources of wealth and power, to a variety of patronly interests, to other clients from diverse disciplines, and to diverse sites of knowledge production such as universities, informal academies, and centres of practical expertise. We conclude this article by suggesting the importance of what we call connectivity to early modern production of natural knowledge. For a variety of contingent reasons, English clients were poorly connected.

The top tier consists of court patronage proper. The most geographically expansive was imperial patronage. The classic example is that of the Holy Roman Imperial court at Prague, which Rudolph II turned into a centre for occult philosophy and natural magic. One could include here the Papal and Spanish courts. Whilst Aldrovandi had connections to all of these, residents of Anglican England did not.

The courts of monarchical nation states, such as France, England, and the Scandinavian countries, were different. Their spheres of political and cultural control were geographically coincident, and their policies concerned territorial consolidation and expansion. England was

Batho in Robert Fox (ed.), *Thomas Harriot* (ref. 26). Blagrave's patrons include Sir Thomas Parry, Sir Francis Knollys, William Cecil, Lord Burghley, Lord Charles Howard, Baron of Effingham, Lord High Admiral of England.

³⁰ Alan G.R. Smith, *Servant of the Cecils: The life of Sir Michael Hickes* (Totowa, New Jersey, 1977); Roy Strong, *Henry Prince of Wales and England's lost Renaissance* (London, 2000).

³¹ In one of a well-known series of marginalia to his copy of John Blagrave's *Mathematical Jewel* (London, 1585), Harvey recommends on the title page 'mie mathematical mechanicians' James Kynvin and Humphrey Cole, as well as 'Jon Reynolds, Jon Redd, and Christopher Payne', who were in turn recommended to him by his fellow Leicester clients Thomas Digges and Cyprian Lucar. See the British Library copy, shelf mark 1653/294.

especially concerned with repulsing the Spanish threat, expanding its American colonies, subjugating Ireland and, under the Stuarts, integrating England and Scotland.

Different again were the princely courts of the city states that made up much of Italy and Germany. These were client states, dominated by Europe's dynastic powers, and subject to their more powerful patronage. They had limited political autonomy and, therefore, less preoccupation about territorial boundaries. As Findlen has suggested, such states directed their efforts at pre-eminence into cultural competition.³² That is why Cosimo patronised Galileo. England was not such a polity.

In none of these courts was patronage monolithic. Indeed, there were several causes promoting diversity. First, patronage was the main tool rulers had for maintaining a balance of power and range of options. Aristocratic factionalism was inevitable but if rival factions were balanced by shifting flows of largesse, it could be turned to advantage. Devolution of patronage to an inner circle of trusted advisors-cum-intermediaries also encouraged diversity. Rulers allowed different factions to promote different political, religious or cultural policies, thereby disguising their own allegiances, changes of mind or uncertainties. This was Elizabeth I's favourite strategy. Radical redistribution of patronage (often involving the 'fall of the favourite' which Biagioli considers was Galileo's fate -as it was certainly Raleigh's) satisfied frustrated ambitions and ensured the entry of new talent. Finally, when a ruler had a spouse and children, as Elizabeth I did not, they built up distinct satellite courts. Under James I, Prince Henry's court became the focus of cultural and scientific activity whilst Anna of Denmark's provided noblewomen with the considerable cultural influence they exercised in Denmark.³³

Of course, the oligarchs of political entities such as Venice, Bologna, German 'free cities' and Swiss cantons had considerable powers of patronage, notably over the appointment of physicians and university faculty, even if there was no court as such. As humanistic values spread through Europe, these regional elites extended their patronage to support small, informal academies and coteries of intellectuals, most of whom gained their primary income from other, more formal state positions. 'Court' patronage thus shades into aristocratic patronage. Once again, England's political structure precluded much of this diversity. Percy was rare, perhaps unique, in maintaining a quasi-autonomous philosophical academy.³⁴

A parallel, overlapping network of patronage was ecclesiastical. After the Reformation, the Roman Catholic Church continued to operate an extensive system. Indeed, as it lost territory,

³² Findlen (ref. 3), 347 and passim.

³³ See John Robert Christianson, *On Tycho's island: Tycho Brahe and his assistants* (Cambridge, 2000), 14ff.

its policy of Counter-Reformation actually increased resources in an effort to consolidate at least its ideological and cultural hegemony. Catholic patronage had the unusual feature that, when popes died or papal legates were replaced, their successors frequently sidelined incumbents, to whom they had no obligations. They promoted their own networks and intellectual interests.³⁵ Obviously, English practitioners had no access to the richness or diversity of Catholic patronage.

The growing confessional divides between Catholic, Lutheran, Calvinist and Anglican states significantly disrupted the circulation of personnel, and to some extent practices and ideas, if not of artefacts such as books, instruments and specimens.³⁶ The closer integration of church and state in Protestant countries, especially England, tended to lessen the distinction between ecclesiastical and political patronage. More significant than explicitly ecclesiastical patronage was the rise of religious orthodoxy as a factor in patronage choices and networks. Some connections were forged between continental Calvinists and English puritan patrons and clients. It was through these that Lambert Daneau's *Physica Christiana* was translated into English by a client of Francis Walsingham.³⁷ But, since England was struggling to secure an independent Anglican religion, the connections were fewer.

Early modern practitioners had two relatively new sources of patronage, which were well developed in England. There were new corporations such as the College of Physicians, founded 1518, but still attempting to secure its influence, the Muscovy and East India Companies of merchant adventurers and Gresham College. The newest patron, in some scholars' interpretations, was 'the public'.³⁸ By the turn of the seventeenth century several countries, including England, had a flourishing commercial press and an audience willing to consume vernacular works. In science these were mainly of a practical or instructional nature.

Whilst public opinion would increasingly supplant elite patronage as the measure of scientific credibility, serious and innovative natural philosophers still required it for their livelihood and reputation. We believe that, compared with Italians like Aldrovandi or Galileo, English practitioners depended upon a limited network centred on the royal court, with a concomitant limitation of resources, interests and personnel.

³⁴ Timothie Bright, a Cecil client, said that William Cecil's house was akin to a university. See William J. Carlton, *Timothie Bright, Doctor of Physicke* (London, 1911), 28-9. We have yet to investigate the claim. Sir Philip Sidney might be another example.

³⁵ See, for example, Biagioli (ref.3), ch. 5, on Galileo and Barbarini (Urban VIII), and Findlen (ref.3), 357.

³⁶ Luce Giard, "Remapping Knowledge, Reshaping Institutions", in S. Pumfrey, P. L. Rossi and M. Slawinski (eds), *Science, Culture and Popular Belief in Renaissance Europe (Manchester, 1991)*, 19-47.

³⁷ See section 3.2 below.

³⁸ Arthur F. Marotti, "Poetry, Patronage and Print", in Cedric C. Brown (ed.), *Patronage, Politics, and Literary Traditions in England, 1558-1658* (Detroit, 1993), ch. 1.

Having reviewed forms of patronage, we move on to the interests of patrons in natural knowledge. The purpose of this analysis is to show that, whilst many interests were represented in England, utilitarian ones predominated.

We might list first direct self-interest. The financial drains of patronage obligations and conspicuous consumption led some to back alchemical projects. Elizabeth's Privy Counsellors were no exception.³⁹ Princes and leading aristocrats routinely retained experts in medicine and astrology (frequently the same person), to advise on their personal health and fortune. That rulers privately exposed to such clients their physical and mental worries explains why they often chose (or suspected) them to be special emissaries or spies. Elizabeth's physician-astrologers Elisha Bomelius and John Dee both came under suspicion.⁴⁰ William Paddy, one of Robert Cecil's physicians, had the code name "No. 40" in the secret negotiations that secured James I's accession.⁴¹ Cecil became James' first favourite and was made Earl of Salisbury, whilst Paddy was knighted and served James as a personal physician. Timothie Bright, a physician in Philip Sidney's circle, accompanied him on a mission to Paris, when the St Bartholomew's Day Massacre forced them to join the refugees in Sir Francis Walsingham's embassy.⁴²

Courts patronised a more eclectic range of healers than medical establishments liked, and tended to erode the formal medical hierarchy. In James's court, for example, College Galenists were forced to minister alongside favourites from the provinces, Paracelsian physicians, or unlearned specialists with reputations in 'courtly' conditions such as gout or venereal disease. Continental court patronage was vital to Gerhard Dorn's and Adam Bodenstein's work in the collation of Paracelsian texts, and to the legitimation of the innovative natural philosophies of court physicians.⁴³ The role of English court patronage in this regard needs more research, although very few court physicians made novel interventions in natural philosophy. The most famous, William Gilbert, did so with a conspicuous lack of patronly support for his magnetic philosophy.

Courtly interest underpinned the florescence of Renaissance occultism. Clients as diverse as Dee, della Porta, Brahe, Campanella and Fludd tended to ground their claims to a greater control over nature in eclectic, Neoplatonist or Paracelsian ontologies that placed greater emphasis than did Aristotelianism upon concepts of spirit, microcosm, sympathies and harmonies.

³⁹ See section 3.3 below.

⁴⁰ Hugh Trevor-Roper, "The Court Physician and Paracelsianism", in V. Nutton (ed.), *Medicine at the courts of Europe, 1500-1837* (London, 1985), 79-94. For Bomelius and Dee see sec. 3.3 below

⁴¹ Donald S. Pady, "Sir William Paddy M.D. (1554-1634)", *Medical History*, xviii (1974), pp. 68-82.

⁴² In dedicating to Sir Francis Walsingham his *Abridgement of Fox*, London, 1589. Bright mentions 'that especiall protection from the bloody massacre of Paris nowe 16 years passed...'

⁴³ Moran, "Patronage" (ref. 14), 485.

The power, novelty and heterodoxy of their occult philosophies, especially where they threatened traditional theology and metaphysics, left the exponents in need of, and good candidates for, patronly protection. In England, James I's protection of the Rosicrucian Robert Fludd and other 'Paracelsians' stands out, certainly in contrast to the reluctance of Elizabethan patrons. Dee's decision to emigrate certainly fits an image of an Elizabethan court uninterested in occult philosophy.

A few patrons had genuine intellectual interests in some aspects of science. These form the group whom Moran has called 'prince-practitioners', who conducted their own research with the help of clients.⁴⁴ Noble- or prince-practitioners were rare, however. Tycho's biography illustrates one of the obstacles. As a rich nobleman, he began by funding himself [he was a patron in his own right], but encountered resistance because mathematics was considered to be the work of non-noble professionals. Nevertheless, Tycho attracted numerous clients from all over Europe, including Kepler. The royal patronage of Frederick that Uraniborg relied upon was always contentious and when Frederick died, Tycho was forced to become a client of Rudolph II (who was more interested in Tycho's alchemy than his observational astronomy).⁴⁵ Tycho's literal ennobling of astronomy explains why Edward Wright, for example, frequently cited him in his *Certain Errors in Navigation* (London, 1599). In his preface he clearly did not expect patronage of astronomy, but expressed a:

Hope (whether vaine or no I know not) of some Mecoenas at length to be raised up at length of a munificent spirit to be raised up, though not to do as has that magnificall Tycho in his Uraniburg, ... [so that navigation] may have some increase, like as Astronomie hath much advancement by Tycho Brahe alone, who for his deserved renowne cannot be too oft named.⁴⁶

He removed the reference from the 1610 edition, when Prince Henry seemed to have Maecenas potential.

Biagioli emphasises that princes generally preferred to keep a distance between themselves and their clients' intellectual commitments.⁴⁷ As in politics, they liked to balance factions and to appear to stay above the fray of dispute. It is, therefore, not remarkable that James

⁴⁴ Moran, "Prince-practitioners" (ref. 24).

⁴⁵ Christianson, *On Tycho's island* (ref. 33), 258-4. See also Victor E. Thoren, *The lord of Uraniborg* (Cambridge, 1990).

⁴⁶ Edward Wright, *Certain Errors in Navigation* (London, 1599), 'Praeface to the Reader', 3.

⁴⁷ Mario Biagioli, 'Scientific revolution, social bricolage, and etiquette', in *The scientific revolution in national context*, Roy Porter and Mikuláš Teich (eds.) (Cambridge, 1992), 11-53. He has expanded parts of the argument, mainly for the decades following our study in Mario Biagioli, 'Etiquette, Interdependence, and Sociability in Seventeenth-Century Science', *Journal of Critical Inquiry*, xxii (1996), 193-238.

I simultaneously patronised Isaac Casaubon and Robert Fludd. James was the dedicatee of Casaubon's 1614 exposure of the antiquity of the *Corpus Hermeticum*, whilst Fludd dedicated several works to James, including the first volume of his *Utriusque Cosmi* of 1617, 'a most impressive dedication in which James is saluted as "Ter Maximus", the epithet sacred to Hermes Trismegistus, and as the most potent and wise prince in the world.'⁴⁸

Most of our scholarly knowledge of Renaissance patronage of natural knowledge concerns such controversial clients with reputations for radical innovation if not outright heterodoxy, even when, as for Fludd, historians have discarded dubious claims for them as forerunners of modern science. The values of European court culture created space for many kinds of ambitious, controversial producers of natural knowledge.

But why? A major part of the answer lies in Findlen's concept of cultural competition, from which we derive our concept of ostentatious science.⁴⁹ Once again, science was little different from other forms of cultural production. Courtly values privileged display, ostentation and excess. Just as an aristocrat's attire, retinue, manners and largesse signified his (or her) social wealth, so could the intellectual performances of his scientific clients. Natural philosophers often filled the same role as poets, musicians or rhetoricians in providing entertainment of a kind that demonstrated the patron's intellect, discernment and power. Biagioli has shown how some of Galileo's apparently combative and ill-considered writings (on the sublunary nature of comets, for example), were produced to order for set piece debates.⁵⁰ Collections of natural magic such as Della Porta's show that one of its functions was the elevated entertainment of elites. Museums and cabinets of natural history similarly allowed a patron to entertain and impress distinguished guests, as well as establishing his court as a site of scholarship.⁵¹ Many instruments commissioned by or presented to patrons have their scientific functionality literally overlaid by complex ornamentation. John Blagrave's *Mathematicall Jewell* is an English example.⁵²

We propose to call the products of such patronage 'ostentatious science', and we distinguish it (if often problematically) from our next category of 'utilitarian science'. This is not to suggest, of course, that Galileo's astronomy or Croll's chemical philosophy⁵³ were devoid of serious scientific endeavour or were mere display, or even that they consciously compromised

⁴⁸ Isaac Casaubon, *De rebus sacris et ecclesiasticis exercitationes XVI. Ad Cardinalis Baronii Prolegomena in Annales, & primam eorum partem, de Domini Nostri Iesu Christi natiuitate, vita, passione, assumptione* (London, 1614). His death prevented later volumes of this Protestant assault on Baronius; Robert Fludd, *Utriusque Cosmi majoris scilicet et minoris metaphysica atque technica historia in duo volumina secundum cosmi differentiam divisa* (Frankfurt, 1617/18); For dedication see Frances Yates, *The Rosicrucian enlightenment* (London, 1972), 78.

⁴⁹ Findlen, *Possessing Nature* (ref. 3).

⁵⁰ Biagioli, *Galileo, Courtier* (ref. 3).

⁵¹ Findlen, *Possessing Nature* (ref. 3), 227-30.

⁵² John Blagrave, *The Mathematicall Jewell* (London, 1585).

sound work with rhetorical excess. Indeed, genuine intellectual novelty and persuasive argument were highly regarded by patrons of ostentatious science.

We create the category in order to distinguish it from, and focus attention on, other forms of patronage, such as that which produced utilitarian science. We believe that the superb research conducted on ostentatious (and indeed prince-practitioner) science has misled historians, including ourselves, into using it as the model of patronage. Ostentatious science fulfilled the interests of patrons and states engaged in cultural competition. Cultural competition was, in part, a surrogate for territorial or dynastic competition – like diplomacy perhaps, the conduct of war by other means.

On this reading, it is no accident that patronage studies of natural knowledge have been dominated by work on Italian and central European (especially German) courts. These were the princely courts of rather small client states. Their borders were fixed, and their territories mapped and defined. Political change was ultimately controlled by the dynastic powers of the Spanish and Austrian Hapsburgs, France, the Pope, the Holy Roman Emperor and, later, Sweden. With no realistic expansionist or imperial ambitions, courts such as Cosimo's in Florence, Alfonso II d'Este's in Ferrara or Wilhelm's in Hesse-Cassel signified their power, vitality and limited independence internally. Cultural production and competition were key signifiers. We suggest that ostentatious science fitted the interests of client states, which could increase their cultural but not their territorial hegemony. Through his telescopic discovery of Jupiter's moons or 'Medicean stars', Galileo could offer to extend Cosimo's possessions to include the heavens, but not neighbouring states.⁵⁴

At the other extreme lay what we call utilitarian natural knowledge. As Bruce Moran has recently observed:

In northern Europe, where the consolidation of regional power gained new vigor in the sixteenth century, political and economic motives dominated in turning the attention of princes towards the patronage of practical mathematics and the mechanical arts. The identification of new sources of wealth required an exact knowledge of the prince's own sphere of political and economic influence. In this regard, mapmaking and the design of surveying instruments became important elements in defining the regional extent of the Court's legal jurisdiction and economic privileges. Navigational instruments, proportional

⁵³ Owen Hannaway, *The Chemists and the Word* (Baltimore and London, 1975).

⁵⁴ Cosimo's support of Galileo's Copernicanism signalled cultural but not de facto independence from Rome. One might suggest that when Aldrovandi's natural historical collections outgrew the flora and fauna of Northern Italy, he

compasses, triangulation instruments, mining machinery and cartographic tools became instruments of state, and the manufacture of such instruments tended to become state of the art.⁵⁵

Of course, client states continued to have considerable interests in natural knowledge and practices that could improve their economic and administrative efficiency. Moreover, there was no absolute division between utilitarian and ostentatious knowledge. New instruments or maps could be purely functional or elaborate. Claims of philosophical importance or classical precursors could be added to work that was primarily practical. The dependence of a flourishing high culture upon wealth and good governance could be emphasised, just as natural philosophers appealed to the courtly ethos of the *vita activa* by finding practical applications for their work. In any case, court culture everywhere was agonistic and competitive, governed by an aristocratic desire to *display* power, including power over nature, in accordance with humanistic codes of etiquette.

Nevertheless, our research so far suggests that the English court approached the patronage of natural knowledge with a different cluster of predominantly utilitarian interests. Elizabethan and, to a lesser extent, Jacobean courtiers and politicians were preoccupied with matters of defence and control at home, imperial expansion abroad, and economic self-sufficiency and prosperity. Catholic Ireland needed subjugation through plantation and physical might, as well as political diplomacy. Some outlying English regions, notably the Catholic North-West were not reliably governed. Scotland also posed a threat until Mary was executed and James VI's accession was secured.

In the last half of Elizabeth's reign the perceived threat of Spanish invasion and destabilisation was especially great. The survival of England as a Protestant state was held to depend upon its new and burgeoning naval prowess. If a defeat of Philip II's armada was expected, it was by no means certain. Coastal defences, like military organisation in general, were considered to be inadequate. Expeditionary forces were sent to Ireland and to the new Dutch Republic, which Leicester ingloriously commanded. Later, James I, plagued by fears of Catholic conspiracies before and after the Gunpowder Plot, actively sought a leading role in alliance of Protestant rulers as Europe headed towards the Thirty Years' War.

The economy was also poor. Elizabeth's and James's courts were in permanent financial crisis. Securing a sound and adequate money supply was perhaps the most pressing domestic

could promise possession only of an abstract, systematised nature. As political possessors of vast territories of equally vast biodiversity, the Spanish or Austrian Hapsburgs became more appropriate patrons.

problem after religion: it dominated Burghley's administration in particular. So too did the expansion of overseas trade, improved land use, the identification of natural resources and the increased production of raw materials. There were attempts to establish colonies in America. All these concerns related to England's external security – not just defence but equally prosperity to wage war and self-sufficiency in the event of war: this was Burghley's "most constant political preoccupation".⁵⁶

In short, England seems to be an archetypal consolidating Northern European state, which leads to the hypothesis that English patronage of natural knowledge differed in being less ostentatious and more utilitarian. Our initial findings confirm the hypothesis to a degree that has surprised us. There was not just less patronage of ostentatious natural knowledge, but virtually none at all! This suggests that other, more local factors besides utilitarian concerns were in play. We conclude this paper with some suggestions based on our concept of connectivity. But first we present our findings thus far.

3. The patronage of natural knowledge in early modern England.

Although it was ubiquitous, English patronage was rarely as splendid as in Europe's richer or more culturally competitive courts. Henry VIII had used patronage self-consciously to begin a belated English Renaissance, but the ensuing decades of religious and political turmoil left Elizabeth's administration in straitened circumstances. Elizabeth herself acquired a contemporary reputation for 'parsimony' in patronage,⁵⁷ but the justification remains uncertain, as does the extent to which she, as a female monarch (indeed a 'virgin queen'), devolved it to leading male courtiers such as the Earls of Leicester and Essex. Recent studies of William Cecil, Lord Burghley, and his son Robert (later made 1st Earl of Salisbury by James I) have demonstrated that 'the Cecil family were [sic] not only politically dominant, but also formed the vital centre of a network of cultural, artistic, economic and intellectual patronage unequalled in England in the second half of the sixteenth and early seventeenth centuries.'⁵⁸ Cecil was an outstanding patron, especially in his costly programme of constructing grand houses and gardens that he undertook in order to secure his (and his son's) status as Elizabeth's chief minister.

⁵⁵ Moran, "Patronage" (ref. 14), 485.

⁵⁶ Felicity Heal and Clive Holmes, "The Economic Patronage of William Cecil", in Pauline Croft (ed.), *Patronage, culture and power* (ref. 1) 199-229, 204.

⁵⁷ Levy-Peck (ref.1); Wallace T. MacCaffery, 'Place and Politics in Elizabethan Politics', in John Neale (ed.), *Elizabethan government and society* (London, 1961).

⁵⁸ Croft (ref. 1), ix; See also J. Husselby, "Architecture at Burghley House: the patronage of William Cecil, 1553-1598", unpublished Ph.D. dissertation (University of Warwick, 1996).

Our study of Elizabethan patronage of natural knowledge shows that it was certainly distributed between the main administrators and courtiers: the Queen was rarely directly involved. Since her nobles had different interests and agendas, any Elizabethan 'policy' is not easily detectable. In some areas, by the end of her reign Elizabeth emerged as a centralising patron. She amalgamated various companies of players into 'The Queen's Men', probably the better to control the religio-political content of the theatre, but we find no similar trend in natural knowledge. Nevertheless, there appears to have been a very widespread emphasis upon utilitarianism.

The accession of James VI and I brought major changes to the nature of patronage, both generally and in natural knowledge. First, James brought with him a royal family. Anna of Denmark, Prince Henry and, after his brother's premature death in 1612, Prince Charles headed influential satellite courts. The short-lived court of Prince Henry attempted to emulate the Henrician renaissance of his eponymous forebear, and included the more vigorous promotion of natural knowledge.⁵⁹

Secondly, James was a strongly centralising monarch, who sought an absolutist's influence over England's institutions and policies. Concerning the legal system, his insistence upon increasing the power of the crown over English common law and an 'independent' judiciary led by Edward Coke is well known, as is Francis Bacon's willingness to assist him. Compared with Elizabeth's administration, more patronage of natural knowledge emanated directly from the royal courts and James' succession of favourites. Moreover James effected a clearout of Elizabethan personnel when he arrived with his Scottish entourage.⁶⁰ Only Burghley's son, Robert Cecil, continued to dominate as James' first favourite.

Finally, James attempted to be a much more munificent and intellectual patron than Elizabeth. James strongly cultivated the image of monarchy as a fountain, an endless dispenser of grace and favour. Despite James' profligacy, and the widely-criticised crass corruption that accompanied the concentration of patronage in the hands of favourites, these were good years for clients used to Elizabethan constraints.⁶¹ Furthermore, James' self image of a humanist scholar ensured that natural philosophy at last received some courtly patronage.

For all of these reasons, there are important contrasts between Elizabethan and Jacobean systems of patronage of natural knowledge, as of other activities. We shall offer some provisional

⁵⁹ Strong, *Henry Prince of Wales* (ref. 30).

⁶⁰ Neal Cuddy, "The revival of the entourage: the bedchamber of James I, 1603-1625", in David Starkey et.al.(eds.), *The English court from the wars of the roses to the civil war* (London, 1987), 71-118.

⁶¹ Levy-Peck, *Court patronage* (ref. 1).

comments on these contrasts at the end of our paper. However, our initial research has focused more on Elizabethan patronage, and it will form the basis of our report below.

In England as elsewhere, patronage of natural knowledge differed little from patronage of other forms of cultural production, except for its relative lack of importance. The same group of Elizabethan courtiers or Jacobean favourites dominated activities as diverse as the commissioning of works of art and architecture, supporting musicians, masques and companies of players, influencing fellowships at Oxford and Cambridge colleges or promoting the religious activities of doctrinal cliques.⁶² For most of the patrons, the quantity of evidence of patronage in these areas, in the form of works dedicated, petitions received, correspondence exchanged and influence dispensed, swamps that for natural knowledge.

The extent and diversity of cultural patronage is becoming clearer. Cecil emerges as a significant backer of schemes to exploit England's natural resources, but it scarcely matched his architectural, not to mention political patronage.⁶³ Robert Dudley, Earl of Leicester, although another leading promoter of practical mathematics, was more concerned with advancing puritan theologians, more ensnared (as Chancellor of Oxford University) by academic disputes, and more financially burdened by 'The Earl of Leicester's Men'.⁶⁴

Patrons also had obligations to their local power bases, which bound them to a range of intellectual clients. Thus Thomas Egerton, Baron Ellesmere, advanced professionals of many kinds from his Shropshire homelands, through Brasenose College, Oxford to positions of influence. His patronage extended to the recusant Aristotelian natural philosopher John Case, who dedicated his *Lapis Philosophicus* to Egerton: Case was a Shropshire protege – and private tutor to Egerton's son. However, works of natural knowledge form only three of the scores of dedications that Egerton received.⁶⁵ Although we are rediscovering the ubiquity of scientific patronage, it must be kept in proportion.

3.1 From Clients...

⁶² See, for example, Greenblatt, *Renaissance self-fashioning*; Evans, *Ben Jonson and the poetics of patronage*; Croft, *Patronage, culture and power*; Parry, *The golden age restor'd*; Wainwright, *Musical patronage in seventeenth century England*; Cross, *Patronage and recruitment in the Tudor and early Stuart church*. For full references to all, see ref. 1.

⁶³ Croft (ref. 1), 'Introduction', ix, xv.

⁶⁴ Rosenberg, *Leicester* (ref.1), passim.

⁶⁵ Louis A. Knafla, "The Country Chancellor: The Patronage of Thomas Egerton, Baron Ellesmere" in French R. Fogel and Louis A. Knafla, *Patronage in late Renaissance England: papers read at a Clark Library seminar, 14 May 1977* (Los Angeles, 1983). For dedications see 'Appendix'. William J. Carlton, *Timothie Bright, Doctor of Physicke*, London, 1911.

To establish English patronage networks we began from a base of client practitioners who published works with letters of dedication to their patrons. This database of practitioners continues to undergo additions and subtractions. On one hand, the claims of clientage made in dedications need to be confirmed. Conversely, there is, of course, substantial archival evidence of clients who published nothing. So far, we have identified some 70 practitioners for whom some evidence exists.

Dedications to patrons by authors were an important way of publicly signalling a connection. To honour one's patron, or patrons, was necessary, and not just because such public gratitude was the price of continued support. Given the inferior status and uncertain reputation of the typical author of a work of natural knowledge, it was the dedicatee who first guaranteed the authority of a work; a serious work, especially a novel one, without an authoritative dedicatee risked lacking credibility. Thus in 1594 Hugh Platt dedicated to the Earl of Essex his *Jewell House of Art and Nature. Conteyning divers rare and profitable Inventions, together with sundry new experiments in the Art of Husbandry, Distillation and Moulding...*. He commended it to "rest secure under the shadow of so honourable a Patron" (as Essex still was) and believed that it would thereby avoid the "deepest censure, ech author of novelties... is every way in danger of".⁶⁶

Successive editions allowed clients to advertise and repay debts to new patrons. The first, 1599 edition of Edward Wright's *Certain Errors in Navigation* was dedicated to the 3rd Earl of Cumberland, who inaugurated Wright's career as a navigation expert, but the second edition of 1610 boasted a dedication to Henry, Prince of Wales in whose court Wright now worked.

Successive editions can equally reveal patronage problems. In John Blagrove's pro-Copernican *Astrolabium Uranicum Generale* of 1596 he thanked the Lord High Admiral, Charles Howard, Baron of Effingham for having been "pleased to take further notice of me by my personal preference". Blagrove, a gentleman of limited independent means, mentioned that he had "beene always exceedingly bounde, Next to the [ailing...] Lord Burleigh, Lord High treasurer of England, unto the late right Honorable Sir Francis Knolles". Blagrove had honoured his debt by dedicating previous works to both men, but he needed a new patron to continue to protect his family against "most injurious and wicked practices heretofore vehemently prosecuted against us". But when, two years before his death in 1611, he dedicated his *Art of Dyalling* to James I's privy counsellor Sir Thomas Parry, he complained that "alas, time hath bereft me of many my most Honorable Favourers. And only your Honour now succeeding your Honorable Father in place of honour, is the principall hope left unto me, who in my Mathematicke infantry [infancy] both favoured me, and furnished me out of your admirable and generall library, of such

mathematickes books as in those daies were hardly, or not elsewhere to be gotten". Blagrave's dedication to Parry probably owed more to legitimate hope based on past favour than to an established patronage connection.⁶⁷

Since practitioners' suggestions of clientage in dedications need confirmation, biographical studies of their careers are important. At this stage of the research we have merely augmented existing biographies. Given the dearth of 'important' Englishmen in the period, and the lack of attention to patronage, a few works stand out as exemplars that expand upon the available biographical summaries. Most of these confirm the importance, but difficulty, of obtaining reliable and especially ostentatious patronage, especially under Elizabeth. Clulee's study illustrates why the ambitious John Dee left England.⁶⁸ Walton's pamphlet on Thomas Harriot documents Harriot's appalling luck in moving from one disgraced patron, Raleigh, to another, Northumberland - and the negative consequences for Harriot's domestic reputation and international renown.⁶⁹ Pumfrey confirms that, whilst there is evidence of Dr William Gilbert's medical patrons (who included Cecil, Walsingham and other privy counsellors) there is no sign of support for his magnetic philosophy.⁷⁰ Whilst things improved under James for the likes of Harvey, Fludd and Casaubon, the several recent biographies of Francis Bacon touch upon the lack of interest that this otherwise consummate courtier generated in his programme of natural philosophical reform.⁷¹ We badly need more knowledge of the careers within patronage of most early modern practitioners, for most of whom the literary remains of clients are sparse and scattered.

In fact the convention that authors needed a consenting noble dedicatee was beginning to break down for certain genres.⁷² As 'the public' became a new kind of authority-conferring patron, writers of popular and practical works, including some of natural knowledge, began dedicating books "to all true students of Geography and Cosmography" as did the astrologer Simon Forman in his *Groundes of the Longitude* of 1591, or even "to the courteous reader", to whom Mark Ridley addressed his English version of William Gilbert's magnetic philosophy. In 1596 the prolific commercial writer and lecturer Thomas Hood barely apologised to Sir John Burrowes for

⁶⁶ London, 1594. Preface, sig. A2-3.

⁶⁷ Blagrave's *Baculum familiare* (London, 1590) was dedicated to Francis Knollys, and *The Mathematicall Jewell* (London, 1585), to William Cecil.

⁶⁸ Clulee, *John Dee's natural philosophy* (ref. 3), 196-8.

⁶⁹ Walton (ref. 29).

⁷⁰ Stephen Pumfrey, *Latitude and the Magnetic Earth* (Cambridge, 2002), 19-23.

⁷¹ Keynes, *William Harvey* (ref.3); William H. Huffman, *Robert Fludd: essential readings* (London, 1992); D.H. Willson, *King James VI & I* (London, 1956); John E. Leary, *Francis Bacon and the politics of science* (Ames, Iowa, 1994); Julian Martin, *Francis Bacon and the reform of natural philosophy* (Cambridge, 1992); Jardine and Stewart, *Hostage to fortune* (ref.25); Stephen Gaukroger, *Francis Bacon and the transformation of early-modern science* (Cambridge, 2001).

his “bold attempt, that uppon so small acquaintance I should presume to dedicate this work [*The Mariners Guide*] unto you”. The “sufficient excuse for my presumption” was that Burrowes bore “an Honorable regard” for navigation.⁷³ Likewise, Antony Linton, the obscure Sussex parson who puffed a magnetic longitude scheme in his 1609 *Newes of the Complement of the Art of Navigation*, which he dedicated to James I, had no connections with the royal court. Indeed, the magnetic experts patronised by Prince Henry moved immediately to destroy his credibility.⁷⁴

3.2 ...To patrons.

It is obviously more difficult to establish the diverse interests of patrons. Franklin Williams’ *Index of Dedications and Commendatory Verses in English Books before 1641* is invaluable (if occasionally unreliable) for identifying natural knowledge, though it was usually one interest among many.⁷⁵ The growth of transgressive and speculative dedications like Hood’s is helpful. So too are dedications of foreign natural philosophical and related works translated into English, where the translator-author may not otherwise be known for works of natural knowledge. For example, we have stated that few patrons supported natural philosophers. Indeed, the only truly English works of natural philosophy were John Case’s *Lapis Philosophicus*, patronised by Egerton, and those of Fludd. But there were two translations. Daniel Widdowes abridgement of Gulielmus Scribonius 1583 *Rerum naturalium doctrina methodica* was published in 1621 by the soldier-surveyor John Wid[d]owes as *A Description of the World*. He dedicated it to his master Sir William Parsons, Surveyor General of Ireland, noting that his work of natural philosophy also “represent[ed] most lively, vast countries within a small map”.⁷⁶

More significantly, Thomas Twyne, the puritan translator and physician⁷⁷ dedicated his 1578 edition of the Calvinist Lambert Daneau’s *Physica Christiana*, a work that extracted a system of natural philosophy from the Bible, to Elizabeth’s fervently protestant secretary Francis Walsingham. This was but one example of the intellectual connections established between Elizabeth’s court and Calvinist scholars. As Twyne noted, Daneau’s work was a perfect counterpart to the translation of New Testament by Theodore Beza, Calvin’s successor in Geneva, published two years earlier by Walsingham’s under-secretary Lawrence Tomson and which also

⁷² Marotti (ref. 38).

⁷³ Mark Ridley, *Magneticall Bodies and Motions* (London, 1613).

⁷⁴ Pumfrey, *Latitude* (ref. 70), 194-9.

⁷⁵ London, 1962.

⁷⁶ John Widdowes, *A Description of the World* (London, 1621), “Epistle Dedicatorie”, sig. A1.

⁷⁷ DNB, vol.xix, pp.1330-1.

claimed Walsingham's protection.⁷⁸ Twyne had earlier dedicated a translated collection of religious writings to Nicholas Bacon.⁷⁹ Both Bacon and Cecil had connections with Beza.⁸⁰

Leicester's command of the expeditionary force to the Netherlands made him an obvious patron of Cyprian Lucar's *Arte of Shooting*, a translation of Niccolo Tartaglia with Lucar's own appendix on gunpowder⁸¹. The dedication was provided by the publisher, John Harrison (a Leicester client and publisher of William Harrison's *Description of England*, also dedicated to Leicester) who was probably acting as Lucar's patronage broker. Amongst many translated works John Frampton's *Loyfull newes out of the newfound world* (London, 1577), his translation of Nicolas Monardes celebrated *De Simplicibus Medicamentis ex occidentali India delatis quorum in medicina usus est*, was dedicated to Sir Edward Dyer.

As Eleanor Rosenberg has shown, a leading patron like Leicester received scores of dedications from clients.⁸² Those from client mathematicians like Lucar or Thomas Digges or from medical writers like William Cuningham, William Gale and John Jones, are dwarfed by those from historians like John Stow and William Grafton, puritans like Robert Fills and John Harmer, and explicitly anti-Catholic propagandists such as John Feild and Anthony Munday. A host of lexicographies testify to literary patronage befitting Leicester's Chancellorship of Oxford University (and Elizabeth's undisguised disappointment with Leicester's linguistic skill).⁸³

As Lord High Admiral from 1586 to 1618, Charles Howard, Baron of Effingham was naturally associated with works like John Davis' *Seamans secrets*, Thomas Styward's *Pathwaie to martiall discipline*, Walter Raleigh's *Discoverie of the... Empire of Guiana*, and Edward Wright's translation of the Dutchman Simon Stevin's important *Haven Finding Art by the Latitude and Variation*.⁸⁴ But even he received more of his fourteen dedications from religious and anti-Jesuit authors. It is therefore not surprising that the majority of the 25 works dedicated to Francis Bacon were theological, with a few on law and one on a masque at Bacon's inn of court. What is surprising is that Bacon's protection was not sought by any innovative natural philosophers or other practitioners, unless one includes the fifth edition of William Vaughan's *Directions for*

⁷⁸ *The New Testament of Our Lord Iesus Christ translated out of Greeke by Theod. Beza: whereunto are adioyned brief summaries of doctrine vpon the Euangelistes and Actes of the Apostles, together with the methode of the Epistles of the Apostles by the said Theod. Beza: and also short expositions on the phrases and hard places taken out of the large annotations of the foresaid authour and Ioach. Camerarius.* By P. Loseler, Villerius. Englished by L. Tomson (London, 1576).

⁷⁹ Thomas Twyne, *The Garlande of Godly Flowers* (London, 1574).

⁸⁰ Beza was Theodore Mayerne's Godfather. See Ralph Vigne, "Mayerne and his successors: Huguenot physicians under the Stuarts", a paper delivered at the Royal College of Physicians in December 1985, published by the Wellcome Institute for the History of Medicine.

⁸¹ Niccolo Tartaglia, *Three bookes of colloquies concerning the arte of shooting* (London, 1588).

⁸² Rosenberg, *Leicester* (ref.1).

⁸³ Rosenberg, *Leicester* (ref.1), 140-41.

⁸⁴ London, 1599.

health, a conventional work he had previously dedicated to family members.⁸⁵ By contrast, two of the three works dedicated to Percy (on astrology and the golden ratio) reflected his interest in mathematical magic.⁸⁶

Moving from published to archival evidence, the literary remains of the leading English patrons have been invaluable. Patronage of natural knowledge was considerably deeper and more diverse than can be inferred from written works. Many unlearned practitioners, instrument makers and projectors whom the archives reveal as clients did not produce work that could be published with suitable encomia. Nevertheless, patrons like Lord Treasurer Cecil continued to commission or receive from clients many manuscript treatises, for their private edification or concerning specific questions. To be sure, most dealt with religion and politics, as did Francis Thynne's lavish manuscript 'Lives and successions of the Treasurers of England'.⁸⁷ But the notorious non-conformist Robert Browne, a kinsman whom Burghley assisted, offered him one proving that Oxbridge taught the arts and sciences erroneously and laboriously⁸⁸. William Bourne compiled for Cecil a 'Treatise on the property or qualities of glasses, according to the making, polishing and grinding of them', and another on buoyancy.⁸⁹ John Montgomerie compiled a substantial 'Treatise concerninge the mayntenance of the navie', which he dedicated to Leicester "to signifie my loving affection".⁹⁰ Cecil received another on the discovery and utility of lands in the southern hemisphere.⁹¹ Valentine Russwarin, a foreign physician dedicated a natural philosophy of urine to Cecil, together with a plea that he promote his "sute" and usefulness.⁹² Thomas Digges also produced manuscripts for Cecil and Leicester.⁹³

As had been common in the early years of print culture, manuscripts were sometimes later printed. The Revd. William Barlow, chaplain to Prince Henry, wrote the first version of his *Magneticall Advertisements* (1616) as a private 1609 manuscript dedicated to Sir Thomas

⁸⁵ William Vaughan, *Directions for Health, both naturall and artificiall* (London, 1617). Richard Gething, *Calligraphotechnia, or the art of faire writing sett forth, and newly enlarged* (London, 1619), is not a treatise but a series of engraved templates illustrating a formal bureaucratic style.

⁸⁶ Auger Ferrier, *A learned astronomical discourse, of the iudgement of nativities* (London, 1593); John Ford, *The golden meane... Discoursing of the nobleness of perfect virtue in extreames* (London, 1614).

⁸⁷ See BL MS. Stowe 573.

⁸⁸ BL MS. Lansd. 64.34. See also <http://www.exlibris.org/nonconform/engdis/brownists.html>

⁸⁹ BL MS. Lansd. 121 f.13; Also William Bourne, 'The Nature and Quality of Water: as touching the Swimming and Sinking of Things', c.1565, according to E.G.R Taylor *Mathematical practitioners* (Cambridge, 1967) 176, 319.

⁹⁰ BL MS. Add. 18035.

⁹¹ BL MS, Lansd., 100, f.19.

⁹² BL MS. Lansd., 101, ff.8-15.

⁹³ Digges offered Cecil an 'astronomical manuscript' on May 14, 1547. BL Lansdowne 19.30. He probably produced for Leicester "The Second Paradoxe. That the antique Roman and Grecian discipline martiall doth farr exceede in excellencie our modern, notwithstanding all alterations by reason of the late invention of artillery and fireshott' BL MS. Lansd. 98 f.6 ff.; *Calendar of State Papers Domestic, Edward VI. Mary, and Elizabeth*, I, 1547-1580, December 11th 1572. Thomas Digges to Lord Burghley. Digges 'has waded as far as ancient grounds of astrology would bear him to sift out the unknown influences of this new star or comet. Sends notes of observations and predications.'

Chaloner, controller of the prince's court, which he reworked and published after accusing Mark Ridley of plagiarising it for his *Magneticall Bodies and Motions* of 1613.⁹⁴

By the late Elizabethan period, print culture was sufficiently established that clients writing on natural knowledge routinely sought a wider, more international audience than manuscript circulation easily allowed. However, publication, together, of course, with a dedication, had to bring mutual benefit to both patron and client. The lack of such benefit may explain why there was so little published by the famous clients of 'the wizard earl' Henry Percy. Despite his enduring support for Thomas Harriot, Robert Hues and Walter Warner, and his lesser patronage of Edward Wright, Nicholas Hill and Paul Buck, not one of the three dedications he received was from these men. It is only from Northumberland's papers that we know that he supported Harriot, indeed with houses and a stipend of £100 p.a.⁹⁵ Percy's clients stood to lose from his status as an incarcerated traitor. Conversely, Elizabeth I was cautious in her dealings with John Dee.

In short, whilst any analysis must begin with written works, a full picture of English patronage depends upon a painstaking analysis of state papers, library and private archives, which we have only just begun. The single most complete, relevant and accessible archive is formed by the British Library Lansdowne Manuscripts. Thanks to Cecil's extraordinary longevity as Elizabeth's chief minister, and his obsessive bureaucracy, these have given us an unparalleled insight into the intellectual influence of a leading noble patron, just as they form the basis of Heal's and Holmes's recent study of Burghley's neglected patronage of 'economic' projects.⁹⁶

From our preliminary examination of all these sources, we have compiled a database of no fewer than 30 patrons of natural knowledge, ranging from dominant figures such as James I to minor ones such as the navigator Thomas Cavendish, an early patron of Robert Hues. In Elizabeth's reign, her senior ministers and favourites emerge as the central players. They are William Cecil (Lord Burghley), and his son Robert Cecil (1st Earl of Salisbury); Robert Dudley (Earl of Leicester), his nephew Sir Philip Sidney, and his step-son Robert Devereux (2nd Earl of Essex); Henry Percy (9th Earl of Northumberland); Sir Walter Raleigh; George Clifford (3rd Earl of Cumberland); Charles Howard of Effingham (Lord High Admiral). Although many clients lived to span both reigns, among the patrons only Robert Cecil remained to serve James VI & I.

Many of these patrons were closely linked by family, marriage or other courtly connections. In the sphere of politics, and of gaining more influence at court, they were

⁹⁴ See William Barlow, *Magneticall Advertisements* (London, 1616), Preface.

⁹⁵ Batho, "Thomas Harriot" (ref.26) 33; John Shirley (ed.), *Thomas Harriot, Renaissance scientist* (Oxford, 1974), ch. 2.

⁹⁶ Heal and Holmes, "The Economic Patronage of William Cecil" (ref.45).

themselves clients, who could gain favour, inter alia, by recommending trusted physicians or ingenious men in their entourage. The interconnections are very visible in the group of philosophers and physicians associated with Sir Philip Sidney, the poetic Platonist, major patron of the arts and nephew of the Earl of Leicester.⁹⁷ The best known is Thomas Moffet. Moffet was primarily a client of the Earl of Essex, who seems to have admired his unorthodox interests, which ranged from the natural history of insects to Paracelsian medical philosophy. Indeed Essex supported the irascible Moffet and forced a reluctant College of Physicians to grant a license to Moffet's own client, the 'quack' healer Leonard Poe. (This was the breakthrough Poe needed, and he rose to become James I's royal physician!).⁹⁸ Moffet advised Sidney on the 'barrenness' of his wife Frances, Sir Francis Walsingham's daughter. When Sidney died, Frances married Moffet's patron Essex. Moffet maintained his links with the Sidney family through his association with Sir Philip's sister, Mary Herbert, Countess of Pembroke, to whom Moffet dedicated his treatise on silkworms. As children, Mary and Philip had both been tutored by John Dee. Mary was reputed to have gained an interest in natural philosophy, even making alchemical experiments, medical preparations and raising silkworms with Moffet's assistance. On Moffet's death in 1604 another of the circle, Matthew Lister, became her physician, and later served Robert Cecil and Anna of Denmark. Timothie Bright, another physician with wide interests, though primarily a Cecil client, also served Philip Sidney.⁹⁹

3.3 The Elizabethan patron – William Cecil and utilitarian interests

William Cecil, created Lord Burghley in 1571, was Elizabeth's chief adviser from her accession almost until his death in 1598. She relied heavily upon his counsel in all matters, especially concerning the Catholic threat and her sister Mary.¹⁰⁰ Even as Burghley's health failed in the 1590s she refused to allow his son Robert to succeed him. As was typical in court culture,

⁹⁷ Alan Sinfield, "Power and ideology: an outline theory and Sidney's *Arcadia*", *English Literary History*, lii (1985), 259-277, 270. Sidney, of course, also gave military service, which stimulated his utilitarian concerns. He wrote from the Netherlands asking, "to what purpose should our thoughts be directed to various kinds of knowledge, unless room be afforded for putting it into practice, so that public advantage may be the result". We are grateful to Thomas Dixon for this quotation.

⁹⁸ Frances Dawbarn, "New Light on Dr Thomas Moffet: The triple roles of an early modern physician, client, and patronage broker", *Medical History*, forthcoming.

⁹⁹ Margaret P. Hannay, "'How I These Studies Prize': The Countess of Pembroke and Elizabethan Science", in Lynette Hunter and Sarah Hutton (eds.), *Women, Science and Medicine: 1500-1700. Mothers and Sisters of the Royal Society* (London, 1997), 108-121.

¹⁰⁰ On Cecil see Conyers Read, *Lord Burghley and Queen Elizabeth* (New York, 1960), and the recent shorter survey Michael A.R. Graves, *Burghley. William Cecil, Lord Burghley* (London, 1998).

Burghley signalled his wish by patronising lavish entertainments for the Queen at his major residence, organised around a *Tempest*-like theme of rural retreat.¹⁰¹

Promoted from Secretary to Lord Treasurer in 1572, Burghley presided, successfully at first, over the English economy and state finances during a period when military expenditure created constant crises. Between 1585 and 1603 more than 100,000 men were pressed into service abroad.¹⁰² Nevertheless, he maintained the stability of English coinage, following a successful recoinage in 1560. He was less successful at raising taxes, in part because he profited personally from endemic evasion and keeping income assessments static. His own assessment was £133 p.a., whilst his real income was more like £4000, financial clout to match his powers of political patronage.¹⁰³ But, although he also profited as master of the wards, he generally opposed the growing corruption of the later Elizabethan years.

Burghley's influence was rivalled only by Robert Dudley, Earl of Leicester. The two are sometimes cast antagonistically as father figure and suitor, or 'moderate' and 'Protestant ideologue' respectively, but in important matters of policy including, it seems utilitarian patronage, they and their circles co-operated pragmatically.¹⁰⁴ A rupture occurred when Leicester insisted upon the military campaign to support the Dutch Republic against Spain – a campaign that fatally ruined first his reputation and then his health.¹⁰⁵ Until his death in 1588 they had many clients in common, including Thomas Digges and Thomas Bedwell, Keeper of the Ordnance Stores and maker of military instruments.¹⁰⁶

Not just a consummate practical politician, Burghley also had a good humanist mind. Around 1550 he had been, along with fellow Johnians John Cheke (Elizabeth's tutor), his brother-in-law Sir Nicholas Bacon and Sir Thomas Smith one of the leading 'Athenians', advocating not just reformed religion but with it a return to a classical pronunciation of Greek. On Elizabeth's accession he secured positions for them.

Smith especially, together with Bacon and the reforming merchant Sir Thomas Gresham were also profound influences upon Burghley's 'economic policy'.¹⁰⁷ Smith's 1549 policy manuscript 'Discourse of the Commonweal' (eventually published in 1581) coherently advocated

¹⁰¹ Croft (ref. 1), xiv.

¹⁰² John Guy, *Tudor England* (Oxford, 1990), 387.

¹⁰³ Guy (ref. 78), 383.

¹⁰⁴ Guy (ref. 78), 258.

¹⁰⁵ Guy (ref. 78), 338.

¹⁰⁶ See Mordechai Feingold, *The mathematicians' apprenticeship: science, universities and society in England, 1560-1640* (Cambridge, 1984), 77 and Johnston, "Mathematical Practitioners" (ref. 8), 319-344.

¹⁰⁷ The extent to which Burghley operated an economic policy (and whether it was conservative or radical) is discussed in Heal and Holmes, *passim*.

government intervention in the economy as a solution to the legacy of debasement.¹⁰⁸ ‘By allurements and rewards’ entrepreneurs were to be encouraged to increase domestic production and manufactures. Thirsk has read Cecil’s development of monopoly patents (which by 1601 were criticised as another form of corruption) as his implementation of the policy, together with inducements for foreigners to settle and bring new processes to England. As Heal and Holmes observe, ‘Cecil was claimed to have combed England and Europe for new processes of manufacture. He certainly employed a variety of local agents to report on the feasibility of projects. And when these new ventures seemed practicable Cecil was willing to invest in his entrepreneurs’.¹⁰⁹

As we shall see, there is no doubt that such a ‘utilitarian’ interest dominated Burghley’s patronage of natural knowledge. But we should note first that Burghley’s patronly responsibilities brought him into contact with a much broader range of intellectual concerns. In the first place, Burghley was Chancellor of Cambridge University from 1560 until his death. His humanism made his a more suitable appointment than that of Leicester, his counterpart at Oxford. Like the more puritan Leicester, Burghley was active in ensuring that academic communities conformed to his version of Elizabethan policy, especially in religion. He regulated the frequent academic disputes, and attempted reforms with a vigour that disproves the simplistic distinction between a court culture regulated by patronage and an insulated university culture.¹¹⁰

Burghley was involved in university matters ranging from Walsingham’s request that Magdalen College be reformed, through to the provision of a plague-free water supply to granting leave for physicians to study abroad.¹¹¹ The Archbishop of Canterbury asked him to prevent the university press printing “schismatical books”.¹¹² He was petitioned by both sides in a controversial appointment to the readership of physic at puritan dominated St John’s College.¹¹³ He intervened from personal obligation too. Roger Ascham, Elizabeth’s tutor had been his client and friend, and his widow dedicated the first (1570) and subsequent editions of *The Scholemaster* to Burghley.¹¹⁴ So Burghley tried to get Ascham’s impoverished son Giles a pension and a fellowship at Oxford.¹¹⁵

¹⁰⁸ *A discourse of the commonweal of England, attributed to Thomas Smith*, ed. Mary Dewar (Charlottesville, 1969); see also Mary Dewar, *Thomas Smith: a Tudor intellectual in office* (University of London, 1964).

¹⁰⁹ Heal and Holmes, “The Economic Patronage of William Cecil...” (ref. 45), 203.

¹¹⁰ This is an important point. In England as elsewhere, universities were ultimately under local political control and patronage influence. However, Oxford and Cambridge possessed an institutional inertia that left obviously courtiers with less power to determine policy and personnel than they exerted over London clients.

¹¹¹ BL MS. Lansd. 18.90; BL MS. Lansd.19.20; BL MS. Lansd. 12.48.

¹¹² BL MS. Lansd. 42.45.

¹¹³ BL MS. Lansd. 23.14-16.

¹¹⁴ Roger Ascham, *The Scholemaster* (London, 1570). In the dedication Margaret Ascham mentioned not only Cecil's chancellorship of Ascham's university, but also "how much my sayd husband was many wayes bound vnto you, and

Probably his most significant philosophical intervention was his protection of the Johnian Fellow Everard Digby, grandfather of the atomist Kenelm Digby. Everard was unpopular primarily for his religion but also for his immoderately anti-Ramist defence of *logica vetera*, and was deprived of his fellowship in 1587. Ramists, with their motto ‘everything said by Aristotle is false’, were controversial, but in Lord Keeper Egerton and, it seems, Leicester, had powerful patrons in Oxford. Leicester’s client Gabriel Harvey published a much criticised Ramist *De restitutione logica* in 1583. [Guy 414] Burghley had Digby restored (against Leicester’s wish), and later helped him to move on to a church living.¹¹⁶

Much more significant, from the standpoint of natural knowledge, was Burghley’s apparent inability to get Cambridge University to plant a physic garden. This was probably a matter of some importance to him. Cecil family patronage poured into the creation of great gardens – a signifier of political greatness. Burghley’s superintendent of gardens, and valued client, was John Gerard. Cambridge was petitioned in 1588 and a letter of recommendation, drawn up by Gerard on Burghley’s behalf, remains in Burghley’s papers.¹¹⁷ It proposed the “purchasing of publicke gardens... at the University of Cambridge... whereby the noble science of physick is made absolute...”.¹¹⁸ Rebuffed, Gerard expanded his physic garden at his London home in Fetter Lane. His famous *Herball or Generall Historie of Plants* of 1597 is, of course, dedicated to the “right honourable and my singular good Lord [Burghley]”, and pays tribute to his patron’s encouragement.¹¹⁹ The extraordinary number of prefatory commendations, many in Latin, from men of state, learned physicians and others, were to establish that, despite Gerard's lack of formal learning, his was a project to be taken seriously. Gerard noted that the foreign university cities of Montpellier and Padua had physic gardens, and that he had successfully grown many little known herbs in England.¹²⁰ Physic gardens fitted perfectly with Burghley’s policy of encouraging self-sufficiency through copying foreign techniques.

Like many courtiers, Burghley took a keen interest in physic and physicians. In 1576 he was informed about ‘disorders to be reformed’ in the College of Physicians.¹²¹ He was involved in

how gladly and comfortably he vsed in hys lyfe to recognise and report your goodnesse toward hym, leauyng with me then hys poore widow and a great sort of orphanes a good comfort in the hope of your good continuance". See also the editions of 1571, 1579, and 1589.

¹¹⁵ See BL MS. Lansd. 34.21; 39.48; 54.70; 71.85; 107.4.

¹¹⁶ BL MS. Lansd. 102.16; 34.12; Guy (ref. 78), 414; W. R. Sorley, "The Beginnings of English Philosophy", in A. W. Ward & A. R. Waller (eds), *The Cambridge History of English and American Literature in 18 Volumes* (1907–21), *Volume IV. Prose and Poetry: Sir Thomas North to Michael Drayton*, ch. 14, section 6.

¹¹⁷ BL MS. Lansd. 107.92.

¹¹⁸ BL MS. Lansd.107, f.155.

¹¹⁹ John Gerard, *The Herball or Generall Historie of Plants* (London, 1597), sig. A2.

¹²⁰ See BL MS. Lansdowne 107, f.155; Gerard, *Herball* (ref. 94), 'To the well affected Reader and peruser of this booke'.

¹²¹ BL MS. Lansd.21.60.

the selection of Royal Physicians: in 1570 Elisha Bomelius, the royal physician cum astrologer petitioned him to be released in order to serve the Czar.¹²² His own household was served by the best, including William Gilbert. Timothie Bright dedicated to him *Hygieina, id est de sanitate tuenda medicinae* in 1582.¹²³ Burghley's ill health, especially his gout, provided entrees for many aspiring healers. Doctor Henry Hector proposed to cure his gout and later collated remedies from Averroes and others¹²⁴. Dr Masters and Mr Dion among others provided advice, while Dr Henry Landwer prescribed some medical slippers.¹²⁵ Burghley even asked one Kelley [probably Edward Kelly] to return to England and cure him.¹²⁶ Other physicians sent him directions for pains in the head¹²⁷, recipes for sage water and healing baths¹²⁸, and Burghley wrote out his own regimens¹²⁹. In his old age he received from John Evelyn a paper describing his cure for deafness, accompanied, of course, by a petition.¹³⁰

Burghley, then, came into contact with a variety of practitioners of natural knowledge. But there is no evidence from the Lansdowne papers that he ever patronised natural philosophy or 'theoretical' mathematics. Indeed, only Gerard's *Herball*, with its illustrations and multiple encomia might conceivably be termed 'ostentatious' natural knowledge. This is in marked contrast to his enthusiasm for utilitarian natural knowledge, including the numerous economic projects discussed by Heal and Holmes.

It was not just a Copernican astronomer like Digges who was rebuffed. Few petitioners, even (or especially) projectors, received patronage. In the first place, a noble like Burghley paid little attention to a putative client unless he was vouched for by a patronage broker. Courtiers found that his secretary Michael Hickes exercised considerable brokerage power.¹³¹ Even the case for Timothie Bright, the Burghley physician and inventor of shorthand or secret writing, to become Robert Cecil's tutor was made through Hickes.¹³² Burghley's known willingness to reward projectors meant that his office received hundreds of petitions. For dealings with

¹²² BL MS. Lansd.12.73. See also BL MS. Lansd.12.79 for the Archbishop of Canterbury's response.

¹²³ Timothie Bright, *Hygiēna, id est de sanitate tuenda medicinae* (London, 1582-3).

¹²⁴ BL MS. Lansd. 27.43; 55.43.

¹²⁵ BL MS. Lansd. 18.35-6; 121.19; 29.7.

¹²⁶ BL MS. Lansd. 104.56.

¹²⁷ BL MS. Lansd. 46.12.

¹²⁸ BL MS. Lansd. 68.88; 77.92.

¹²⁹ BL MS. Lansd. 75.78.

¹³⁰ BL MS. Lansd. 77.90.

¹³¹ Francis Bacon's early legal career was promoted by Burghley (his uncle) and his son Robert (his cousin). Thus in 1593 Bacon asked Hickes to advance his suit. (BL MS. Lansd 75, f56). Hickes received rewards for such services. (BL MS. Lansd 46.14.) It was also through Hickes that suits for the Mastership of St John's College Cambridge were promoted. (BL MS. Lansd. 108, 9). Ralph Parr, an Oxford scholar, attempted to advance his suit by sending him some Latin verses. (BL MS. Lansd 99.71.)

¹³² BL MS. Lansd 51.27. Bright had just completed his *The Art of Short, Swift and Secret Writing* (London 1588), dedicated to Elizabeth.

projectors, Burghley used a number of clients as intermediaries. Armagil Waad was important until his death in 1568. Peter Osborne of the Exchequer advised on metals and mining.¹³³ whilst the Welsh official William Herle effectively became a permanent agent, with artisanal contacts in the Low Countries. Heal and Holmes conclude that Burghley supported, for example with patents, schemes of three kinds. First, those that secured greater self-sufficiency in strategic resources, such as hemp and flax for the navy and, especially, the mining and refining of iron. Secondly, the indigenous production of imports that wars would disrupt, notably salt, oil (for soap) and sulphur. Finally, there were innovative forms of production, ranging from fen drainage to improved sackbuts.

The ‘heady days’ of projection ended around 1570. From our own survey of Lansdowne papers after this date, it is clear that the focus did not change. The following is a representative sample of the scores of petitions intended for Cecil’s attention after 1570: a description of a newly invented portable mill, useful for soldiers on campaign;¹³⁴ practical information on the cultivating of vines and grapes;¹³⁵ suggestions for improving the mechanical arts which included new designs for hoists lifts, and pulleys which could be used in warfare, and a device “to make a boat to goe faster on the water without ower or saile”;¹³⁶ a letter concerning the “conditions necessary for to bring to passe the invention of brimston and oyle, And the profite that may grow thereof to the Queenes Majestie and her subjectes”;¹³⁷ notes in Cecil’s own distinctive hand concerning the production of gold and silver ore;¹³⁸ an offer to Lord Burghley of a “thin Aqua Chymica” which came with a peremptory “demande off your honour [for] a new yeares gifte”;¹³⁹ news of a grant by the Queen for the production of new furnaces;¹⁴⁰ a general petition assuring Burghley that “her Majestie shall proffitte by the effort of my inventions... from ten to twelve thousand ponde, or more...”¹⁴¹

In terms of natural knowledge, the schemes fall into three broad classes: agriculture, the mechanical arts, and (al-)chemical processes, primarily concerning metals. It is therefore not surprising that Burghley’s circle welcomed approaches from alchemists. In the 1560s Armagil

¹³³ Heal and Holmes, “The Economic Patronage of William Cecil” (ref. 45), 208. (Osborne was also the dedicatee of Timothie Bright’s *Treatise of Melancholie* of 1588.)

¹³⁴ BL MS. Lansd. 101, f.65.

¹³⁵ BL MS. Lansd. 101, ff. 36-42.

¹³⁶ BL MS. Lansd. 19, f.52.

¹³⁷ BL MS. Lansd. 22, ff. 68-72.

¹³⁸ BL MS. Lansd. 25, f. 144.

¹³⁹ BL MS. Lansd. 60, f. 177.

¹⁴⁰ BL MS. Lansd. 105, ff.176-178.

¹⁴¹ BL MS. Lansd. 108, f.36.

Waad had managed the project of projection of Burghley's client Cornelius de Lannoy until de Lannoy's arrest for non-production.¹⁴²

This is the context in which we must place the most extraordinary of Burghley's projects, his involvement in the ill-fated 'Society for the New art of making Copper and Quicksilver by way of Transmutation'. Transmutation also concerned Burghley, as it concerned many others including Isaac Newton, because of its implications upon coinage. The well-documented episode concerned the claims of one William Medley to have a new alchemical process. Early trials and reports suggested that the method had some foundation. Medley argued the case for greater investment and more time. Investment came in abundance, when Elizabeth I formally approved the Society. Councillor-investors included Burghley, Leicester, Sir Thomas Smith, who himself kept alchemical stills.¹⁴³ Anxiety built as Medley consumed much and produced nothing.¹⁴⁴

Where some European courts had both practical and philosophical interests in alchemy, there is scant evidence that Elizabeth's politicians were interested in its occult philosophy. Accompanied by Edward Kelly, John Dee had, for that reason, ended up petitioning Rudolph II in Prague. Elizabeth's Privy Council requested the return of a great talent, even sending Sir Edward Dyer with Burghley's "pray[er] to God to direct you to bestow the Gifts that God hath given you rather upon your own place, and Country, than upon strangers".¹⁴⁵ But the talent was Kelley, not Dee, and the skill very likely his reported ability to make gold alchemically.

Burghley's patronage of Medley and other alchemists has predictably been seen as rash credulity. This is unlikely. As Heal and Holmes say of his use of agents and brokers, his "impulse was always to test empirically the grandiose claims for the public good with which he was assailed". Indeed,

His meticulous attention to detail, his readiness to invest time to secure solutions, his refusal to take claims on trust, are characteristics that emerge in every aspect of his political engagements, not least in response to the economic projects. His response to the abstruse technical debates between native and Italian military architects concerning the structure for the new walls of Berwick – build test models of each and subject them to

¹⁴² See *Calendar of State Papers Domestic, Elizabeth*, Vol. XL. 28. [July 15th 1566.] "Arm. Waad to Leicester and Cecill. Has repaired to the Tower and examined Mr Cornelius [Lannoy] as to delay in assays of metals, etc. Particulars of the conversation which took place." See also Heal and Holmes, "The Economic Patronage of William Cecil" (ref. 56), 209.

¹⁴³ John Strype, *The Life of the Learned Sir John Smith* (Oxford, 1820), 161.

¹⁴⁴ In BL MS. Lansd. 29, f.139 T. Smith wrote to Lord Burghley on March 8th 1579, urging haste in Medley's business, and worrying if the profit of his new art would answer the expense; Strype's *Life of Sir Thomas Smith* (ref. 143), 100-105, 282.

¹⁴⁵ BL MS. Lansd. 103, ff.217.

bombardment – typifies his response to arguments about lead-furnaces, drainage pumps, or rape-seed production.¹⁴⁶

What we might call Burghley's ideology seems to have been pragmatic, empirical and utilitarian. It contrasts with, for example, contemporary Italian noblemen who interested themselves in the practical, military mathematics. As Rose and Biagioli have argued, it was from the traditional noble interest in the art of war that patrons first supported the recovery of ancient mathematics texts, and then became proficient mathematicians themselves, valuing mathematics in itself as a humanistic, courtly accomplishment.¹⁴⁷ It is possible that the Berwick debates reflect, in part, a clash of an ostentatious, Italian patronage culture with a utilitarian English one.

3.4 The Elizabethan client – Thomas Digges and evolving ambitions.

Thomas Digges (1545/6-1595) aspired to be a new astronomer in the realist tradition advocated by Copernicus, practised in his time by Tycho Brahe and developed further by Kepler and Galileo. His early work shows him to be convinced that observational and mathematical astronomers could intervene in cosmological debate, disproving conventional doctrines about the immutability and solidity of the heavens, and even establishing the truth of heliocentrism. His later work, however, conformed to English utilitarian interests, and was exclusively concerned with the military arts. The shift was almost certainly forced upon him by Elizabethan patronage culture.

Digges was the son of Leonard, a learned and wealthy gentleman mathematician from an established Kent family, who died c.1559. However, his father was attainted for treason in the Wyatt rebellion against Queen Mary and his estate was confiscated. He may have avoided execution through the intervention of Edward Clinton Fiennes, Lord Clinton and later 1st Earl of Lincoln. Leonard became a pioneering author of practical and popular vernacular works of mathematics, possibly as a means of income.¹⁴⁸ In 1553 he published the first of many editions of his *Prognostication*, an almanac including basic astronomical techniques, the 1555 edition of which he dedicated to Fiennes. *Tectonicon*, a work of surveying, followed in 1556, and he left unfinished works which Thomas completed and published as *Pantometria* (1571, on cartography)

¹⁴⁶ Heal and Holmes, "The economic patronage of William Cecil" (ref. 45), 208, 220.

¹⁴⁷ See Mario Biagioli, "The Social Status of Italian Mathematicians, 1450-1600," *History of Science*, xxvii (1989), 41-95; Paul Rose, *The Italian Renaissance of Mathematics* (Geneva, 1976).

¹⁴⁸ See the biographical information usefully collated at http://es.rice.edu/ES/humsoc/Galileo/Catalog/Files/digges_tho.html and http://es.rice.edu/ES/humsoc/Galileo/Catalog/Files/digges_leo.html

and *Stratioticos* (1579, on military engineering). Some time after Elizabeth's accession, Thomas obtained some restitution of the estate, although the extent of his gentlemanly independence is unknown.

He did not attend university, but was tutored in mathematics by his father and by John Dee, who was a friend of Leonard. Thus Thomas was well versed in practical mathematics but, like Dee (and possibly his father) he believed that mathematics and mathematicians had a higher calling.

After Leonard's death, Dee acted as a friend and patron to Thomas Digges. He permitted Digges' entrance onto the international Latin stage with an address to the 'benevolo lectori' of Dee's *Parallaticae commentationis praxeosq[ue] nucleus quidam* (London, 1573). At the same time Digges established himself as a leading observational astronomer with his work on the new star in Cassiopeia, an event that interested mathematicians, theologians and politicians alike. This, together with his reputation as the continuer of the astrological prognostication, seems to have brought him some patronage from Cecil.

Digges now acquired some patronage connection with Cecil. He provided Cecil with his manuscript observations and prognostications concerning the new star.¹⁴⁹ He went on to dedicate to Cecil his astronomically ambitious *Alae seu Scalae Mathematicae* of 1573. Like Tycho, Digges concluded from observations of parallax that the star was a celestial not a meteorological phenomenon, that there had been changes in the heavens, and that mathematical astronomy could therefore determine cosmological questions. Several European astronomers commented favourably upon it, including Tycho, and Digges may have cultivated Tycho as a potential patron.¹⁵⁰

In 1574 Digges presented Cecil with another astronomical treatise.¹⁵¹ This may have been an early version of his extraordinary Copernican *Perfit Description of the Celestiall Orbes*. Whatever it was, Cecil's patronage of Digges seems to have ended, and the *Perfit Description* appeared in 1576, appended to another edition of the *Prognostication* and dedicated to his father's patron Edward Fiennes, now Lord High Admiral and Earl of Lincoln.

After 1578 Digges became a highly favoured client of the most influential patron after Cecil, Robert Dudley, Earl of Leicester. Given the zealous protestantism that Digges exhibited in the *Perfit Description* and elsewhere, Leicester was an appropriate patron. But the switch

¹⁴⁹ *Calendar of State Papers Domestic*, Edward VI. Mary, and Elizabeth, vol I, 1547-1580, December 11th 1572. Thomas Digges to Lord Burghley.

¹⁵⁰ Thoren, *The lord of Uraniborg* (ref. 45).

¹⁵¹ BL MS Lansd. 19.30.

signalled the end of Digges' attempts to establish himself as a radical new astronomer. Leicester patronised him exclusively as an expert on the military arts. Unlike his friend John Dee, he accepted and made the most of these limited opportunities.

He dedicated the *Arithmaticall Militare Treatise, named Stratioticos* to Leicester, where he poignantly announced his change of direction. It was to be his last new work of natural knowledge.¹⁵² He had:

spent his younger years, even from my cradle, in the sciences liberal, and especially in searching the most difficult and curious demonstrations mathematical... yet finding none, or very few, with whom to confer and communicate those my delights (and remembering also that grave sentence of the divine Plato, that we are born not for ourselves, but also for our parents, country and friends), after I grew to years of riper judgement, I have wholly bent myself to reduce those imaginative contemplations to sensible practical conclusions of those my delectable studies, as also to be able, when time is, to employ them to the service of my prince and country.¹⁵³

In 1581 Leicester employed him to survey Dover Castle and town, and in 1582 put him in charge of the huge project of refortifying Dover Harbour. In 1586 he accompanied Leicester as muster-master-general of his patron's expeditionary force to the Netherlands, a post he held until shortly before his death. He defended Leicester's honour by writing a defence of his much-criticised relief of Sluse.¹⁵⁴ Reciprocally, as numerous papers show, Leicester remunerated Digges and protected him (as apparently did Cecil) in several litigious disputes.¹⁵⁵ Thus, even though Leicester seems to have been no more interested in Digges' innovative astronomy than was Cecil, he did provide a mathematician with courtly patronage of a very high order. Digges pragmatically chose to advance his country not Copernicanism.

¹⁵² London, 1579. He composed, possibly for Leicester, an unpublished manuscript called "The Second Paradoxe. That the antique Roman and Grecian discipline martiall doth farr exceede in excellencie our modern, notwithstanding all alterations by reason of the late invention of artillery and fireshott" BL MS. Lansd. 98 ff6.

¹⁵³ Preface, Leonard Digges, amended by Thomas Digges, *An Arithmaticall Militare Treatise, named Stratioticos*, 1579.

¹⁵⁴ http://es.rice.edu/ES/humsoc/Galileo/Catalog/Files/digges_tho.html

¹⁵⁵ Of considerable correspondence between Digges and Leicester, see especially BL Add. MS. 48084, ff. 232-311b. 'Letters and papers, mostly of Thomas Digges, Muster-master-General, relating to musters; 1585-1595; BL Add MS. 48083 ff. 235-246 concerns Digges' dispute with Commander John Norris. Digges also petitioned Burghley in a complaint against Waad, BL MS. Lansdowne 72. 63; BL MS. Lansdowne 67.5-6 documents Digges' complaint to Burghley against one William Digges, over a matter of several thousand pounds. See also BL MS. Egerton 1694.

3.5 Anomalous networks – Henry Percy and Thomas Harriot.

Any account of English patronage of natural knowledge, especially one that suggests a general ideology of utilitarianism, must address the patronage relationship between Henry Percy, 9th Earl of Northumberland and Thomas Harriot, together with the other scholars in his circle. If our preliminary research suggests that English patronage was utilitarian, and clients dissuaded from natural philosophy, then Percy and Harriot are significant exceptions. As we saw, Harriot has been called ‘the English Galileo’.¹⁵⁶ If we take seriously the importance of patronage in the construction of Galileo’s intellectual identity and work, that would make Percy the English Cosimo de Medici.

Percy was no Cosimo. To be sure, he had genuine, wide ranging intellectual interests and patronised clients to advance them. Leaving out his interest in the occult, the ‘variety of studies [suited] to a young head’ which he listed in his *Advice to His Son* (1609)¹⁵⁷ included ‘Arithmetic, Geometry, Logic, Grammar Universal, Metaphysics, the Doctrine of Motion, Astronomy, the Doctrine of Generation and Corruption, Cosmography, the Doctrine of *de Anima*, Moral, Politics, Economics, the Art Nautical and Military.’¹⁵⁸ But this work was written whilst Percy and his family were imprisoned in the Tower of London. He was in no position to advance anyone’s career or promote any innovative or heterodox natural philosophy.

In fact, Harriot began as a client of Percy’s friend Sir Walter Raleigh, whom he may have met in Oxford before he graduated in 1580. He was certainly a member of his London household by 1583. The mutual interests binding patron and client were navigation and exploration. In this high point of his popularity with Elizabeth, Raleigh used Harriot for his voyages to Virginia. Harriot trained his captains, mapped the new territories, surveyed their economic resources. He repaid Raleigh’s patronage by publishing in 1588 (and dedicating to him) his *Breife and true report of the new found land of Virginia*, a work that functioned in large part as propaganda for Raleigh – attracting support for a colony and countering hostile rumours about Raleigh’s ambitions.¹⁵⁹

In the event, it was, interestingly, Harriot’s only published work, and it supports a Diggesian picture of patrons bending bright mathematicians and philosophers to utilitarian work. At about the same time Harriot compiled for Raleigh a manuscript on projectile motion. Some have read it as the promising beginnings of a Galileo-style new theory of motion. The recent

¹⁵⁶ See ref. 20

¹⁵⁷ See Batho (ref. 26) for Percy’s occultism.

¹⁵⁸ Percy (ref. 25), 67.

¹⁵⁹ Shirley, *Thomas Harriot* (ref. 20), 19.

analysis by Walton persuasively recasts it as a pragmatic work of ballistics, commissioned by Raleigh as part of his thinking about naval gunnery.¹⁶⁰

The arriviste Raleigh's incautious use of his position as Elizabeth's favourite ensured his decline and fall. His growing friendship with Percy did not help. Percy was an outsider. From a Catholic family his religion was suspect. His powerbase was on the Scottish border (though this allowed him to cultivate the future James I). Perhaps more damningly, he had a justified reputation as a contemplative, free-thinking scholar, who entertained atheistic ideas in philosophy and metaphysics. Raleigh shared his client Harriot with Percy and, as Raleigh's fortunes disappeared in the early 1590s, he became one of Percy's pensioners. When charges of atheism were made against the Raleigh-Northumberland circle, Harriot (whose own beliefs were certainly heterodox) was implicated.

In the late 1590s, Percy sought greater favour by entering the mainstream at court. He volunteered for military service in the Low Countries. He attempted to learn some practical, military mathematics from Harriot, but his service was a fiasco – he was challenged to a duel by a seasoned commander outraged by the foppishness of his entourage. It was afterwards that his relationship with Harriot grew into intellectual companionship, and the pursuit of more speculative mathematics, astronomy and matter theory.

The arrival of James I changed everything. Raleigh soon fell from favour, was formally tried for treason in November 1603, imprisoned in the Tower and finally executed in 1618. Percy, who rode with James from Scotland, had unprecedented influence, until, of course, he, Harriot and others were visited by his Catholic cousin and Gunpowder Plotter, Thomas Percy, on 4 November 1604. Northumberland thus joined Raleigh in the Tower. Harriot was released, after addressing the Privy Council:

I was never any busy medler in matters of state. I was never ambitious for preferments. But contented with a private life for the love of learning that I might study freely.¹⁶¹

However genuinely contented Harriot had with a private life of learning that was how he lived after 1605, as did Percy's other philosophico-mathematical client Walter Warner.¹⁶² Harriot and Warner remained resident at Percy's Syon House, and Harriot received an annual pension of some £100 until he died in 1621. Apart from occasional communication and summonses to the Tower, Harriot had little contact with his patron.

¹⁶⁰ Walton, *Thomas Harriot's ballistics* (ref. 29).

¹⁶¹ Batho (ref. 26), 30; Shirley (ed.), *Thomas Harriot* (ref. 20), 29.

After 1605 he was indeed, perhaps at last, able to ‘study freely’. In the ensuing decade his intellectual trajectory did indeed overlap with Galileo’s, especially in his willingness to synthesise mathematics and natural philosophy. Besides reams of ingenious mathematics he investigated refraction both geometrically and experimentally. He became a convinced Copernican, even Keplerian. He may have pre-empted Galileo in turning telescopes upon the heavens, where he saw “Venus horned like the Moon, and spots on the Sun”.¹⁶³ And he developed an atomic theory of matter.

But only the intellectual trajectory overlapped with Galileo’s. Unlike Galileo, Harriot was barely a public figure. He published nothing. He kept his Copernican and atomistic work as private as possible. Whilst it may be true that historians have only begun to appreciate the scientific fertility of Harriot’s copious manuscript remains, the fact also remains that Harriot exerted almost no national, let alone international influence upon the development of natural knowledge in the early seventeenth century. Patronage analysis suggests that Harriot’s marginality arose directly from the marginality of his patrons, tainted as they were with charges of treason and heterodoxy. The philosophical circle of the ‘wizard earl’ seems to have been powerless as a counterweight to the largely utilitarian style of English patronage. Being similar to the intellectual patronage of ostentatious Italian and German princes, Percy has been treated as an exemplary English patron. On our reading, he was not.

4. Patronage, astronomy and natural philosophy in Elizabethan England – a case study in the consequences of utilitarianism.

Consideration of Harriot and his reputation as an English Copernican returns us to the issue of how the new astronomy fared in England. As we saw, Westman’s and Biagioli’s work has demonstrated the centrality of court culture and patronage to the development of Copernicanism in particular and physical astronomy in general. The number of Englishmen among the early Copernicans shows that English culture was in principle congenial.

Unlike Northern European Lutherans or Mediterranean Catholics, Anglican clerics rarely condemned Copernicanism. Passionate advocates as diverse as the puritan Thomas Digges and the sceptical William Gilbert suffered no public opposition. To be sure, the Reverend William Barlow, chaplain to the late Prince Henry, condemned Mark Ridley’s magnetic Copernicanism as irreligious, but only after provocation, and he admitted that he had refrained from making the

¹⁶² His utilitarian *Tract on the Use of Globes* (London, 1593) was dedicated to Raleigh.

same criticisms of Gilbert out of respect. Harriot's extreme caution is best read as arising out of the more general rumours of his atheism and his weak position as a Northumberland client.¹⁶⁴

Like other European courts, London circles were full of humanist enthusiasts for the *vita activa* such as Gabriel Harvey, who were dismissive of traditional learning and disciplinary constraints. And, as in Galileo's milieu, London hosted a mathematical community which melded ex-university lecturers with practical mathematicians and curious patrons, all with interests in a higher status for mathematics. In short, London court culture replicates in many respects the factors that stimulated the new discipline of physical astronomy elsewhere. Yet significant evidence exists that English patronage worked against it.

We have already reviewed the considerable evidence that patronly interests deflected Thomas Digges from his desired career as a realist astronomer. Where Digges stayed in England, his friend and patron John Dee chose self-exile from a diet of utilitarian, practical mathematical commissions. Dee developed an innovative cosmology even if, despite claims such as French's, he was almost certainly not a Copernican.¹⁶⁵ He certainly argued that mathematics had cosmological significance, and failed to find English patronage that allowed him to combine his mathematical and cosmological interests.

Another mathematician and Copernican was Edward Wright. Wright revealed his Copernican sympathies in the 'Laudatory Address' that he penned for William Gilbert's *De Magnete* of 1600. Wright had been a mathematical scholar and Fellow of Gonville and Caius College Cambridge from 1587 until 1596. We do not know whether Wright, like Gabriel Harvey, resented the intellectual limitations of Cambridge but in 1596 he accepted an offer of patronage from George Clifford, 9th Earl of Cumberland. Despite his lack of experience, he entered Clifford's service specifically to observe and advise on navigational practice during a raiding voyage to the Azores. The commission changed Wright's career. Moving to London, and perforce resigning his fellowship, he published exclusively on navigation, and rose to serve Prince Henry as mathematics tutor, navigation expert and (had the prince not died) Royal Librarian.

Wright's first publication was his famous *Certaine Errors in Navigation* of 1599, the outcome of his work for Cumberland and dedicated to him. In terms reminiscent of Digges, Wright recorded how it was through Cumberland that he 'was first moved, and received maintenance to divert my mathematical studies, from a theoricall speculation in the Universitie, to the practical demonstration of the use of Navigation.' In the preface he wrote that he had

¹⁶³ Appropriately, he bequeathed his two 'perspective trunckes' to Percy. Taylor, *Mathematical Practitioners* (ref. 89), 183.

¹⁶⁴ Batho (ref. 26), 31-2, 45-6. That the accusations were unfounded is shown by Scott Mandelbrote "The religion of Thomas Harriot" in Fox (ref. 26), 246-79.

concentrated on navigation 'neglecting other studies and courses that might have been more beneficial to me'.¹⁶⁶

It is not inconceivable that Wright saw his considerable involvement with Gilbert's *De Magnete*, clearly a work of natural philosophy, as a means of establishing his intellectual credentials as a speculative as well as a practical mathematician, as a mathematician (like Galileo and Kepler) with things to say in his 'address' about the cosmos and Biblical exegesis. Whatever his intention, Wright's patronage opportunities destined him to remain an expert in navigation.

This brings us to England's third early Copernican, William Gilbert himself. Like the numerous physicians mentioned in this paper, Gilbert's rise to prominence as a London doctor depended upon noble patrons. They included Gilbert Talbot, Earl of Shrewsbury, Sir Francis Walsingham, William and Robert Cecil. Such excellent court connections smoothed the path to his appointment as one of Elizabeth's physicians in 1601.¹⁶⁷ Moreover, courtly patronage gave him the credibility, wealth, leisure and intellectual independence to publish his iconoclastic, anti-Aristotelian work of magnetic philosophy.

De Magnete is a remarkable work of natural philosophy in many ways. It demonstrated that the Earth was a magnet, it did so experimentally, it drew out navigational applications, and it argued that terrestrial magnetism rotated the Earth in Copernican orbits. Given the conventions of Elizabethan publishing, it is also remarkable in having no dedication – there is only the address by Edward Wright, Gilbert's inferior in several ways. Whilst Gilbert made characteristically iconoclastic remarks about philosophical authors who sought to dignify derivative work by 'going abegging for some patron', it is reasonable to conclude that Gilbert found no patron for his work of magnetic and Copernican philosophy.

Given the utilitarian interests of most English patrons, we might think that *De Magnete* is the most remarkable and influential work of Elizabethan natural philosophy precisely because it transgressed the boundaries of the readily patronisable. Gilbert's magnetic philosophy did not lack utility. As Edward Wright felt bound to emphasise in his 'Address', *De Magnete* offered solutions to the navigational problems of both latitude- and longitude-finding. But *De Magnete* was primarily a natural philosophy of the Earth's magnetic soul and motions, and their incompatibility with Aristotelian cosmology and theories of matter. With the exception of Henry Percy, we have not encountered an Elizabethan patron who might have been interested in such a work.

In the light of Digges', Dee's and Wright's careers, and of the patronless *De Magnete*, we suggest that Elizabethan court culture differed from the well-studied cultures of Florence, Prague,

¹⁶⁵ French (ref. 3), 102-3.

¹⁶⁶ Edward Wright, *Certain Errors in Navigation* (London, 1599), sig. Q4-Qbv; Preface, p.2.

Hesse-Cassel, the Copenhagen of Tycho and, of course, Tycho's Uraniborg itself. With the exception of the marginal Percy, Elizabethan patrons discouraged clients from exploring the integration of mathematics and natural philosophy into a new discipline of physical astronomy. We suggest that they imposed a patronage culture of utilitarianism. They may have considered the transformative natural philosophy that flourished in relatively rich and territorially secure states to be luxuries in an impoverished, threatened commonwealth.

This is not to say that Elizabethan patronage was conservative. The high and exclusive value placed by noble patrons upon the utility of the mathematical and mechanical arts was surely a major factor in the creation of a large, vibrant, self-confident community. As Bennett has shown, that community matured to make its own claims about the relevance to natural philosophy of its aims and practices.¹⁶⁸ But English court culture did not, of itself, encourage the synthesis of mathematics and natural philosophy that existing patronage studies can suggest was widespread.

5. Jacobean patronage.

We noted above that James's accession considerably changed the nature of patronage. He brought in his own entourage at the expense of many Elizabethan clients, increased the amount of patronage, centralised it, established satellite courts for his wife and son, and set a more splendid and philosophical tone. The expansion of commercial publishing, lecturing and instrument making, of the 'medical marketplace', and of the concomitant role of 'the public' as patron, continued to reduce the role of the genuine patron-cum-dedicatee. Gresham College, finally founded in 1597 but only now hitting its stride, provided a new institutional focus. Our research on Jacobean patronage is at an earlier stage than for Elizabethan, but it seems clear that these changes provided different opportunities for client makers of natural knowledge.

Royal patronage of natural knowledge was new, and encouraged new directions. Where Elizabeth had attracted few dedications, the Stuart household, James and Prince Henry in particular, received many. Probably the most striking development was the growth of Prince Henry's court. James appointed members of the prince's household who would fashion him the image of a sophisticated, learned, prince poised to succeed James as a leader of Protestant Europe. His premature death in 1612, aged 18, was treated as a national catastrophe. In evocation of the earlier Henry, and in marked contrast to Elizabeth, the Henrician entourage spearheaded the

¹⁶⁷ Pumfrey, *Latitude* (ref. 70), 19-23.

¹⁶⁸ Bennett, "Geometry and Surveying" (ref. 8).

patronage and collection of art, architectural work, the accumulation of a royal library of thousands of volumes – and the support of natural knowledge.

Prince Henry was provided with trusted, able tutors who were familiar with the learned noble academies that flourished in Italian states. Henry was, briefly, the most elevated pupil in what Roy Strong has called a ‘small academy of aristocratic youths’¹⁶⁹ and what James himself called ‘a courtly college’.¹⁷⁰

But Henry’s court also became a centre for learning and research in science and exploration, and especially in navigation. The products were sometimes un-Elizabethan and ostentatious – James commissioned Phineas Pett to build for Henry a model galleon, the *Disdain*.¹⁷¹ In many ways, however, the activity remained quite Elizabethan or Cecilian in its utilitarianism. Given that it seems to have been co-ordinated by Thomas Chaloner, that is not surprising. Chaloner had received his Oxford education as a client of William Cecil. He had a reputation as ‘an ardent natural philosopher’,¹⁷² but was also a good mathematician, who tutored Robert Dudley, son of the Earl of Leicester, in mathematics at Oxford. In Cecilian style, Chaloner enriched himself by opening England’s first alum mine in Yorkshire in 1600, and profited from James’ subsequent prohibition of imported alum. As Elizabeth’s reign came to an end, Robert Cecil sent him to Scotland, where he gained James’ favour.¹⁷³ Chaloner was appointed Henry’s tutor in 1603, and became the governor of his household.

Chaloner’s precise involvement with the Henrician programmes of natural knowledge remains unclear.¹⁷⁴ He certainly continued Cecil’s projection policy, and ‘the scheme of M. Villeforest to extract silver from lead was entrusted by [Prince Henry] to Chaloner and Sir William Godolphin for trial.’¹⁷⁵ He may also have recruited William Barlow as the Prince’s chaplain. Whilst Barlow was ordained, he was better known as a navigation expert, who had published his *Navigators Supply* in 1597, dedicated to the Earl of Essex, and who had discussed magnetism with William Gilbert.

Barlow’s duties certainly included continued research on Gilbert’s magnetic philosophy and navigation. He dedicated a 1609 manuscript on it to Chaloner, which formed the basis of his

¹⁶⁹ Strong, *Henry Prince of Wales* (ref. 26), 5. The boys at Henry’s court included Lord Cranbourne (son of Robert Cecil, 1st Earl of Salisbury, and grandson of William Cecil, Lord Burghley), the 3rd Earl of Essex (son of Elizabeth’s favourite, Robert Devereux, 2nd Earl of Essex), and John Harington, heir to the Prince’s tutor Lord Harington of Exton.

¹⁷⁰ DNB vol iii, pp.1367-8.

¹⁷¹ Strong, *Henry Prince of Wales* (ref.30), 35.

¹⁷² Feingold, *Mathematician’s apprenticeship* (ref. 82), 63.

¹⁷³ DNB vol iii, pp. 1367-8.

¹⁷⁴ But see Strong, *Henry Prince of Wales* (ref. 30).

¹⁷⁵ DNB vol iii, pp. 1367-8.

Magneticall Advertisements, only published in 1616 after Henry's court (and his position) was dissolved.

Another key member of Henry's circle was Edward Wright, who moved from ad hoc lecturing and would have 'become the Prince's librarian had the tragic events of 1612 not taken place'.¹⁷⁶ Wright too was employed to further navigation, including the principles of magnetic navigation that he had worked on with Gilbert. These were significant additions to the second edition of his *Certaine Errors*, published in 1610 and dedicated to Henry. Wright and others also advised explorers such as Hudson and Baffin, whose voyages were backed by members of Henry's household. Thomas Lydiat was the Prince's cosmographer, and Humphrey Cole advised on geography.

Thus, while the activity remained predominantly utilitarian, there were significant differences. Clients like Wright, Barlow and Lydiat now had stable positions at court. They formed the nucleus of a group of practitioners. And whilst it would not be true to say that Gilbert's magnetic philosophy formed a major interest, Henry's navigation experts were encouraged to explore this theoretically coherent, causal body of knowledge. Indeed, it was the English works of Wright, Barlow, and their acquaintance Mark Ridley who publicised *De Magnete* to a non-Latinate audience, and who defended it from the attacks of Antony Linton and (his likely source) Guillaume de Nautonnier.

The court of Henry's mother, Anna of Denmark, was also influential.¹⁷⁷ Anna was the daughter of Frederick II and Queen Sophia. Their Copenhagen court, where women exerted intellectual influence, was famous for its patronage of natural knowledge, including new philosophy. Shackelford has uncovered the network of courtly Paracelsians around Peder Sorenson (Severinus). Frederick had personal interests in alchemy and astrology. He and Sophia also supported Tycho's extraordinary astronomical (and alchemical) work at Uraniborg. It seems likely that James VI deepened his acquaintance towards Paracelsian medicine and alchemy when he visited Denmark to conclude the marriage.¹⁷⁸

Certainly James and Anna were active in advancing 'Paracelsian' chemical medicine and philosophy in England. James arrived with his own royal, chemical physician John Craig, and insisted that the College of Physicians alter its statutes concerning foreigners in order to admit him. He intervened personally to protect heterodox and 'unlearned' practitioners such as Leonard

¹⁷⁶ Strong, *Henry Prince of Wales* (ref.30), 164.

¹⁷⁷ Indeed, the extent to which Henry's milieu, before he became Prince of Wales in 1610, was actually controlled by Anna remains unclear. Leeds Barroll, *Anna of Denmark, Queen of England: a cultural biography* (Philadelphia, 2001) suggests that her influence upon Henry was considerable.

¹⁷⁸ Hugh Trevor-Roper, "The Court Physician and Paracelsianism", in V. Nutton (ed.), *Medicine at the courts of Europe, 1500-1837* (London, 1990), 79-94.

Poe and Francis Anthony. Above all, he and Anna invited to court the Huguenot chemical physician Theodore Turquet de Mayerne. Mayerne, a royal physician to the assassinated King Henri IV of France, needed sanctuary. He found it as the personal physician first to Anna, and subsequently to James, Henry, and Charles. James also sanctioned his leading role in the desperate attempts to cure Prince Henry.¹⁷⁹

Jacobean court patronage seems, then, to have been a significant factor in the development of Allen Debus's group of 'English Paracelsians', despite opposition from the College of Physicians. It is important to recall Webster's correction of Debus: English Paracelsians included not only pragmatic empirics from the lower rungs of the medical hierarchy, but also men with sophisticated natural philosophies that drew on alchemical principles.¹⁸⁰ Further research must establish the full extent to which chemical philosophy in Jacobean England depended, as it did in Marburg and Copenhagen, upon the opportunities for disciplinary innovation provided by court culture.

James was not afraid personally to patronise startling new philosophy. We have already noted his support for the eclectic Paracelsian, Rosicrucian and occultist Robert Fludd, and his apparent willingness to accept the dedication of Fludd's extraordinary *Utriusque Cosmi* of 1617. Frances Yates speculation that James was, like Fludd himself, sympathetic to an eirenic and Europe-wide, though Protestant-led, renewal of spiritual philosophy and theology is probably a wild one.¹⁸¹

In any case, James's patronage of Fludd was balanced by his patronage of Isaac Casaubon. Casaubon was, like Mayerne, a prominent Huguenot intellectual, who needed the protection of a Protestant state. He came to England at the invitation of Richard Bancroft, James's first appointment as Archbishop of Canterbury.¹⁸² James seems to have employed Casaubon more as a personal assistant in humanist scholarship than as a scholar in his own right. It appears that Casaubon become quickly disillusioned with life at James's court,¹⁸³ and rather pettishly expressed envy at the salary of James's physician, fellow Huguenot refugee, Theodore Mayerne.¹⁸⁴

¹⁷⁹ Allen Debus, *The French Paracelsians: the chemical challenge to medical and scientific tradition in early modern France* (Cambridge, 1991); Sir Charles Cornwallis, 'Copie of a letter touching the death of Henry, Prince of Wales', 1613, BL Add. MS. 11,532.

¹⁸⁰ Debus (ref. 6); Charles Webster, 'Alchemical and Paracelsian medicine' in Webster (ed.), *Health, medicine and mortality in the sixteenth century* (Cambridge, 1979), 301-334, esp. 320.

¹⁸¹ Yates, *Rosicrucian* (ref. 37), 78.

¹⁸² Thomas G. Bergin and Jennifer Speake (eds), *Encyclopaedia of the Renaissance* (Aylesbury, 1988), s.v. "Casaubon, Isaac".

¹⁸³ Willson, *King James VI & I* (ref. 55) 230-1, 239-40. The sections on Casaubon are largely un-referenced.

¹⁸⁴ P.R.O. SP/67, f.42, John Chamberlain to Dudley Carleton, December 11th 1572.

The Dutchman Cornelis Drebbel was another beneficiary of the Jacobean court's taste for ostentatious work. Drebbel fed the royal appetite for entertaining wonders, pyrotechnics, and the 'arts mathematicall', inventing among other things, a *perpetuum mobile* or automatic musical instrument made to play by the rays of the sun, and a telescope. Drebbel was a client of both James and Prince Henry, until he attracted the attention of Rudolph II's court in Prague and was permitted to go there in 1610. When Rudolph was deposed in 1612, Drebbel was imprisoned but freed at the request of Henry and, when Henry died also in 1612, James renewed his patronage.¹⁸⁵

Thus James was an ambitious patron of natural philosophy in a style ignored by the Elizabethan court. He put Whitehall back on the European map as a centre of learning and innovation, even if it was not prestigious enough to keep Casaubon happy or to lure Kepler away from Prague, as James entreated him.¹⁸⁶ He supported William Harvey, discoverer of the circulation of the blood, by making him a royal physician. Harvey's *De Motu Cordis* was published outside the period of this study, in 1628, and dedicated to Charles I, although he arrived at his conclusions in the late 1610s. The work is a classic example of ostentatious natural knowledge so rarely patronised in Elizabethan England. His discovery and conclusions were novel contributions to the natural philosophy and anatomy of animals. They seemed to threaten traditional doctrine. There were no clear medical benefits. Above all Harvey crafted his physiology into an ostentatious Galileo-style emblem of the patronage relations that supported it – he analogised the blood circulating from a central heart to the body politic revolving around the vivifying monarch.¹⁸⁷

Much work remains to be done, especially upon significant Stuart patrons such as the Earl of Arundel.¹⁸⁸ Nevertheless, we think that we have established a *prima facie* case for a significant difference in style between Elizabethan and Jacobean patronage of natural knowledge.

6. Patronage and connectivity – a hypothesis.

There is evidence, then, that, compared with the Elizabethan period, Jacobean patronage of natural knowledge took on some of cultural diversity and ostentation exhibited in the canonical

¹⁸⁵ Strong, *Henry Prince of Wales* (ref. 26), 162. The major work on Drebbel is still F.M. Jaeger, *Cornelis Drebbel en zijne tijdgenooten* (Groningen, 1922); see also G. Tierie, *Cornelis Drebbel (1572-1633)* (Amsterdam, 1932); <http://es.rice.edu/ES/humsoc/Galileo/Catalog/Files/drebbel.html>.

¹⁸⁶ Caspar, *Kepler* (ref.3) also notes that Kepler considered James I was his "great hope in matters of creed" and had "intended to dedicate *Harmonices Mundi Libri V* to James I of England", but because of the political situation of the time the dedication was "forbidden by the censor". See pp. 252, 288.

¹⁸⁷ For natural philosophy as emblematic of patronage see Mario Biagioli, "Galileo the Emblem Maker," *Isis* 81(1990), 230-258.

¹⁸⁸ For Arundel's patronage of the fine arts see Parry, *The golden age restor'd* (ref.1), ch. 5.

courts of patronage studies. Consequently, there were more opportunities for clients to engage in disciplinary innovation and new natural philosophy. The impression remains of a comparatively limited network under the control of key political actors. This provisional conclusion returns us to a consideration of connectivity.

For almost every form of our earlier classification of patronage types and interests, the evidence suggests that English clients were poorly connected. First, and most obviously, England was geographically disconnected as an offshore island. Secondly, living in a politically dependent, Anglican state clients could not seek the splendid patronage of imperial courts or the Catholic church without facing exile or worse. The Church of England's patronage was no match for that of Rome, and connections with other centres of Protestant intellectual endeavour were weaker. Moreover, Anglican patronage was under political control, effectively collapsing it into a branch of state patronage rather than an alternative, as it was for Aldrovandi. In any case, we have found no evidence that the Anglican episcopacy patronised natural knowledge.

England's position as a centralising nation state with imperial and colonial ambitions also reduced connectivity. Outside Oxbridge, London hosted the only significant communities of natural knowledge makers. These were primarily mathematical and mechanical practitioners and medical men. At this time there were no other regional capitals with grand patrons, colleges, informal humanist academies, or circles of physicians and practitioners of the arts, as there were in Italy, Germany and, as David Lux has shown for a later period, France.¹⁸⁹ Moreover, court patrons generally directed clients to suitably utilitarian projects, and there were no successful 'oppositional' court subcultures.

The dominance of London presents a further hypothesis for further research on connectivity. London differed from the classic sites of court culture in having no university. Patronage scholars conclude that innovation was stimulated by the geographical proximity (a fundamental form of connectivity) of different sites, personnel and practices. The contiguity of university, dockyard and aristocratic households created this for Galileo in Venice, just as the university, pharmacy, botanical garden, senatorial and ecclesiastical networks provided it for Aldrovandi in Bologna. Both men moved effortlessly between the sites, creating new identities and practices through what Biagioli calls bricolage.¹⁹⁰

It is much less obvious how English clients could creatively combine such roles. To be sure, the gentlemanly Inns of Court were called, even by contemporaries, England's 'third

¹⁸⁹ David Lux, *Patronage and royal science in seventeenth century France: The Academie de Physique in Caen* (Ithaca, New York, 1989).

¹⁹⁰ Mario Biagioli, 'Scientific revolution, social bricolage, and etiquette', in *The scientific revolution in national context*, Roy Porter and Mikuláš Teich (eds) (Cambridge, 1992), 11-53.

university', but we have not found evidence that its institutional sociability promoted natural knowledge.¹⁹¹ Sir Thomas Gresham's College flourished in the early seventeenth century but its professors of astronomy and geometry were required to meet the utilitarian interests in practical mathematics of London's mercantile and maritime communities.¹⁹² The new 'patron' of the book-buying public seems to have been similarly interested in practical self-help manuals not natural philosophy.

This leaves Oxford and Cambridge Universities. The role of the universities in promoting new, more humanistic, courtly and useful natural knowledge has recently become a matter of debate. Set against the conservative picture drawn from an institutional, statutory perspective by Costello, historians such as Feingold and Cormack have pointed to the existence of an informal network of mathematics tutors, whose expertise mediated between the formal curriculum and new interests in practical mathematics.¹⁹³ They rightly point to the university background of many of the London- and court-based innovators, and the range of contemporary instruction they acquired there.

Such work yields two salutary lessons for a study of patronage such as this. First, contrasts between England's university institutions and London must not be overdrawn. As this study confirms, universities were also permeated by networks of patronage centred on London. Secondly, considerable and detailed research is needed to uncover informal communities whose interests defy a simple dichotomy between 'traditional' and 'innovative' work.. Our preliminary findings may well be challenged by more fine-grained archival research.

Nevertheless, at this stage we hypothesise a greater divide between university and court culture in England than elsewhere. For example, it seems to have been impossible for clients to combine the roles of university professor with service to courtiers and merchants and intimacy with sites of practice such as the Deptford dockyards or city instrument makers. If humanists like Gabriel Harvey exaggerated the gulf between the *vita contemplativa* of Cambridge and the *vita activa* in London, clients like Edward Wright were effectively forced to choose between them. And whilst Oxford and Cambridge provided a more fertile preparation than was once thought, their alumni seem to have found material opportunities to develop and influence intellectual, practical and disciplinary innovation once they had left.

We conclude, then, that English practitioners, perhaps uniquely, lacked the rich and various patronage connections of many European counterparts. Consequently, they were more

¹⁹¹ Wilfred R. Prest, *The Inns of Court under Elizabeth and the early Stuarts, 1590-1640* (London, 1972); Brian P. Levack, *The civil lawyers in England, 1630-1641* (Oxford, 1973).

¹⁹² Ames-Lewis, *Sir Thomas Gresham and Gresham College* (ref.7); John Ward, *The lives of the professors of Gresham College*, 1967, Reprint of the London edition of 1740.

dependent upon a small group of courtier politicians whose concerns, especially under Elizabeth, were utilitarian. To repeat, we do not say that early modern English patronage did not support innovation. It was crucial to the consolidation of England as a military and economic power on the world stage. But, like revolutionary France, England seems to have had little need of natural philosophers.

7. Francis Bacon and patronage policy in early modern England.

We have left to the end the most historically influential Jacobean writer on natural knowledge, Francis Bacon. He published his first programme for the reform of natural knowledge, *The Advancement of Learning*, and dedicated it to James I within two years of his accession.¹⁹⁴ It was a play for patronage (indeed, a wordplay on 'advancement'), and Bacon bolstered his cause by presenting copies to leading courtiers such as Robert Cecil (now Chancellor of Cambridge University) and Lord Buckhurst (Cecil's Oxford counterpart).¹⁹⁵ He made occasional attempts to gain support while active in James' administration, but used his *Novum Organum* (also dedicated to James, together with a private address to James)¹⁹⁶ and other parts of *Great Instauration* as a ploy to regain favour after his dismissal from court for corruption in 1620. Bacon's project therefore seems ripe for analysis using patronage theory. Julian Martin and John Leary have already produced brilliant reassessments of Bacon's project.¹⁹⁷ They read it as the product of a lifelong court politician formed in the Elizabethan period and wielding power under James' centralising regime. For example, they point out how incongruous it is to interpret Bacon's vision of natural philosophy as free, open-ended enquiry, when Bacon (and his masters) feared the destabilising potential to the state of free thinking, in natural philosophy as much as in religion. Conversely, they read Bacon's vision as a rigorous, hierarchical state programme. Individual investigators play strictly defined roles as they cooperate to produce knowledge of nature and applications that are primarily of use to the state or commonwealth. Gaukroger's recent analysis agrees that Bacon's project was to bring natural philosophy within the orbit of *negotium* [affairs of state], and to refashion natural philosophers as civil servants. Moreover, he had developed much of it by 1592.¹⁹⁸

¹⁹³ Feingold, *Mathematicians' apprenticeship* (ref. 4) and Cormack, *Charting an empire* (ref. 4).

¹⁹⁴ *The Two Bookes of Francis Bacon. Of the proficiencie and aduancement of Learning, diuine and humane* (London, 1605).

¹⁹⁵ Jardine and Stewart (ref. 71), 285-8.

¹⁹⁶ Jardine and Stewart (ref. 71), 437-8.

¹⁹⁷ Martin and Leary (ref. 71).

¹⁹⁸ Gaukroger (ref. 71), 45-57.

This persuasive reading suggests that Bacon's project was born out of, if not tailor-made for, the courtly values of Elizabethan and Jacobean England. If so, then two questions arise. First, to what extent did Bacon draw upon his first hand knowledge of court patronage of natural knowledge in formulating his vision? Secondly, why did his own efforts to gain James' support for it meet with such little success? In what follows we offer a few early speculations.

Bacon's career had begun with the patronage of his uncle, William Cecil, continued with Robert Cecil's, and he acquired the skills of administration in a fundamentally Cecilian regime.¹⁹⁹ His father had been Cecil's fellow Athenian, and Sir Thomas Gresham was his kinsman. Francis would certainly have been familiar with any Elizabethan patronage policy concerning natural knowledge. For James he controlled the economic system of monopoly patents that Cecil had set up. There are several elements of Bacon's 'reforms' that reflect the utilitarian culture that dominated Elizabethan patronage.

First, there is Bacon's utilitarian concern with the commonwealth. The first purpose of natural knowledge was to improve the material condition of the monarch's subjects, through better health, living conditions and the availability of commodities. Its other purpose, of systematic knowledge of the causes of things, could wait its moment. As Martin and Leary have shown, Bacon's emphasis upon the humane purpose was grounded in sound politics. Those owed much to the commonwealth ideology forged in his father's England.

Second is Bacon's rejection of existing natural philosophies. His dismissal of university Aristotelianism as a sterile system concerned with 'words not things' was, of course, widely shared, not just among ambitious Londoners but in humanist and courtly circles throughout Europe. What is interesting is his similar rejection, as flawed, oversystematised philosophies, of alternatives such as Paracelsism, alchemy and even Gilbert's magnetic philosophy. Bacon did not, of course, believe that the traditional aim of natural philosophers to arrive at general axioms was unattainable. Rather, in the present state of fallen ignorance, it was premature. Whilst they would not have shared Bacon's philosophy, Elizabethan patrons generally acted as though the various new natural philosophies had no value.

Third, and related, is Bacon's strictly utilitarian maxim that 'truth and utility are the very same thing'. As Gaukroger suggests, this is best read in Machiavellian not Platonic terms.²⁰⁰ As such it reflects the pragmatic operationalism that seems to have guided Elizabethan patrons. Fruits, practical results, not fine theories, were the test of a practitioner's worth.

¹⁹⁹ Jardine and Stewart (ref. 71). See for example, 149.

²⁰⁰ Gaukroger (ref. 71), 17.

Fourthly comes Bacon's positive evaluation of the practical arts, especially the mechanical arts. It is the progress made by inventors and practical producers that gives hope that nature can be dominated and the commonwealth given what it needs to be secure. This certainly was Cecil's policy. What Bacon hoped to supply was a rational method that would link a flourishing community of practitioners with productive philosophy. As Harkness has observed, London provided Bacon with concrete inspiration. As a law student he had lived a 'stone's throw from the St Clement – St Dunstan instrument-making neighbourhood... Bacon did not need to actually dream up the displays of ingenuity and inventiveness that he describes [in the *New Atlantis*].'²⁰¹

Fifthly, one might even see Bacon's rigorous empiricism in Elizabethan policy. Just as, for Bacon, a recalcitrant nature had to be tamed by the accumulation of experimental trials and observations, so did Elizabethan patrons treat with suspicion the claims of projectors or educated experts. One recalls Cecil's empirical resolution of the theoretical argument between his military engineers, which Heal and Holmes elevate into a kind of Cecilian methodological principle.²⁰²

Finally, in *New Atlantis* we come across another parallel. Agents were to be sent incognito from Bensalem to scour other countries, in order to acquire their knowledge, for example of machines and manufacturing processes. In the real world, Cecil had inaugurated a similar policy of searching abroad for individuals or communities of strangers who would enhance the domestic economy.

There are grounds, then, for reading Bacon in part as a perceptive and ambitious codifier of a specifically Elizabethan patronage culture, a culture that eschewed ostentatious natural philosophy for a utilitarian mastery of nature. Bacon added two crucial dimensions. First, he proposed a method or procedure. The method would eliminate the trial-and-error nature of Elizabethan practice, of both the makers of true natural knowledge, who were generally untrained craftsmen, and of the state patrons, who were also unsystematic and reactive in the work they commissioned. Secondly, via the method, he reconnected the utilitarian aims of the Elizabethan system to the neglected natural philosophical aim of causal knowledge.

Little systematic research has been conducted into the reception of Bacon's programme in his own milieu of the Jacobean court. It is almost impossible to find a positive domestic reaction to Bacon's reforms. As Jardine and Stewart show, Bacon's most admiring correspondent was Tobie Matthew, the exiled and recusant son of an archbishop, whom Bacon had helped to get released

²⁰¹ Deborah E. Harkness, "Strange Ideas and 'English' Knowledge: Natural Science Exchange in Elizabethan London", in Pamela H. Smith and Paula Findlen (eds.) in *Merchants and marvels: commerce, science, and art in early modern Europe* (London, 2002), 137-160, p.151.

²⁰² Heal and Holmes (ref. 49), 220.

from prison. Before he took up his position in Whitehall, Isaac Casaubon read *The Advancement of Learning* to improve his English. Casaubon at least declared himself impressed. Bacon's Latin reply hints at his frustrations:

You are right in supposing that my great desire is to draw the sciences out of their hiding-places into the light... How great an enterprise in this kind I am attempting, and with what small helps, you will perhaps learn hereafter'.²⁰³

The helps were indeed small. James described the *New Organon* as 'like the peace of God, that passeth all understanding', and John Chamberlain reported Henry Cuffes's judgement that "a fool could not have written such a work, and a wise man would not". Harvey (Bacon's own physician) dismissed them as philosophy written 'like a Lord Chancellor', which Gaukroger glosses as criticism of Bacon's faith in expert systems.²⁰⁴ His friend Thomas Bodley read and criticised *Cogitata et visa*, 'entirely failing to comprehend the sweeping nature of Bacon's altered vision' and insisting upon the adequacy of tradition.²⁰⁵

There are, of course, many reasons why a court would not have patronised Bacon's revolution. Leaving aside philosophical arguments about the impossibility (or, to James, comprehensibility) of a 'Baconian method', the universities would have been as resistant as Bodley. Bacon, who would have headed any reform, was a disagreeable and controversial figure. The problems of finance and organisation were beyond the Jacobean government. The payback, in terms of 'experiments of fruit' and enhanced stability, was most uncertain in such a long term project, even if, as Bacon pleaded, James's support would have been worth one hundred years of work.²⁰⁶ Gaukroger has suggested that Bacon failed to appreciate the significance of the existence of his uncle's Gresham College. He also suggests a practical reason:

[Bacon] did not himself have much idea what might be involved at the organisational level... how the tasks [were] to be funded and allocated, or just how the benefits of his proposals might be delivered...²⁰⁷

²⁰³ Jardine and Stewart (ref. 71), 301-9, 303.

²⁰⁴ Gaukroger, *Francis Bacon* (ref. 71), 163n.52.

²⁰⁵ Jardine and Stewart (ref.71), 439, 311

²⁰⁶ Jardine and Stewart (ref. 71), 438.

²⁰⁷ Gaukroger, *Francis Bacon* (ref. 71), 164.

All are weighty explanations, but we would like to suggest one other. If we are right to see Bacon's utilitarian plans as Elizabethan in inspiration, and if James did preside over a change of patronage culture, then it may be that *The Great Instauration* now seemed inappropriate – too utilitarian, perhaps; incapable of delivering results instantly enough to glorify the necessarily munificent patron; unsuited to James's taste for ostentatious philosophy; suspect, maybe, for its hints of puritan millennialism.

Whatever the reason, we know that Baconianism[s] flourished only after James and Bacon's deaths in 1625 and 1626. 1626 is when Webster begins his study of the puritan and anti-Stuart instauration attempted by Hartlib and others. With a dose of historical amnesia, Bacon the client philosopher was eventually joined to a Stuart patron – on the frontispiece of Thomas Sprat's *History of The Royal Society* of 1667.²⁰⁸

8. Conclusion.

This article has ranged from dense but patchy empirical research to barely supported speculation. The first conclusion is that much more research needs to be done, especially of the many informal, less visible networks. It should be done, we believe, because the case of patronage of natural knowledge in England has the potential to transform our understanding of early modern science in several ways.

First, it offers a contrast with other patronage cultures, the nature of which needs more profound testing of our categories of utilitarianism and ostentation. Secondly, it sheds important new light upon the specifically English context, one that may have crucially lacked a richness of opportunity or connectivity present elsewhere. Thirdly, it promises additional explanation of the development of new disciplines such as physical astronomy, chemical medicine and magnetic philosophy. Finally, if Baconian empiricism and utilitarianism had roots in the policy of major Elizabethan patrons, as we tentatively suggest, then courtly patronage will play an even bigger part in our understanding of the so-called scientific revolution.

[We wish to acknowledge gratefully the award of small research grants from both the University of Lancaster and The Department of History, University of Lancaster, which made possible much of the primary source research in this article. We also wish to thank Tom Dixon, Richard Dutton, ,

²⁰⁸ Thomas Sprat, *The history of the royal-society of London, for the making of natural knowledge* (London, 1667), frontispiece.

Alison Findlay, Paolo Palladino, Maurice Slawinski and Richard Wilson for their comments on an early version.

Funding has permitted consultation of only a proportion of manuscripts so far identified as relevant. Where folio numbers are given, they have been consulted. Where a manuscript is referred to in the form (for example), BL MS. Lansdowne 64.34, the reference is to an item number in the index and description.]