

CIVILITY AND SCIENCE : FROM SELF-CONTROL TO CONTROL OF NATURE, 1500-1650

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For the last twenty years, perhaps longer, a fundamental focus of research into the Scientific Revolution has been the institutionalization of the new science. Historians today are well aware that the simple formulation of new ways of thinking about the natural world in the course of the sixteenth and seventeenth centuries hardly accounts for their popularization. The Scientific Revolution deserves its revolutionary sobriquet because the ideas of a Galileo, a Descartes or a Newton eventually became part of the mental baggage of ordinary educated people. Had this not been the case, then their achievement - the creation of a 'mechanized world picture'¹ - would have been of marginal importance and would never have laid the foundations of modern industrial society.

My own work has concentrated on the role of the universities and other institutions of higher education in disseminating the new science.² Because Francis Bacon and other leading lights in the movement poured scorn on the universities as centres of Aristotelian darkness, early historians of science assumed that the universities played little role in the Scientific Revolution beyond providing the odd experimental philosopher, notably Newton, with board and lodging.³ It is now generally recognized, however, that institutions of higher education were crucial agents in the transmission of the new science, albeit belatedly. Before 1700 at any rate, most members of Europe's noble and professional elite gained their major and sometimes only acquaintance with natural philosophy in the classroom. What they were told about the natural world by professors of philosophy, therefore, to all intents and purposes determined their world-view.⁴ In the longer term, too, the different ways in which the new science was transmitted in the classroom had a differential effect on the

direction and fecundity of scientific endeavour in particular states. The development of France, for instance, as the centre of mathematical physics in the period 1790 to 1830 can be explained in large part by the manner in which Newtonian physics came to be taught in the *collèges de plein exercice* after 1750. Like other Frenchmen who were schoolboys in the decades before the Revolution, Laplace, who studied at Caen under Christophe Gbled, was introduced to Newtonianism mathematically. The first six months of the physics course was devoted to the study of mathematics from first principles to calculus: the knowledge thus acquired was next used to study the physics of motion as the starting-point for understanding Newtonian astronomy.⁵ In England, in contrast, Newton was introduced experimentally. Although Cambridge in the eighteenth century was the centre of a highly sophisticated mathematical education, the university showed little interest in mathematical physics.⁶ Not surprisingly, then, England in the early nineteenth century had a reputation for the vitality of its experimental but not mathematical science.⁷

Admittedly, universities have not been the primary focus of historians' attention. For obvious reasons much more has been (and continues) to be written about scientific academies, especially the Royal Society and the Paris Académie des Sciences.⁸ There is an obvious reason for this. It was in and through the academies that experimental philosophers gained peer-group recognition for their activities and the new science evolved a set of ethical and technical practices which gave it a definitional identity. Furthermore, it is clear that in a hierarchical, ordered society the establishment of scientific academies under princely patronage was the key to the social acceptance of the new science and an essential stage in its popularisation. In France at least it was only the emergence of the Académie des Sciences as a strident promoter of Cartesian mechanical philosophy at the turn of the eighteenth century when Fontenelle became its secretary that caused the abandonment of Aristotelian natural philosophy in the *collèges de plein exercice*. Before 1690, although professors had been relatively quick to integrate new discoveries within the traditional physics curriculum, they had been generally hostile to all forms of mechanism: the fundamental explanation of the behaviour of natural phenomena was judged still to lie in their

substantial forms. After 1700 virtually all professors taught a Cartesian physics, albeit one that usually rejected the idea of the beast machine⁹.

Yet if the princely and state academies were central to giving the new science a definitional identity and establishing its respectability, they made a relatively late appearance on the Scientific Revolution's stage. None was established before 1660 and only three (one in desuetude) by the turn of the eighteenth century. Scientific academies were really Enlightenment institutions : on the eve of the French Revolution they existed the length and breadth of the continent and had even set down roots in the New World.¹⁰ Prior to 1660 a number of private societies had temporarily flourished, such as the mid-seventeenth century Paris Montmor academy, but the majority of Renaissance academies, especially in Italy, had had a literary not scientific rationale.¹¹ For this reason, it is unwise in tracing the genesis of the princely scientific academy to place too great an emphasis on the influence of its private forebears, although this has always been the historiographical tradition. Rather, the starting-point for the scientific academy lay in the court, and the forerunner of the academician was the omnipresent and largely anti-Aristotelian Renaissance court magician/astrologer/Paracelsian. In this regard, the princely academy was like many other parts of the state bureaucracy. It began life as an individual office within the prince's household, then moved out of court and became an independent institution.

Initially, then, in the sixteenth and the first half of the seventeenth centuries, the new science gained social credibility because its proponents were patronized directly by the prince and his retinue. Consequently, any account of its institutionalization should pay as much attention to science in the court as science in the academy. This is not to say that members of the first academies would necessarily have acknowledged this pedigree, for many specifically distanced themselves from the occult activities of the Renaissance magi. Increasingly, academicians associated themselves with the alternative and eventually dominant atomist anti-Aristotelian tradition which saw nature as a machine rather than a living organism. Nevertheless, in emphasizing the institutional continuity between the magus and the academician, further support is given to the contention, first asserted by Frances Yates and now a historiographical commonplace,

that Renaissance magic and the Scientific Revolution were much more closely associated than was traditionally thought. Apart from Descartes and his closest followers, most mechanical philosophers gave some credence to vitalist and spiritualist accounts of nature.¹²

The importance of the court in creating a space within which the new science could safely flourish cannot be underestimated. One example from my own work on French medicine will suffice as an illustration. In early modern Paris only those who were graduates of the Paris faculty of medicine were allowed to practise physic legally in the capital. As the Paris faculty was a committed supporter of Galenic medicine until the late seventeenth century, this meant that Paracelsian physicians, as well as Galenists trained in other medical faculties, were denied the right to ply their profession in the city. However, from 1504 it was accepted that when the French court was in the capital, royal physicians whatever their educational background, could practise physic in Paris. As the court was resident at the Louvre from the turn of the seventeenth century, it became possible for an alternative medical community to develop under its aegis whose representatives included Paracelsians such as Joseph Duchesne (Quercetanus), Turquet de Mayerne (later physician to James and Charles 1 of England) and Théophraste Renaudot (first editor of the court gazette). For twenty years from the early 1670s a group of non-Paris graduates practising in the capital (many probably with little connection with the court at all) were even able to form themselves into a quasi-faculty called the *Chambre royale* under the protection of the king's chief physician, Antoine d'Aquin. In their midst were to be found a number of the earliest proponents of iatromechanism in France, such as the Jansenist physician to Port-Royal who had gained his medical degree at Reims, Philippe Hecquet.¹³

Despite the importance of the court, however, its role in the Scientific Revolution has been little studied to date. The potential of the subject was first recognized twenty years ago by my Oxford colleague, Robert Evans, author of a detailed monograph on the world of the Emperor Rudolf II, patron *inter alia* of Kepler.¹⁴ Until recently, however, Evans's insights were largely ignored and it is only in the last few years that science in the court has attracted significant interest, undoubtedly

part of a wider concern with the early modern court as historians have turned their attention away from the study of administrative and fiscal reform to government by faction and patronage as the key to successful state-building.¹⁵ The most important publication to date is the pioneering *Galileo : Courtier* by the present professor of the history of science at the University of Harvard, Mario Biagioli.¹⁶ Biagioli's book is of seminal significance in that it attempts not merely to emphasize the role of the court in promoting and protecting the new science but also, in the case of the Medici duke of Tuscany, offers an explanation for the mutual attraction of court and society. His explanation is located in the anthropological concept of gift-giving. Scientific discoveries are like valuable presents: when associated with the prince's name they add lustre to discoverer and patron. By christening Jupiter's satellites Medician stars Galileo assured that his telescopic discovery would be taken seriously. By graciously accepting the tribute, the Medici duke raised his family to a new height in Europe's princely dynastic pantheon.¹⁷ A similar technique of self-promotion, it could be argued, was used by Raleigh when he called his American colony Virginia after Queen Elizabeth.

Biagioli's depiction of Galileo as a court sycophant would hardly have pleased his Harvard predecessor, the positivist Georges Sarton, and hardly gells with the traditional view of Galileo as scientific hero and martyr. Yet the work is perceptive in locating the attraction of the new science for the court in the contemporary obsession with power and prestige. Proponents of the new science only received patronage from the Renaissance court because they had something to offer the prince (or to sell if one prefers a more capitalist metaphor). Where Biagioli overstates his argument (certainly if he wishes it to have more than an individual significance) is in arguing that the new scientist could only enhance the power of his patron morally. What defines the new science against the old is its practitioners' rhetoric of utility. Paracelsians, Renaissance alchemists and their mechanist successors claimed that they would make their patrons healthier and wealthier. On one level they peddled elixirs of life, knowledge of the future, and the possibility of changing base metal to gold. On a more elevated level they were projectors who promised to make the prince a rich man by improving the prosperity of his subjects. Theirs was a worker-science that would enhance the prince's dignity

through its material achievements. Bacon's state-sponsored Salomon's House had a more serious intention than confirming the Stuarts' quasi-divine status by placing their dynastic name in the list of heavenly bodies.¹⁸ Moreover, there is no reason not to believe that princes (or the advisors) were unable to grasp the utilitarian argument. In an age when the cost of warfare was for ever rising and the large states were permanently in debt, philosophers who claimed that their work would make the prince materially richer were certain to gain an audience. In the second half of the seventeenth century projectors like Johann Joachim Becher or Leibniz were scientific entrepreneurs who hawked their ideas from court to court looking for the highest bidder. Where they found a prince impervious to their utilitarian arguments, only then would they play directly on a prince's desire to enhance his peer-group dignity. Their art was to find what a prince most desired, then tailor their spiel to suit his fancy. The petty German Count of Hanau, for instance, was an enthusiastic collector of art and natural curiosities. Becher, therefore, encouraged him to buy land from the Dutch West Indian Company and start a sugar plantation. The profits would benefit his tiny population and provide the count with the wherewithal to cut a dash as patron of the arts.¹⁹

However, even if we extend the argument of mutual benefit beyond Biagioli's narrow analysis, it still seems to me that we have not fully grasped the attraction of the scientist to the court. (The attraction of the court to the scientist in an hierarchical, status-ridden society is of course abundantly clear.) It is one thing for the prince to find the siren promises of the scientist seductive, it is another for him (and his advisors) to be convinced, especially in Catholic courts. What recent historians have failed to do is to get to grips with the fact that the Counter-Reformation Church was highly suspicious of worker-science and associated it with magic.

In the late middle ages the Church seems to have been relatively relaxed about magic. Indeed, the distinction between religion and magic itself seems to have been blurred even in the eyes of educated Churchmen. After the Council of Trent this was no longer the case. Locked much more tightly than ever before in a strict Aristotelian world-view,

the Catholic Church both doubted and condemned those who claimed the ability to manipulate nature for human convenience. Mankind, it was believed, could *imitate* but never *replicate* the natural world: art (or artifice) and nature were separate categories.²⁰ Replication was only possible through divine or diabolic agency, although in the devil's case replication was actually a *trompe l'oeil* : Satan and his minions lacked the power to effect real change.²¹ To Counter-Reformation Catholics, therefore, worker-science smelt of chicanery, the devil and diabolic pacts. Only God worked true miracles and only priests through the sacraments could invoke divine aid. As experimental philosophers were not usually priests, they could lay no claim to divine power and must consequently have supped with the devil.²²

Admittedly, Protestant theologians were far less hostile to worker-science. Although theirs remained a resolutely Aristotelian culture before the mid-seventeenth century, it was equally the case that Luther had condemned classical philosophy as roundly as scholastic theology. In consequence, there was much more space in Protestant lands for anti-Aristotelians, such as Paracelsus and his followers, who could claim to be engaged in a parallel reformation of natural philosophy, especially if they grounded their new science in the supposedly pre-classical and hence more authentic hermetic philosophy, recovered in the late fifteenth century.²³ But even Protestants had their doubts. It must be remembered that the Faustian myth, first completely set down in print by Speiss in 1587, developed in Protestant Europe and its greatest Renaissance exponent was the Cambridge-educated Christopher Marlowe.²⁴

The Protestant tolerance of anti-Aristotelian philosophies, of course, only confirmed the suspicion of Catholic theologians. The new science stank of heresy as well as magic. Some of its leading advocates, moreover, in the late Renaissance hardly did the general cause much of a service. Giordano Bruno's belief in an infinite universe populated with other life forms understandably led him to the stake when he foolishly returned to Counter-Reformation Italy in 1593. The fact that Calvinist Oxford had found his ideas as outrageous as Catholic Paris in the course of his travels round Europe was no mitigation for his intellectual crimes.²⁵ But Bruno's radical opinions not only brought his life to a

horrid end; they seriously blackened the reputation of other magi. Thereafter for at least fifty years worker-scientists in Catholic Europe trod carefully. Descartes's caution is well known, although in his case it was Galileo's fate not Bruno's that seems to have discouraged him from publishing his *Le Monde et le traité de l'homme* in the 1630s.²⁶ His mechanist rival in France, Pierre Gassendi, was just as nervous. Throughout his life he refused to accept the validity of Harvey's theory of the circulation of the blood - indeed claimed to have found experimentally that the septum of the heart was porous - in part, one suspects, because the discovery was promoted by the English arch-hermeticist, Robert Fludd.²⁷

In the light of the Catholic Church's hostility, it is surprising that any God-fearing Catholic monarch or his councillors ever patronized a worker-scientist before 1650. Rather, it would have been expected that the conversion of a court to Counter-Reformation baroque piety would quickly have led to the dispersal of the magi, as happened at the imperial court on the death of the ecumenical Rudolf II and the succession of the orthodox Matthias.²⁸ Indeed, in a Counter-Reformation atmosphere, Galileo's moral bargain with the Medici duke should arguably have been the only possible one for the experimental philosopher. Galileo offered his patron fame : his gift was acceptable and safe within a Counter-Reformation world-view, for he merely revealed the existence of Jupiter's satellites to an ignorant Christian audience; he made no claim to be able to harness their influence to augment Medici wealth or power.

The fact that many Catholic as well as Protestant courts in the century 1550 to 1650 continued to be full of alchemists, astrologers, Paracelsians and projectors is thus rather perplexing. The French court was notoriously full of such people, not just in the reign of the ex-Huguenot, Henri of Navarre, but especially in the era of the Cardinal-Ministers. Richelieu, to the dismay of orthodox Aristotelians like the Paris faculty physician, Gui Patin, was the patron of worker-scientists *par excellence*. His taste was epitomized by his protection of Théophraste Renaudot, ex-Protestant and Montpellier medical graduate, whose eclectic interests included founding the court *Gazette*, running a government-backed pawn shop, and holding weekly *conférences* where like-minded

friends discussed a whole range of contemporary scientific issues.²⁹

It is my contention that the Catholic (and indeed Protestant) courts' patronage of the worker-scientist can only be fully explained with reference to Renaissance court culture and its ethic of self-control. Superficially this ethic was not at odds with Counter-Reformation or Protestant piety. An ethic that stressed good manners, decorum, politeness and above all accepting with the same indifference the gifts of fortune as well as its 'slings and arrows' shared a lot in common with a post-Reformation Christianity which stressed the negation of the self and kindness and charity towards one's neighbour at the expense of one's time and money.³⁰ The resemblance, however, was superficial. The court ethic, most famously expressed in Castiglione's *Il libro de cortegiano* (first published in 1528) was a product of Renaissance humanism. It was the courtly embodiment of the marriage of classical and Christian virtues promoted by Christian humanists with different degrees of emphasis from Petrarch to Erasmus. Castiglione took Erasmus's *Enchiridion Militis Christiani* (first published in 1504) and gave it a particular institutional spin.³¹ The Christian humanist ethic was founded on a positive, Neoplatonic anthropology which stressed the possibility, albeit within limits, of overcoming the baneful effects of original sin and refashioning oneself in imitation of Christ, not out of fear but love. The humanist emphasis lay, as in Pico della Mirandola's eponymous clarion call of the late fifteenth century, *De hominis dignitate*, on human potential.³²

In this respect the ethic's starting-point was very different from the deeply Augustinian premise of Protestant piety and the only slightly less Augustinian assumptions of its Counter-Reformation counterpart, especially as interpreted by Dominican and later Jansenist theologians. In the eyes of the mainstream confessions mankind was fatally flawed. People might have the rational capacity to know or discover how to behave correctly in God's eyes - although some pessimistic Protestants even doubted this.³³ But people were certainly unable to behave as they should without divine grace. If most Catholics could accept that there had been virtuous (though not justified) pagans, whereas most Protestants could not, this was only because Counter-Reformation theologians accepted that God gave all men a general, sufficient grace to choose good

rather than evil. All fallen men were the slaves of their passions. There was no self-fashioning without divine aid.³⁴

The courtly and religious ethic in the late Renaissance were therefore as chalk and cheese. Their accommodation in the form of the confessionally committed 'Christian gentleman' was always potentially tense. This is emphasized when it is remembered that the court ethic had a darker side in the form of Machiavellianism.³⁵ A contemporary of Erasmus, Castiglione and other important promoters of Christian humanism such as Vives and Sir Thomas More, Machiavelli was a much more radical figure who cut the ethic of refashioning adrift from its Christian moorings. In *Il principe* (published in 1532 but written in 1515 and dedicated to another earlier Medici) the ethic of self-control became the ethic of *raison d'état*. Through historical examples, most graphically in the life of the papal bastard, Cesare Borgia, rulers were taught the value of rising above commonplace morality and behaving brutally and unjustly to better secure their position. Machiavelli never suggested evil behaviour for its own sake was justifiable - indeed, tyrants such as Agathocles of Sicily were specifically condemned.³⁶ But he did preach the ethics of deceit. Rulers were not just taught not to over-react to bad or good news in contrast to their medieval predecessors. (One thinks of Henry II of England's over-hasty order to dispatch Thomas Becket). They were further taught to hide their feelings completely. Indeed, Machiavelli suggested that the prince could not simply control his nature but transcend it. Human beings could refashion themselves into animals. As necessity required it, princes were to become the lion or the fox.³⁷

The humanist ethic was thus a creative, extremely destabilizing philosophy, albeit one successfully codified and constrained in the courtly handbooks of Castiglione and his followers.³⁸ It must be stressed, too, that it was a lived ethic, not just a literary invention. In the sixteenth century many, perhaps most, princes and their courtiers fell far short of the ideal: Elizabeth I of England, for instance, ran a glittering Renaissance court but she was notorious for her passionate rages and acid tongue. The ethic, too, had to fight for space with the contemporary cult of family honour and blood that religious differences only helped to exacerbate. The courts of the sixteenth and early seventeenth centuries

were sites of orchestrated violence as much as of conduct becoming a gentleman. Feuding Montagus and Capulets were to be found in every princely household and duelling was commonplace.³⁹ By the end of the sixteenth century, however, the ethic was winning adherents, even icons like the Englishman, Sir Philip Sidney, killed at the Battle of Zutphen in 1586,⁴⁰ as rulers came to see the value of turning aggressive court peacocks into tame gilded butterflies. The ethic began to be firmly institutionalized too with the foundation of noble academies, first in Italy, then in northern Europe, where gentlemen were taught civility as well as the code of arms.⁴¹ As the seventeenth century progressed the new code triumphed. Richelieu might occasionally present an undignified aspect to the uninitiated onlooker when he raged and wept, but he was a master of emotional blackmail as his success in the Day of Dupes in 1630 confirms: his tantrums were very much contrived and they were not tolerated in others.⁴² The French court by the mid seventeenth century was permanently wedded to a conformist ethic of politeness and restraint. The pathetic machinations of the Frondeur aristocracy in the years 1648-53 were the swansong of the ethic of honour.⁴³ At the court of Louis XIV the ethic of civility reached its apogee. Louis XIV was the perfect Counter-Reformation Christian gentleman whose mask never slipped. Even when told of the death of his beloved son and heir, he quickly regained his composure, while all around him were distraught with grief. Before entering his carriage as he left the dauphin's apartments, he still had the presence of mind to inform an attendant minister that the Conseil d'état would meet on the morrow as usual under his chairmanship, albeit a little late. Grief could not be allowed to come between the king and his duty.⁴⁴

In fact, it may well be the case that the ethic of civility was more deeply-rooted in the courtier's breast than Counter-Reformation or Protestant piety. Certainly this assumption would help to explain one of the more peculiar and little documented 'crazes' of the sixteenth and seventeenth centuries - the fascination with the pseudo-science of physiognomy - the science of reading someone's character in his physical features. Based on the contents of a pseudo-Aristotelian treatise, it was a science that became incredibly popular with the elite at just the moment the new ethic of civility was being promoted.⁴⁵ It is not difficult to see

how the two could be related. If men had the power to refashion themselves completely - indeed, could permanently wear a mask - they became unknown quantities. In a world well aware that this power could be used for good or ill (and at the turn of the seventeenth century, the elite no longer had only the word of Machiavelli that this was the case - the educated had discovered Tacitus),⁴⁶ the new ethic was highly disturbing, especially when one was among strangers or enemies. The science of physiognomy offered a way out of the bind. The Huguenot poet, theologian, hermeticist and soldier, Agrippa d'Aubigné, claimed in his memoirs that his life had been saved by his ability to read the character in the face.⁴⁷ Physical signs had to replace the spoken word if the state of the human heart was to be henceforth grasped.

If the ethic of civility was so deeply-rooted, it is not difficult to understand the welcome given to worker-science by the court. If it were possible to refashion human nature so completely that an individual no longer betrayed his true feelings, then novel claims about the possibilities of manipulating the wider natural world must have appeared plausible at the very least. In a European society deeply coloured by Reformation and Counter-Reformation Augustinianism, the court, to the extent its members were imbued with an alternative view of the world, was the obvious institution in which an anti-Aristotelian natural philosophy could be promoted and protected. The traditional centre of science, the university, could hardly serve this function, or only serve it inadequately, even if some adepts of the new science did hold university appointments, usually in mathematics.⁴⁸ The university was too dominated by the Augustinian culture of its theology faculty; it was still tied too closely to its historic mission of producing an educated clergy to provide more than a living or temporary billet for experimental philosophers whose enthusiastic belief in the worker-potential of their research ran counter to the university's traditions.⁴⁹ It was not by chance that Galileo abandoned his mathematics chair at Padua for the Medici court. He may have been able to pursue his independent researches while a university professor, but only the court, as Biagioli realized, could give his work status and credibility in the first half of the seventeenth century.⁵⁰ The university as an institution was at best indifferent, at worst hostile, to the new science, especially when its adepts broke with Aristotle. Thus at Paris from 1624 all anti-Aristotelian

positions were legally banned at the behest of the faculty of theology, after the (al)chemist, De Claves, had attempted to promote Paracelsian and atomist ideas in a public debate in the Latin Quarter.⁵¹

This is not to say that the court was the only space before the second half of the seventeenth century where the new science could find protection and promotion. Within the Catholic world a case could be made for identifying the Jesuit order as an alternative or additional centre of scientific activity.⁵² The Church *tout court*, then, was not indifferent or hostile to the new science. But the Jesuits were the least Augustinian, most obviously human-centred Counter-Reformation theologians, as their critics (especially the Jansenists) continually complained.⁵³ The Order's commitment, too, to their missionary work overseas to Japan and China may have given its members a greater sympathy for and interest in the utilitarian claims of the new science. Adrift on the vast oceans of the world or struggling to gain access to the Chinese emperor's court, they may have seen the potential of worker-science as a way of easing their path. Certainly, the Flemish Jesuit missionary, Ferdinand Verbiest, presented himself as a magus.⁵⁴ The Jesuits, too, were experts at refashioning themselves to suit the environment they inhabited: they were ersatz courtiers rather than monks whose rigorous training had taught them an impressive self-control. Loyola's *Spiritual Exercises* (completed 1548) and Castiglione's *Book of the Courtier* have a certain affinity - hence the Jesuits' success at court.⁵⁵ Finally, the Jesuits were notorious for seeing themselves as peculiar vessels of divine grace. Unlike many other priests, Jesuit scientists would have had no scruples of conscience about their activities: any ability on their part to control nature was a divine, not a diabolic, gift. The Jesuits' patronage of the new science, therefore, can be dismissed as a special (if no less important) case.⁵⁶

Admittedly, too, the term *court* must be used quite loosely if the argument is to take into account the groups of scientists who existed outside the princely household proper, such as the Peiresc circle in Provence or the Pascal circle in Rouen.⁵⁷ It is quite possible to see the court both as a physical space and a set of social practices. Civility could exist in the countryside among noblemen non-resident at court; it could

even take up residence among the non-noble elite to the extent the 'civilizing proces' (to use the term of the German sociologist, Norbert Elias) quite rapidly percolated downwards in the sixteenth and seventeenth centuries.⁵⁸ The prince and the courtier need not be the only people to sympathize with the endeavours of the new science. Indeed, arguably, the growing influence of the new science by the turn of the eighteenth century - the decreasing marginalization of the experimental philosopher - reflected not just its hold on the court but its wider, court-led, acceptance in society.⁵⁹ In some ways the Enlightenment begins when the Renaissance values of civility and human potential succeed in displacing the Augustinian pessimism of the Post-Reformation, baroque world within a significant section of the elite.

This process took a long time. At the turn of the seventeenth century even those close to the court could be very suspicious of the possibility of refashioning human nature, or at least were convinced that it could only be done at great cost to the individual. Shakespeare's plays - consumed of course by the English court as much as by the London 'groundlings' - frequently suggest that the courtier's mask could not always be successfully worn. Villains habitually let their guard slip. Macbeth collapses on seeing Banquo's ghost in the course of a feast; Lady Macbeth commits suicide, her wits gone. But even the relatively sinless can suffer from 'beguiling the time'.⁶⁰ Hamlet feigns madness to survive in (to his mind) a poisonous court, but in turn goes mad. And there are plenty of hints that Hamlet himself (if not Shakespeare) inhabits an Augustinian universe.⁶¹

Before the mid-seventeenth century in Protestant England, then, the chances of the experimental philosopher gaining much of a hearing outside the court was minimal.⁶² Of course, such a statement flies in the face of the Marxist argument (formulated some time ago by Bernal and Christopher Hill in particular) that the new science in England and elsewhere came from the needs of Renaissance navigators. The constituency for the new science, indeed its cause, lay with a burgeoning mercantile elite, not the aristocratic court.⁶³ Given the obvious navigational potential of the astronomical work of the new science and the centrality of the longitude problem in the endeavours of scientific

'projectors' the Marxist view needs to be taken seriously.⁶⁴ Suffice it to say for the present that the argument need not be irreconcilable with the court-centred analysis presented in this paper. It would be useful to know how far the search for improved navigational techniques (and other life-saving inventions, such as the means of purifying salt water) were promoted by seamen or their aristocratic patrons. It should not be forgotten, in England at least, that the expeditions of Elizabethan sailors to the far corners of the earth were usually court financed : the Queen and her courtiers took a cut in the profits.⁶⁵ In England, too, gentleman-scientists, like Robert Boyle, were not afraid to interest themselves in such projects.⁶⁶

This paper has primarily set out to explain how court and scientist came together in the course of the sixteenth and early seventeenth centuries. It argues that the marriage can be traced to the Renaissance ethic of civility which became deeply embedded in court life. It is not intended to imply that this Renaissance ethic itself contained a belief in material progress, however optimistic and anthropocentric it might have been. In fact, it is difficult to find such an assertion in the work of Renaissance humanists. More's *Utopia*, published in 1516 (supposedly based on a real conversation with a sailor in Bruges), is peculiar in emphasizing how a well-ordered state could promote good health, longevity and labour-saving techniques.⁶⁷ Significantly, the most outrageous exponent of the new ethic of self-fashioning - Machiavelli - had no vision of a future where human beings could control nature as well as themselves. In *Il principe* rulers who construct their own ethical world to ensure their better survival possess *virtù*, as Machiavelli redefines the term. Continually pitted against *virtù* is *fortuna*, an arbitrary goddess who can undermine the best laid plans. *Fortuna* can be equated with the untamed forces of nature - especially disease. No ruler can outwit the uncontrollable tyranny of the natural world. The hero of *Il principe*, Cesare Borgia, ultimately fails in his attempt to establish himself as the ruler of an independent state in the Romagna through the death of his father, Pope Alexander VI, and his own fatal illness.⁶⁸ But Cesare is illegitimate : even more than the rest of us he is a child of *fortuna* and will be destroyed by her. Machiavelli has no conception of how to defeat the blind goddess, except in the *Discorsi* through the institutional

strengths of the state.⁶⁹

It required an imaginative leap therefore on the part of the prince and his courtiers to grasp the potential of the new science. The leap might have been logical but it need not necessarily have been made. Although the paper stresses the significance of the court as an institutional locus for the new science before the age of the academies, the argument should not exclude the possibility that many courtiers failed to make any connection between self-control and the control of nature. As before any marriage is contracted, the suitor (in this case the experimental philosopher) had to woo his bride : his suit might often have been rejected by the unimaginative or the suitably pious. The argument is not meant to be deterministic.

It took a long time, too, for the experimental philosophers themselves to effect an intellectual linkage between the ethics of civility and worker-science. A number of experimental philosophers were clearly as much masters of self-control as masters of nature and demonstrated in their personal lives that the magus and the courtier were not implausible bed-fellows. Bruno, we now know, was an adept courtier, dissembler and Elizabethan spy.⁷⁰ Others were as much absorbed by humanity's potential for self-fashioning as they were by its ability to tame nature. Francis Bacon, a moralist and lawyer as well as an apologist for the experimental philosophy, was fascinated by Machiavelli and wrote an important essay on 'cunning'.⁷¹ He knew at first hand, too, from his activities as an interrogator of suspected Catholic traitors in the 1590s, how successfully humans could disguise their true feelings : physical torture not physiognomy had been his key to prising open the human heart. It was not surprising that he believed nature would also deliver up her secrets if put to the question.⁷²

But if Bacon was a moralist as well as a philosopher of scientific method whose ethical and scientific writings continually interacted and reflected his personal experience as a crown legal officer, he never specifically related the one to the other. No worker-scientist seems to have done this before Descartes in the mid-seventeenth century, another experimental philosopher adept at self-fashioning who broke free from his

family and intended career as a judge and set himself up in exile as a semi-recluse.⁷³ It is usually said that Descartes is the only great philosopher never to have written an ethics. This is true and in an important respect the Frenchman confined his work to natural philosophy and its metaphysical underpinning.⁷⁴ Nevertheless, he did compose a short treatise on *Les Passions de l'âme* in the 1640s, which he wrote for Princess Elizabeth of the Palatinate, exiled in Holland (her father's electorate had been occupied by the Spanish in the Thirty Years War). In this treatise, Descartes made it quite clear that he accepted totally the culture of civility : its final section (article 50) asserted unequivocally : 'qu'il n'y a point d'âme si faible qu'elle ne puisse, étant bien conduite, acquérir un pouvoir absolu sur ses passions.'⁷⁵ Everyone could be a Louis XIV if they wanted. Descartes's importance, though, lies not in his confirmation of the culture of civility but in his explanation of its possibility. In the treatise on the *Passions*, in his *De l'homme* (posthumously published in 1662) and in his metaphysical writings with their emphasis on the absolute separation of body and soul, Descartes provided an explanation rooted in physiology of the cause of our desires and our ability to master them. He is thereby true to his tree of knowledge, outlined in the 1647 introduction to the French translation of the *Principia philosophiae* (Latin original 1644), which unorthodoxly presents ethics as a branch of physics.⁷⁶

Ultimately, then, in the mid seventeenth century the court culture of self-control was given a scientific underpinning and the ethic of civility was cleverly shown to be consistent with the new, mechanical philosophy. Before Descartes the experimental philosopher could only offer the prince moral and material gifts. With the publication of *Les Passions de l'âme* in Amsterdam in 1649, one experimental philosopher - himself, ironically, a free spirit released by his personal wealth from the need for a courtly attachment - offered the prince and his court the richer present of self-understanding. Descartes's philosophy did not just explain why Aristotelian natural philosophy was a nonsense; it undermined the whole framework of the Christian Augustinian outlook. For this reason, although Descartes was a Catholic Christian, he was a subversive who gave intellectual credibility to the culture and cult of civility. In this way, if the new science continued to draw inspiration from the court, court

culture drew inspiration from the new science, at least in its mechanist form. Molière's *Misanthrope*, written and produced twenty years later, bears witness to their fruitful symbiosis. The work of a court dramatist influenced by the mechanical philosophy, the *Misanthrope*, first performed in 1666, is an outrageously confident statement of the rectitude of the ethic of civility. Those who reject the possibility or importance of the ethic do not simply subscribe to an alternative, more traditional Christian culture : they are now misanthropic, put outside humanity altogether.⁷⁷

Notes

1. The title of the English translation of E.J. Dijksterhuis's famous account of the origins of classical science : Oxford, 1961.
2. See especially L.W.B. Brockliss, *Higher Education in Seventeenth- and Eighteenth-Century France: A Cultural History* (Oxford, 1987), especially chapters 7 and 8.
3. In particular, Martha Ornstein, *The Role of Scientific Societies in the Seventeenth Century* (Chicago, 1928).
4. The most recent account of the role of the universities in the new science is Roy Porter, 'The Scientific Revolution and the Universities', in Hilde De Ridder-Symoens (ed.), *History of the University in Europe*, volume ii (Cambridge, 1986).
5. Brockliss, *French Higher Education*, pp. 379-85, 452-3. The point is made at length in my unpublished paper, 'L'Enseignement des mathématiques dans l'ancien régime et la fécondité de la science française à l'époque révolutionnaire et napoléonienne' [seminar paper given in Paris, 1994].
6. Roy Porter, 'Science, Provincial Culture and Public Opinion in Enlightenment England', *British Journal for Eighteenth-Century Studies*, 3 (1980), 20-46; John Gascoigne, *Cambridge in the Age*

of the Enlightenment : Science, Religion and Politics from the Restoration to the French Revolution (Cambridge, 1989), chapter 9, 'mathematics ascendant'.

7. I owe this comparative thought initially to a conversation with Dr Geoffrey Cantor of the University Leeds in 1982. Other universities showed little interest in mathematics and taught Newton experimentally, too : see Geert Vanpaemel, *Echo's van een wetenschappelijke revolutie : De mechanistische natuurwetenschap aan de Leuvense Artesfaculteit (1650-1797)* (Verhandelingen van de Koninklijke Academie voor Wetenschappen, Letteren en Schone Kunsten van België, klasse der wetenschappen, Year 48, no. 173: Brussels, 1986), chapters 6 and 7.
8. In recent years the latter has been a particular focus of attention : e.g. Alice Stroup, *A Company of Scientists : Botany, Patronage, and Community at the Seventeenth-Century Parisian Royal Academy of Sciences* (Berkeley and Los Angeles, Calif., 1990); David J. Sturdy, *Science and Social Status : The Members of the Académie des Sciences, 1666-1750* (Woodbridge, 1995).
9. L.W.B. Brockliss, 'Descartes, Gassendi and the Reception of the Mechanical Philosophy in the French *collèges de plein exercice*, 1640-1730', *Perspectives on Science*, 3: 4 (1995), especially pp. 462-4. Only the Jesuits until the mid-eighteenth century continued to reject a mechanist account of the superlunary world. In France, the *collèges de plein exercice*, about 100 in number, taught the Latin and Greek humanities and philosophy (of which natural philosophy of physics formed a part). To all intents and purposes the colleges supplanted the traditional teaching role of the French faculties of arts from 1600.
10. James E. McClellan, *Science Reorganized : Scientific Societies in the Eighteenth Century* (New York, 1985); Daniel Roche, *Le Siècle des lumières en province: Académies et académiciens provinciaux, 1680-1789* (2 vols.; Paris, 1978). Many academies did not specifically limit their interests to the natural sciences.

11. L. Boehm and E. Raimondi, *Università, accademia e società scientifiche in Italia e in Germania del cinquecento al' settecento* (Bologna 1981); Frances Yates, *The French Academies of the Sixteenth Century* (London, 1973); Harcourt Brown, *Scientific Organization in Seventeenth-Century France, 1620-1680* (Baltimore, 1934).
12. Most famously Newton who spent much of his leisure time at Cambridge in alchemical pursuits. For the role of vital forces in English experimental philosophy, see especially the essay by John Henry in Roy Porter and Mikuláš Teich (eds.), *The Scientific Revolution National Context* (Cambridge, 1981). For a succinct statement of Yates's position, see her 'The Hermetic Tradition in Renaissance Science', in Charles Singleton (ed.), *Art, Science and History in the Renaissance* (Baltimore, Ma., 1967). The one thing that all magi and mechanists shared in common was a commitment to worker-science : see below.
13. L.W.B. Brockliss and Colin Jones, *The Medical World of Early Modern France* (Oxford, 1997), pp. 328-36; L.W.B. Brockliss, 'The Medico-Religious Universe of an Early-Eighteenth Century Paris Doctor : The Case of Philippe Hecquet', in Andrew Wear and Roger French (eds.), *The Medical Revolution of the Seventeenth Century* (Cambridge, 1989), especially pp. 193-4.
14. R.J.W. Evans, *Rudolf II and His World : A Study in intellectual History, 1576-1612* (Oxford, 1973), especially chapters 6-7.
15. E.g. Sharon Kettering, *Patrons, Brokers and Clients in Seventeenth-Century France* (Oxford, 1986). There is now a new London-based journal devoted to court studies edited by Robert Oresko.
16. Chicago, 1993. See also Bruce Moran, *The Alchemical World of the German Court : Occult Philosophy and Chemical Medicine in the Circle of Moritz of Hessen (1572-1632)* (Stuttgart, 1991).

17. Biagioli explores the role of princely scientific patronage more generally in his 'Scientific Revolution, Social Bricolage, and Etiquette' : see Porter and Teich (eds.), *The Scientific Revolution*.
18. Salomon's House-appears in Bacon's utopian fable, the *New Atlantis* (composed 1624). It is a state-sponsored laboratory, where an elite of experimental philosophers and their servants collect, sift and interpret natural data for the good of mankind. For a detailed account of Bacon's commitment to worker-science, see Antonio Perez-Ramos, *Francis Bacon's Idea of Science and the Maker's Knowledge Tradition* (Oxford 1988). For a general account of the utilitarian basis of the new science, see Thomas Dacausta Kaufmann, *The Making of Nature : Aspects of Art, Science and Humanism in the Renaissance* (Princeton, NJ, 1993).
19. Pamela H. Smith, *Science and Culture in the Holy Roman Empire* (Princeton, NJ, 1974), pp. 140-72 (the book is a study of Becher).
20. The distinction between art and nature was carefully set down by Aristotelians at the beginning of their commentaries on Aristotle's *Physics*. For a concise example, see Scipion Dupleix, *La Physique*, reprint of the 1640 edition, ed. Roger Ariew (Paris, 1990), pp. 110-11. Dupleix's manual, first published in 1603, was a particularly popular vernacular example of the genre.
21. For a typical statement to this effect, see Jean Fernel, *De abditis rerum causis*, 2nd edition (Paris, 1551), pp. 157-60. Fernel, a Paris physician and court doctor, was the continent's most widely read exponent of Renaissance Galenism.
22. Promoters of the Counter-Reformation *could* sympathise with worker-science but they were exceptions that proved the rule : see below for a discussion of the attitudes of the Society of Jesus.
23. In the sixteenth century Hermes Trismegistus was thought to be

- a preclassical Egyptian prince whose writings contained a fuller version of Mosaic wisdom than Plato's. In fact, they were Neoplatonist works of the period AD 100-300.
24. Marlowe's *Faustus* seems to have been first performed in 1594. The Faustus legend was referred to by Luther and Melanchthon.
 25. Bruno was eventually executed at Rome in 1600. The fullest account of his life and work is Frances Yates, *Giordano Bruno and the Hermetic Tradition* (London, 1964).
 26. René Descartes, *Oeuvres philosophiques*, ed. F. Alquié (3 vols.; Paris, 1963-73), i. 487-8, 492-5, 497 : letters to Mersenne, November 1633-April 1634.
 27. For Gassendi on Harvey, see Olivier Bloch, *La Philosophie de Gassendi* (The Hague, 1971), pp. 440-2. Gassendi was the author of an *Observatio de septo cordis* (1639) .
 28. Rudolf's most famous court mathematician-magus, Kepler, did continue to be patronized by his successor.
 29. Howard Solomon, *Public Welfare, Science and Propoganda in Seventeenth-Century France : The Innovations of Théophraste Renaudot* (Princeton, NJ, 1972). The discussions of the *conférences* were published in their fullest form under the title, *Recueil des questions traitées es conférences de bureau d'adresse* (7 vols.; Lyons, 1660). There is no secondary study of Richelieu's patronage of the new science. For a general account of the fortunes of one heterodox scientific philosophy in seventeenth-century France, see Allen G. Debus, *French Paracelsians : The Chemical Challenge to Medical and Scientific Tradition in Early Modern France* (Cambridge, 1991). The Austrian court, too, quickly succumbed once again to an interest in the occult : see R.J.W. Evans, *The Making of the Habsburg Monarchy, 1550-1700 : An Interpretation* (Oxford, 1979), part iii, *passim*.

30. It is now accepted by religious historians that reformed and counter-reformed Christians had much the same view of the ideal Christian life : in contrast to late medieval piety, the emphasis was placed on a life of virtuous action rather than contemplation and ritual : see especially, John Bossy, *Christianity in the West, 1400-1700* (Oxford, 1985).
31. Erasmus's best-selling ethical treatise was written for everyman or at least every educated man; it was certainly not just for courtiers.
32. The new ethic doubtless helps to explain why Erasmus was such a relentless self-publicist, albeit with the aim of enhancing the dignity and importance of humanist learning : through portraits and engravings he invested his activity and achievements with the significance of St. Jerome's, and in second and later editions of his works he used the letters of admirers to enhance their importance. For this less endearing side of Erasmus, see Lisa Jardine, *Erasmus, Man of Letters : The Construction of Charisma in Print* (Princeton, NJ, 1993).
33. Luther thought that man's rational capacity was irredeemably warped; Melanchthon, the systematizer of Lutheranism, did not : see the recent account in Sachiko Kusukawa, *The Transformation of Natural Philosophy : The Case of Philip Melanchthon* (Cambridge, 1995), especially ch. 2.
34. Catholic theologians accepted that good actions were not meritorious *per se* : they only became so if God decided to turn sufficient into efficient grace; as this grace was only available to Christians, pagans could not be saved. Theologians were divided as to whether God offered us efficient grace at our behest, Jesuits tending to take the anthropocentric, Dominicans the theocentric, position. A useful introduction to post-Tridentine salvation-theology is Henri de Lubac, *Augustinianism and Modern Theology*, English translation (London, 1963); also Louis Capéran, *Le Problème du salut des infidèles : essai historique*

- (Paris, 1912). The Jansenist position was extremely theocentric and scarcely differed from the Protestant one. The fullest account of the movement remains E. Gazier, *L'Histoire générale du mouvement janséniste* (2 vols.; Paris, 1922).
35. A brilliant analysis of this tension is to be found in Stephen Greenblatt, *Renaissance Self-Fashioning : From More to Shakespeare* (Chicago, 1980).
 36. *Il principe e altre opere politiche*, introduction by Delio Cantimori (Milan, 1983), pp. 38-40 (chapter viii).
 37. *ibid.*, pp. 67-8 (chapter xviii).
 38. Courtly handbooks were produced in imitation of Castiglione until the mid-seventeenth century. A late French example is Nicolas Faret, *L'Honneste Homme ou l'art de plaire à la court* (Paris, 1630). For a detailed study of this ethic in the first part of the seventeenth century, see M. Magendie, *La Politesse mondaine et les théories de l'honnêteté en France au XVIIe siècle de 1600 à 1660* (2 vols.; Paris, 1925).
 39. On duelling and the cult of honour in France, see François Billaçois, *Le Duel dans la société française des XVIe-XVIIe siècles : essai de psychosociologie historique* (Paris, 1986); Arlette Jouanna, *L'Idée de race en France au XVIe siècle et au début du XVIIe siècle : 1498-1614* (Paris, 1977); and Kristen B. Neuschel, *Word of Honour. Interpreting Noble Culture in Sixteenth-Century France* (Ithaca, NY, 1989).
 40. Sidney's cultivation of gentility brought him European renown. The most recent study of the man and his work is Blair Worden, *The Sound of Virtue : Philip Sidney's Arcadia and Elizabethan Politics* (New Haven and London, 1996).
 41. The most detailed study is N. Conrads, *Ritterakademien der Frühen Neuzeit. Bildung als Standesprivileg im 16. und 17.*

Jahrhundert (Göttingen, 1987). For a general account, see G.P. Brizzi, 'Ritterakademien e seminaria nobilium', in id. and J. Verger, *L'Università dell'Europa : del Rinnovamento scientifico all'età dei lumi* (Milan, 1992). None was founded in England.

42. On the Day of Dupes Richelieu was initially apparently ousted from his position of Chief Minister by the Queen-Mother, only to be reinstated and Marie de' Medici humiliated and exiled. For the Cardinal's emotional outburst before Louis XIII and his mother, on this occasion, see Michel Carmona, *Richelieu : l'ambition et le pouvoir* (Paris, 1983), pp. 504-5.
43. The period saw an unholy alliance of nobles and disgruntled bureaucrats in unsuccessful revolt against the centralizing policies of Richelieu and Mazarin. The threat to royal power that could result from the ethic of honour had been graphically exposed by the Jesuit-educated Corneille in *Cinna* (1640).
44. Mémoires de Saint-Simon, ed. G. Trug (7 vols., Paris, 1953-61), iii. 813-4 (1711). Courtiers were apparently surprised on this occasion by the king's sang-froid.
45. I am indebted to Martin Porter of Magdalen College, who is preparing a doctoral thesis on the craze in England, for introducing me to the science of physiognomy. Once his thesis is completed, we will know much more about this peculiar phenomenon which was part of popular not just elite culture in the period. A leading writer on physiognomy was the Neapolitan magus, Giovanni Battista Porta.
46. Tacitus, as a late Roman writer, was ignored in the fifteenth and early sixteenth centuries for the humanists of the Italian Renaissance found their inspiration in the works of writers of the late Republic and Augustan eras. Machiavelli in his major treatise of political theory, the *Discorsi* (composed 1513-21), found sustenance for his *raison d'état* philosophy in Livy not Tacitus. It was the late Renaissance humanist, Justus Lipsius, who above

all resurrected Tacitus : see Richard Tuck, *Philosophy and Government, 1572-1651* (Cambridge, 1993), chs. 2-3.

47. Mémoires, ed. L. Lalanne (1854), p. 54 (in 1580). I am indebted to my research pupil, Emma Lorimer of Magdalen College, for this reference.
48. The number who did so is impossible to gauge accurately on the present level of knowledge. It is evident that Oxford and Cambridge offered shelter to adepts in the new science long before the fledgling Royal Society met at Wadham under Wilkins's protection in the 1650s : see Mordechai Feingold, *The Mathematicians' Apprenticeship : Science, Universities and Society, 1560-1640* (Cambridge, 1984). My own research on Paris, on the other hand, suggests that northern Europe's leading university had hardly any experimental philosophers among its professors and resident MA's in the century 1550 to 1650, even in the medical faculty. The independent Collège Royal, founded by Francis 1, which gave Gassendi employment in his last years, was more important. What is needed is more studies of the kind being at present undertaken for Louvain by Steven Vanden Broecke.
49. Admittedly, the largest faculty was often law in this period (e.g. at Salamanca) but the theology faculty was always dominant; importantly professors in arts were normally clerics, aspiring to preferment in the Church, while most of Europe's 150 or so universities in 1650 did not have a functioning medical faculty.
50. Of course, if Padua had had a court or Florence a university, then Galileo might have kept a foot in both camps, like a number of other mathematicians and physicians interested in the new science. The importance of such dual appointments is emphasized by Robert S. Westman, who criticizes Biagioli for drawing too absolute a distinction between the world of the university and the court : see id., 'Two Cultures or One ? A Second Look at Kuhn's *The Copernican Revolution*', *Isis*, 85 (1994), 98-100.

51. C. Duplessis d'Argentré, *Collectio judiciorum de novis erroribus qui ab in initio duodecim saeculi... in ecclesia proscripta sint* (3 vols.; Paris, 1728-31), ii. 146-7.
52. The important role of the Jesuits in the new science is now finally beginning to be recognized. Their colleges, founded all over Europe, sheltered a number of important mathematicians and astronomers and they were particularly active in the fields of electricity and magnetism. Figures like Athanasius Kircher can definitely be seen as magi. The value of Jesuit science has been most recently assessed in a special issue of *Science in Context*, 3: 1 (1989), 'After Merton: Protestant and Catholic Science in Seventeenth-Century Europe'. See also J.L. Heilbron, *Elements of Early-Modern Physics* (Berkeley, Calif., 1982), pp. 93-107; Evans, *The Making of the Habsburg Monarchy*, part iii, *passim*; and some of the essays in Luce Giard (ed.), *Les jésuites à la Renaissance : système éducatif et production du savoir* (Paris, 1995). It remains to be seen, however, whether all members of the Order, or only a coterie, supported worker-science. In theory, the Order even in the early eighteenth century remained committed to an Aristotelian natural philosophy : see the account in G. Sortais, 'Le Cartésianisme chez les jésuites français au XVIIe siècles', *Archives de la philosophie*, 6: 3 (1929), 1-109. Much more will be known when Michael-John Gorman of the Warburg Institute completes his study of Italian Jesuit science.
53. Most notoriously in Pascal's, *Lettres provinciales* (1656-7).
54. I am indebted to Jeroen Nilis of the University of Louvain for this information. See John W. Witek (ed.), *Ferdinand Verbiest (1623-1688). Jesuit Missionary, Scientist, Engineer and Diplomat* (Monumenta Serica Monograph Series, XXX: Leuven, 1994).
55. Furthermore, the Jesuits were promoters of the Erasmian conception of civility. For their adaptation of Renaissance humanism to the Counter Reformation, see especially François de Dainville, *La Naissance de l'humanisme moderne* (2 vols.; Paris,

1940).

56. Other, much smaller, regular orders were also interested in the new science pre-1650, most notably the Minims : it was the Paris Minim, Mersenne, who created the first international correspondence network of experimental philosophers. The Minims, like the Jesuits, had an anthropocentric theology. On the Order, see P.J.S. Whitmore, *The Order of Minims in Seventeenth-Century France* (The Hague, 1967). The most recent study of Mersenne is Peter Dear, *Mersenne and the Learning of the Schools* (Ithaca, NY, 1988).
57. Less well-known is the Towneley circle in the north of England which flourished in the Restoration period and played a part in the discovery and verification of Boyle's law : see Michael Hunter, *Science and Society in Restoration England* (Cambridge, 1981), p. 82.
58. Norbert Elias, *The Court Society*, English translation (New York, 1983). Aristocratic manners became more and more refined to keep ahead of their vulgarization.
59. This argument, of course, assumes that there was no independent 'burgher' constituency for the new science which could have helped to popularise and legitimate the work of experimental philosophers : Marxists would disagree. See what is said, below.
60. Macbeth, Act 1, scene V : Lady Macbeth to Macbeth : 'To beguile the time,/ look like the time; bear welcome in your eye,/... But be the serpent under't.'
61. Hamlet has been to Luther's Wittenberg and in Act 3, scene I, describes his own character to Ophelia in the blackest terms : 'I am myself indifferent honest, but yet I could accuse me of such things that it were better my mother had not borne me....'
62. We have earlier cited Marlowe's *Faustus*. Another, this time

comic, dramatization of the worker-scientist, was Ben Jonson's *Alchemist* (published 1612). Jonson, a writer of masques, was very much a court figure. A much more positive portrayal of the magus (in this case a prince-magus, like the Emperor Rudolf II) is Shakespeare's Prospero in the *Tempest*.

63. J.D. Bernal, *The Extension of Man* (London, 1972), especially chapter 6, and C. Hill. *Intellectual Origins of the English Revolution* (1965).
64. The longitude problem was eventually solved by a Lincolnshire carpenter's son, John Harrison, in the eighteenth century : see Dava Sobel, *Longitude : The True Story of a Lone Genius Who Solved the Greatest Scientific Problem of his Time* (London, 1996).
65. The concept of 'burgher' science may have more relevance in the most urbanized parts of Europe - the Low Countries, regions of the Holy Roman Empire and the Po valley. Clearly work needs to be done on the scientific patronage of urban oligarchies in Europe in the sixteenth and seventeenth centuries before a final verdict is given.
66. *Robert Boyle by Himself and His Friends*, edited and introduced by Michael Hunter (London, 1994), pp. 82, 87 (on purifying salt water). On court and aristocratic patronage of scientific inventions useful to navigation, see Hugh Kearney, 'Puritanism, Capitalism and the Scientific Revolution', *Past and Present*, 28 (1964), 90-4.
67. Thomas More, *Utopia*, English translation by Paul Turner (London, 1965), pp. 97-101.
68. *Il principe*, pp. 36-7 (chapter vii).
69. In Machiavelli's eyes, the most stable and long-lasting political entities have a monarchical, oligarchical and democratic element.

Monarchies quickly degenerate into tyrannies when children fail to inherit the virtues of their fathers (another one of nature's tricks!). Ibid., pp. 110-14 (*Discorsi*, book 1, chapter ii).

70. John Bossy, *Giordano Bruno and the Embassy Affair* (London, 1991), *passim*. From 1583-5 Bruno lived in the French ambassador's house in London : while there he acted as Walsingham's agent.
71. Francis Bacon, *Works*, ed. J. Spedding, R.L. Ellis and D.D. Heath (14 vols.; London, 1857-74), ii. 153-8. For his appreciation of Machiavelli, see *inter alia*, id., *The Advancement of Learning*, ed. W.A. Wright (Oxford, 1900), pp. 201, 240-2. Bacon, it should be noted, heralded the new type of seventeenth-century experimental philosopher who claimed to be as suspicious of hermeticists as Aristotelians : see P. Rossi, *Francis Bacon : From Magic to Science*, English translation (Chicago, 1968).
72. A point made in Julian Martin, *Francis Bacon, the State and the Reform of Natural Philosophy* (Cambridge, 1992), p. 166.
73. Through the autobiographical and largely unverifiable *Discours de la méthode* (1637), this self-fashioning became a public and permanent event.
74. In the *Discours de la méthode*, his first published and discursive account of his philosophy, Descartes specifically excludes ethics and religion from the realms of knowledge to be scrutinized, at least initially, by his sceptical method : instead, he claims to have adopted the ethics and religion of the culture he inhabited, what he called 'une morale par provision' : see id., *Oeuvres philosophiques*, i. 591-8 ('troisième partie').
75. *ibid.*, iii. 994. Not for nothing had Descartes been educated at the Jesuit college of La Flèche : cf. note 54 above.
76. *ibid.* iii. 779-80. Ethics and physics (or natural philosophy)

would have been seen by contemporary Aristotelian professors as two separate branches of philosophy, only connected to the extent they depended on the same metaphysical principles : the Aristotelian concept of motion, for instance, could be used in both moral and physical analyses.

77. For Molière, another Jesuit pupil's, views on natural philosophy, see R. McBride, *The Sceptical Vision of Molière* (London, 1977). For his views on civility, see Andrew Calder, *Molière : The Theory and Practice of Comedy* (London, 1993), chapter 7.