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FRANCIS BACON

The New Organon

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FRANCIS BACON

The New Organon

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Preface

My thinking about Francis Bacon's philosophical works has been enormously influenced, and altered in significant ways, by the work I have done over the past five years, leading up to the co-authored biography of Bacon, *Hostage to Fortune: The Troubled Life of Francis Bacon* (1998). That biography was in every sense a collaboration; both the research and the actual writing were conducted as a vigorous partnership between myself and Dr Alan Stewart of Birkbeck College. Accordingly, I acknowledge with deep gratitude here the important part Alan Stewart's research, wisdom and friendship have played in the production of this piece of work.

Lisa Jardine

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Michael Silverthorne

Introduction

Francis Bacon was born in 1561, the fifth and last surviving son of Sir Nicholas Bacon, Lord Keeper to Queen Elizabeth I, the second surviving child of his second wife. Left a widower in 1552, with six children under twelve to bring up, Nicholas had rapidly married Anne Cooke, one of five highly educated daughters of Edward VI's tutor, Sir Anthony Cooke, celebrated, like their father, for their learning and piety. All made extremely advantageous marriages: Margaret to a prominent goldsmith; Elizabeth to Sir Thomas Hoby and then to the son of the earl of Bedford; Katherine to Sir Henry Killigrew. Most significantly, Mildred became the second wife of William Cecil, later Queen Elizabeth's Principal Secretary of State. Thus Francis was kin to some of the most powerful and influential figures of his time.

This was just as well, since he had to contend, throughout his life, with the fact that his father left him inadequately provided for financially. Sir Nicholas was in the process of making suitable long-term purchases of land for Francis and his elder brother Anthony when he died unexpectedly in 1579. Had that settlement been complete, Bacon later claimed, he would have been able to devote his entire life to study, and his grand plan for an entirely new system of learning might have reached completion in his lifetime. As it was, he was obliged to pursue a civil career, practising law at Gray's Inn in London from the 1580s. Around 1590 Francis and Anthony sought to ballast their financial prospects by entering the service of the earl of Essex as scholarly secretaries and collectors of intelligence.

Given his volatile relationship with the queen, Essex was a poor choice of backer, and in the aftermath of the Essex rebellion (following which

Essex was beheaded), Francis was lucky to survive politically. But then, Bacon was never a good judge of the men in his life. Under the next monarch, James I, he made an equally unwise choice when he threw in his lot with the duke of Buckingham just prior to his disgrace. Bacon's mother complained frequently that he indulged his male servants and turned a blind eye to their petty thieving.

At the time the first edition of *The New Organon* appeared in 1620, as part of a volume publicly presenting in full for the first time the ambitious plan for Bacon's 'Great Instauration', or 'Renewal', of learning, its author was at the high point of his political career. After a series of unsuccessful bids for office under Queen Elizabeth, Bacon's fortunes had slowly improved with the accession of King James in 1603. After 1616, when he became a Privy Councillor and close confidant of the king, his career finally took off. He was made Lord Keeper in 1617 (an office his father had held under Queen Elizabeth), then Lord Chancellor and Baron Verulam in 1618. According to contemporaries, his lifestyle quickly grew in grandeur to match his high office. He kept a vast retinue, dressed his servants and himself with an ostentation verging on the unseemly, and entertained prodigiously and lavishly.[1]

With hindsight, we, of course, know that by the middle of 1621 Bacon had lost everything – impeached, disgraced, briefly imprisoned in the Tower, then banished permanently to the enforced leisure of his country home. But at court and in the intellectual community at large *The New Organon* must have seemed, in October 1620, like the culminating achievement of one of the brightest stars in England's political firmament.

The work's ambitiousness matched that of its author; nor did Bacon separate this bid for worldwide intellectual recognition from his more parochial aspirations at the English court. It would, he hoped, further cement the king's personal commitment to him. In a private letter to James accompanying the presentation copy, Bacon flattered him with the suggestion that he was the person at whom the entire 'Great Instauration' was directed:

> The work, in what colours soever it may be set forth, is no more than a new logic, teaching to invent and judge by induction (as finding syllogism incompetent for sciences of nature), and thereby to make philosophy and sciences both more true and more active. This, tending to enlarge the bounds of Reason and endow man's

[1] For Bacon's biography see, most recently, L. Jardine and A. Stewart, *Hostage to Fortune: The Troubled Life of Francis Bacon* (London, Gollancz, 1998).

estate with new value, was no improper oblation to your Majesty, who, of men, is the greatest master of reason, and author of beneficence.[2]

A history of experiments

A 'Great Renewal' of learning written by the Lord Chancellor was guaranteed a serious reception as a work of philosophy. In December 1620, just two months after its official publication date, the English diplomat Henry Wotton, on a mission to Vienna, wrote to Bacon to acknowledge safe receipt of three copies of *The New Organon*.

He was not yet in a position to comment on the philosophical work, Wotton apologised, 'having yet read only the first Book thereof, and a few Aphorismes of the second'. For the time being, therefore, he would instead make a modest practical contribution to the Lord Chancellor's grand scientific project, for which *The New Organon* was to provide the methodological infrastructure. Wotton had apparently agreed to send Bacon reports of interesting scientific matters he encountered in the course of his embassy: 'I owe your Lordship even by promise (which you are pleased to remember, thereby doubly binding me) some trouble this way: I mean by the commerce of *Philosophical* experiments, which surely, of all other, is the most ingenious Traffick.'

Wotton went on to tell Bacon that he had just returned from a visit to the home of the famous astronomer Johannes Kepler. He had, indeed, decided to present Kepler with one of the copies of *The New Organon* sent by Bacon, 'that he may see that we have some of our own that can honour our King, as well as he hath done with his *Harmonice Mundi*'. In Kepler's study Wotton had seen a most remarkable piece of scientific apparatus in action:

> He hath a little black tent, exactly close and dark, save at one hole, about an inch and an half in the Diameter, to which he applies a long perspective-tube, with the convex glasse fitted to the said hole, and the concave taken out at the other end, through which the visible radiations of all the objects without are intromitted falling upon a paper, which is accommodated to receive them. And so he traceth them with his Pen in their natural appearance, turning his little Tent round by degrees till he hath designed the whole aspect of the field.[3]

[2] J. Spedding (ed.), *Letters and Life* (7 vols., London, Longman, Green, Longman and Roberts, 1861–74), 7, 119–20.

[3] L. Pearsall Smith (ed.), *The Life and Letters of Sir Henry Wotton* (2 vols., Oxford, Clarendon Press, 1907), 2, 206. See also S. Alpers, *The Art of Describing: Dutch Art in the Seventeenth Century* (Chicago, University of Chicago Press, 1983), 49–51.

Here, clearly, was a device with a whole range of possible applications. Kepler's 'little black tent' was a refined version of a favourite piece of seventeenth-century European new technology, the *camera obscura*. It would, Wotton pointed out, be a particularly useful technical tool for covertly drawing accurate maps and harbour plans.

Wotton's letter (which Bacon's nineteenth-century editor Spedding omitted from his definitive edition)[4] shows how Bacon's political status at home allowed him unusually direct access to emerging seventeenth-century science on the mainland of Europe. It belongs alongside two letters sent by Bacon's friend Toby Matthew from Italy, the first written in 1616 (also omitted from the *Works* by Spedding) and reporting Galileo's support for Copernican astronomy, the second informing Bacon that Galileo had produced a written response to Bacon's own paper on the ebb and flow of tides. Together they confirm that Bacon did not simply comment on, but took an active part in, what stands today as cutting-edge European scientific thought of his day.

Although Wotton had barely begun reading the second book of *The New Organon* when he wrote to Bacon, he was correct in anticipating that the *camera obscura* was not mentioned among the examples of new technology in the 'privileged instances' section of the book. Bacon did, however, there discuss a related piece of lens technology, the microscope, , in some detail. Among the 'privileged instances' which specially advance the investigation of nature, Bacon lists 'instances that open doors or gates' – instances which 'assist direct actions of the sense'. The microscope falls within this category of valuable aids to the senses:

> Apart from spectacles and such things, whose function is simply to correct and alleviate the weakness of impaired vision, and so provide no new information, [such] an instance … are microscopes, lately invented, which (by remarkably increasing the size of the specimens) reveal the hidden, invisible small parts of bodies, and their latent structure and motions. By their means the exact shape and features of the body in the flea, the fly and worms are viewed, as well as colours and motions not previously visible, to our great amazement. (II.39)

Bacon's information on the moving parts of tiny organisms made visible by the microscope came from closer to hand than the written reports he

[4] Spedding keeps Bacon's 'life' (of which his letters are obviously a crucial part) separate from his 'works' (his published science and philosophy). He therefore consistently excludes letters which refer directly to Bacon's scientific practice. See L. Jardine and A. Stewart, 'Judge Him According to His Works: James Spedding's Textual Defence of Francis Bacon' in N. Jardine and M. Frasca-Spada (eds.), *History of the Sciences/History of the Book* (Cambridge, Cambridge University Press, in press).

received of Continental scientific activity. William Harvey (of circulation-of-the-blood fame) recorded in his landmark work *On the Motion of the Heart and Blood in Animals*, published originally in Latin as *De motu cordis*, two years after Bacon's death, in 1628:

> In bees, flies, hornets, and the like, we can perceive something pulsating with the help of a lens; in *pediculi* [little lice], also, the same thing may be seen, and as the body is transparent, the passage of the food through the intestines, like a black spot or stain, may be perceived by the aid of the same magnifying lens.[5]

For Harvey the value of such observations was as 'ocular' confirmation that the heart acts as a pneumatic pump, driving the blood in a perpetual circuit around the body of an animal, whatever its size. The anatomical investigations which clinched his revolutionary discovery were, of course, conducted on much larger-scale organisms. As Physician Extraordinary to James I (and later to his son Charles), Harvey had access to a wide and exotic range of animals on whose living and dead bodies he could experiment. By 1616, when he first outlined the theory of blood circulation in the Lumleian Lecture to the Royal College of Physicians, he had dissected not only human cadavers but innumerable royal deer and an ostrich from the king's menagerie; he had also conducted simple vivisectional experiments on domestic animals and excised the hearts of live vipers.[6]

Bacon was at one time one of Harvey's aristocratic patients (in 1619 both Bacon and the king suffered extended bouts of the stone).[7] According to John Aubrey, Harvey recalled that Bacon had the cold hazel eyes of the vipers on his dissection table. It was also Harvey who observed to Aubrey of Bacon that 'he writes philosophy like a Lord Chancellor' – which comment, Aubrey adds, was meant 'in derision'. In *The New Atlantis*, it is the Royal Physician's anatomical dissections which Bacon has in mind when he describes how his ideal scientists in the imaginary land of Bensalem kept 'inclosures of all sorts of beasts and birds, which [they] use not only for view or rareness, but likewise for dissections and trials; that thereby [they] may take light what may be wrought upon the body of man'.[8] In *The New Organon*, it is Harvey to

[5] R. Willis (trans.) and A. C. Guyton (ed.), *The Works of William Harvey* (Philadelphia, University of Pennsylvania Press, 1989), 76.
[6] R. G. Frank, Jr, *Harvey and the Oxford Physiologists: A Study of Scientific Ideas* (Berkeley and Los Angeles, University of California Press, 1980), 1.
[7] See Jardine and Stewart, *Hostage to Fortune*, 425–7.
[8] J. Spedding, R. L. Ellis and D. D. Heath (eds.), *Works* (7 vols., London, Longman et al., 1857–9), 3, 159.

whom Bacon also alludes when he remarks, in the context of observing the natural processes of generation and growth in animals:

> It would be inhuman to make such investigations of well-formed animals ready for birth, by cutting the foetuses out of the womb, except for accidental abortions and in hunting, and so on. (II.41)

To understand *The New Organon* in the spirit in which it was written, we need to be clear that it is driven by a strong commitment to new technical scientific instruments and the increasing variety of experiments on nature they made possible. *The New Organon* belongs to an early-seventeenth-century English intellectual milieu which included William Gilbert's work with magnetism and Harvey's on the circulation of the blood, which took into account technological innovation on the Continent, and which looked forward to Robert Boyle's and Robert Hooke's experiments with air-pumps in the 1650s. It is an extraordinary attempt to give formal shape to a rapidly emerging (but hitherto largely problem-driven and *ad hoc*) new experimentally based science.

The new scientific method

Bacon's *Novum Organum*, or *The New Organon*, takes its title from Aristotle's work on logic, the 'Organon' or 'Instrument for Rational Thinking'. Bacon argued vigorously in his *Advancement of Learning* that Aristotle's logic was entirely unsuitable for the pursuit of knowledge in the 'modern' age. Accordingly, *The New Organon* propounds a system of reasoning to supersede Aristotle's, suitable for the pursuit of knowledge in the age of science. Where Aristotle's inferential system based on syllogisms could reliably derive conclusions which were logically consistent with an argument's premises, Bacon's system was designed to investigate the fundamental premises themselves. Aristotle's logic proposed certainty, based on incontrovertible premises accepted unquestioningly as true; Bacon proposed an inductive inference, based upon a return to the raw evidence of the natural world. From painstakingly collected assemblages of data ('natural histories') the scientific investigator would use *The New Organon* to nudge his way gradually towards higher levels of probability.[9]

[9] Bacon reminds his reader a number of times in *The New Organon* that his method bears a resemblance to that adopted by the ancients' 'weak scepticism'. On weak scepticism as understood in the Renaissance see L. Jardine, 'Lorenzo Valla: Academic Skepticism and the New Humanist Dialectic' in M. Burnyeat (ed.), *The Skeptical Tradition* (Berkeley and Los Angeles, University of California Press, 1983), ch. 10, 253–86.

The New Organon was the second part of the six-part programme of scientific inquiry assembled under the title *The Great Instauration*, or 'Great Renewal', of learning. As Bacon explains in the published introduction to the *The New Organon* volume, the first part was to consist of 'the divisions of the sciences', comprising 'a Summary or general description of the science or learning which the human race currently possesses' ('Plan of the Work'). Since this part of the enterprise remained incomplete in 1620 (as indeed it did at Bacon's death), the title page to *The New Organon* explains that some account of them will be found in the Second Book of *The Advancement of Learning*.

Beyond the second part of *The Great Instauration* as presented in *The New Organon*, all further parts remained, on Bacon's own admission, woefully incomplete. The third part was to be a comprehensive compilation of 'the *Phenomena of the Universe*, that is, every kind of experience, and the sort of natural history which can establish the foundations of philosophy' ('Plan'). Such a comprehensive collection of natural-historical data would include not simply all natural phenomena ('a history of the bodies of heaven and the sky, of land and sea, of minerals, plants and animals'), but also compilations of the material in all existing academic disciplines, and histories of crafts, trades and other examples of nature 'pressured and moulded' (ibid.). In several places in his works and letters, Bacon stresses that this project is a massive collaborative one, requiring the financial and organisational backing of a 'King or Pope'.[10]

Using the material from this databank, the fourth part was to be a collection of disparate and preliminary worked examples of the 'method' of *The New Organon* in action. This is the vaguest of Bacon's sections, and our understanding of it is based on a single paragraph in the 'Plan', together with some equally sketchy remarks in a letter written shortly before his death. There Bacon describes Part Four as 'an intellectual machinery' comprising 'axioms and higher level observations' of a kind already to be found in his own fragmentary Histories, but 'better adjusted to the rules of the inductive method'.[11] Presumably it would be a series of 'systems', of limited explanatory force – like Gilbert's based on the principle of magnetism or Bacon's own based on his principle of motion. Ultimately such partial explanations would all be subsumed under the totalising explanatory system of the sixth part, where 'the philosophy which is

[10] 'Epistola ad Fulgentium' in Spedding, *Letters and Life*, 7, 531.
[11] Spedding, *Letters and Life*, 7, 532.

derived and formed from the kind of correct, pure, strict inquiry … already framed' is brought to completion ('Plan'). This would finally allow mankind unlimited power to control the natural world not by coercion but by complete understanding:

> For man is nature's agent and interpreter; he does and understands only as much as he has observed of the order of Nature in work or by inference; he does not know and cannot do more. No strength exists that can interrupt or break the chain of causes; and nature is conquered only by obedience. (Ibid.)

Completing the sixth part of *The Great Instauration* himself is, Bacon confesses, a thing both 'beyond our ability and beyond our expectation'. For the time being, the fifth part will consist of provisional discoveries, of the kind made by Bacon himself. These would ultimately be made obsolete by the grand design, but in the meantime would provide encouragement for those looking for tangible results.

Bacon's metaphor of such results being like interest payable upon a capital sum invested, which keep the investor going until the capital itself is redeemed, indicates the strenuously pragmatic thinking behind his philosophical undertaking. The kinds of investors he seeks for his *Great Instauration* need to know they can expect to make a rapid profit. In the long term they may be prepared to indulge the Lord Chancellor in his pursuit of a single overarching system to explain the entire natural world. In the short term, they will need to see immediate pay-off in the form of enhanced procedures in traditional trade and manufacture. It was certainly this aspect of the Baconian project which Charles II, returning in 1660 to a financially weakened England after the Commonwealth period, found particularly attractive when he agreed to give his name and political backing to the Bacon-inspired Royal Society (the 'Royal Society of London, for Improving of Natural Knowledge', to give it its full title).[12]

Observation and experiment

In spite of its reputation as a single-mindedly theoretical work of scientific epistemology, over half of Bacon's *New Organon* is taken up with examples

[12] For the early aspirations of the Royal Society see M. Hunter, 'The Significance of the Royal Society', *Science and Society in Restoration England* (Cambridge, Cambridge University Press, 1981), 32–58. On Baconianism and the Restoration see also C. Webster, *The Great Instauration: Science, Medicine and Reform 1626-1660* (London, Duckworth, 1975).

from applied science which can be traced to contemporary experimental work in a broad range of emerging fields.[13]

What distinguishes the new Baconian view of science (as presented most clearly in *The New Organon*) from that of his predecessors is, indeed, his clear commitment to the role of observation and experiment as a pre-requisite for the construction of scientific theory itself. Earlier scientists (and scientific near-contemporaries elsewhere in Europe) had thought of observation and experiment as demonstrating a conclusion anticipated by systematic deductive reasoning, or as determining a detail or filling in a gap, as required to extend an existing theory. Thus, for instance, Robert Boyle (a keen follower of Bacon) was quick to point out that Blaise Pascal's 'experiments' in hydrostatics, adduced in support of his theoretical principles, are clearly impossible-to-perform 'thought experiments' whose proposed outcomes are calculated to confirm an already decided theory. Bacon, by contrast, regarded observation and experiment – particularly experiments designed to test how nature would behave under previously unobserved circumstances – as the very foundation of science and its generalised methodology. He expected that the process itself of organising the mass of data collected into natural and experimental histories would lead to an entirely new and largely unforeseen scientific theory.[14]

Among such groundbreaking experiments included in *The New Organon* are a number which Bacon had clearly carried out himself, mostly experiments in chemistry and mechanics (he may, however, like Boyle, have had laboratory assistants who actually performed the experiments, while he himself simply observed, as befitted a gentleman). For example, in Bacon's discussion of specific gravity, under 'privileged instances' we find the following description of an experiment using equipment familiar to the seventeenth-century alchemist or chemist:

We took a small glass bottle, which could hold perhaps one ounce (we used a small vessel so that the consequent evaporation could be achieved with less heat). We

[13] For the kind of early scientific tradition to which Bacon's practical experimental experience belongs see Frank, *Harvey and the Oxford Physiologists*, and S. Shapin and S. Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, NJ, Princeton University Press, 1985). It has recently been pointed out that Bacon was relatively cut off from a specifically Continental tradition in published natural history. See P. Findlen, 'Francis Bacon and the Reform of Natural History in the Seventeenth Century' in D. Kelley (ed.), *History and the Disciplines: The Reclassification of Knowledge in Early Modern Europe* (Rochester, NY, University of Rochester Press, 1997), 239–60.

[14] See T. S. Kuhn, 'Mathematical versus Experimental Traditions in the Development of Physical Sciences', *The Essential Tension: Selected Studies in Scientific Tradition and Change* (Chicago, University of Chicago Press, 1977), 31–65.

filled this bottle with spirit of wine almost to the brim; selecting spirit of wine because we observed by means of an earlier table that it is the rarest of the tangible bodies (which are continuous, not porous), and contains the least matter for its dimensions. Then we accurately noted the weight of the liquid with the bottle itself. Next we took a bladder which would hold about two pints. We expelled all the air from it, so far as possible, to the point that the sides of the bladder were touching each other; we had also previously smeared the bladder with grease, rubbing it gently in so that it would be more effectively closed, its porosity, if there was any, being sealed by the oil. We tied this bladder tightly around the mouth of the bottle, with its mouth inside the mouth of the bladder, lightly waxing the thread so that it would stick better and bind more tightly. Finally we placed the bottle above burning coals in a brazier.

Bacon goes on to describe the carefully observed and quantified outcome of the experiment:

Very soon a steam or breath of spirit of wine, expanded by heat and turned into gaseous form, gradually inflated the bladder, and stretched the whole thing in every direction like a sail. As soon as this happened, we removed the glass from the fire, and placed it on a rug so that it would not be cracked by the cold; we also immediately made a hole in the top of the bladder, so that when the heat ceased, the steam would not return to liquid form and run down and spoil the measurement. Then we lifted up the bladder itself and again took the weight of the spirit of wine which remained. Then we calculated how much had been used up as steam or gas; and making a comparison as to how much place or space that substance had filled in the bottle when it was spirit of wine, and then how much space it filled after it had become gas in the bladder, we calculated the ratio; and it was absolutely clear that the substance thus converted and changed had achieved a hundredfold expansion over its previous state. (II.40 (3, 4))

This is a perfectly respectable experiment in expansion of gases, of the kind Robert Boyle would be performing in Oxford by the 1650s. It involves calibration and quantification: spirit of wine, or brandy, is chosen because it vaporises at low temperatures; the quantity of brandy vaporised is calculated by weighing the container before and after heating; the volume to which the vaporised brandy expanded is calculated by calculating the volume of the bladder. The finding was that the vaporised brandy 'had achieved a hundredfold expansion over its previous state'.

Bacon lets his reader know clearly, by the formal locutions he uses, when it is he who has conducted experiments and when he has merely 'heard tell' or read about them at second hand. In another of his own experiments, described under 'privileged instances' of 'range or furthest limit', he tested

'how much compression or expansion bodies easily and freely allow (in accordance with their natures), and at what point they begin to resist, so that at the extreme they bear it No Further [*ne plus ultra*]':

> as when an inflated bladder is compressed, it tolerates some compression of the air, but after a point it can bear it no longer, and the bladder bursts.
>
> We tested this more precisely with a subtle experiment. We took a small metal bell, quite thin and light, like a saltcellar, and sank it in a basin of water, so that it took with it to the bottom of the basin the air held in its cavity. We had first placed a little ball on the bottom of the basin on which to set the bell. The result was that if the ball was quite small (in relation to the cavity) the air retreated into a smaller area, and was simply compressed and not expelled. But if it was too large for the air to give way freely, then the air could not tolerate the greater pressure but partially lifted the little bell and came up in bubbles. (II.45)

This kind of experiment with bells is related to contemporary practical experiments with diving-bells. Sure enough, under 'multi-purpose instances' Bacon refers directly to the technology of diving-bells for salvage operations:

> If the situation requires bodies to be submerged in a depth of water, a river perhaps or the sea, but not to have contact with the water, and not to be shut up in sealed vessels but to be just surrounded by air, very useful is the vessel which is sometimes used to work under the water on sunken ships, which enables divers to stay under water longer and to take breaths in turn from time to time. It was like this. A concave metal barrel [bell] was constructed, and was let down evenly into the water, its mouth parallel to the surface; in this way it carried all the air it contained with it to the bottom of the sea. It stood on three feet (like a tripod) which were a little shorter than a man, so that when a diver ran out of breath, he could put his head into the hollow of the jar, take a breath, and then continue with his work. We have heard that a device has just been invented like a small ship or boat, which can carry men under water for a certain distance. Under the kind of jar we mentioned above, certain bodies could easily be suspended; that is why we adduced this experiment. (II.50 (1))

At the end of this passage we have evidence that Bacon was aware of a celebrated English demonstration of Cornelis Drebbel's 'submarine' ('we have heard that …') and that he anticipated the kinds of experiments in an evacuated chamber carried out forty years later using Boyle's air-pump.

The coherence of Bacon's new scientific method, upon which his 'Great Renewal' of learning rests, depends upon a close relationship between experimental practice and methodical processing of results. This was

clearly understood by the early Royal Society in London, for whom the great Verulam (Sir Francis Bacon) was figurehead, patron saint and 'Father of Modern Science'. Early Restoration scientists like Royal Society Curator of Experiments Robert Hooke took *The Great Instauration* entirely seriously and modelled their own programmes for an experimentally based science directly on Bacon's writings on methodology.[15]

By the end of the nineteenth century, however, attention had become focused almost exclusively upon the formal validity of the inductive method of *The New Organon*, and its adequacy as a substitute for the logico-deductive epistemology which it supposedly superseded.[16] In most modern accounts of Baconian method, the groundbreaking originality of Bacon's direct engagement with contemporary applied science and technology, leading to his attempt to devise an epistemology which reflected the intimate relationship in science between ideas and practice, has been lost from sight.[17]

Baconian induction

The New Organon is laid out in two books of 'aphorisms'. These are relatively concise, unembellished statements designed to indicate that this is 'work in progress', susceptible of improvement and refinement, rather than a finished and coherent 'Organon'. The aphoristic 'method of delivery' ensures that the reader understands that the work is incomplete, and also reveals clearly the competence of the author. As Bacon explained three years later, in the expanded Latin version of the *Advancement of Learning*:

> Delivery by aphorisms ... tries the writer, whether he be light and superficial in his knowledge or solid. For aphorisms, not to be ridiculous, must be made out of the pith and heart of sciences ... A man will not be equal to writing in aphorisms, nor indeed will he think of doing so, unless he feels that he is amply and solidly furnished for the work.[18]

[15] On Hooke and Bacon's legacy see L. Jardine, '*Experientia literata* or *Novum Organum*? The Dilemma of Bacon's Scientific Method' in W. Sessions (ed.), *Francis Bacon's Legacy of Texts* (New York, AMS Press, 1990), 47–68.

[16] This position may be represented by Hall's classic treatment in A. R. Hall, *The Revolution in Science 1500–1750* (London, Longman, 1983) (previously published as *The Scientific Revolution* (1954)). See esp. ch. 7 ('New Systems of Scientific Thought in the Seventeenth Century').

[17] For later philosophers' attitudes to Bacon's inductive method see A. Pérez-Ramos, *Francis Bacon's Idea of Science and the Maker's Knowledge Tradition* (Oxford, Clarendon Press, 1988), chs. 17 and 18.

[18] Spedding et al., *Works*, 4, 450–1.

Aphorisms have the further advantage that they encourage collaborative pursuit of knowledge and 'invite others to contribute and add something in their turn'.

Book One of *The New Organon* clears away the intellectual debris of existing assumptions which distort the perceptions and cloud the judgement of the would-be philosopher. Bacon urges readers not to place their trust in existing authorities, nor to rush to fashionable new systems of knowledge. 'A new beginning [to learning] has to be made from the lowest foundations, unless one is content to go round in circles for ever' (I.31).

To this end, Bacon first discards the cornerstone of traditional logic, the syllogism, because anyone using it can only arrive at conclusions consistent with existing, given premises. These premises themselves – the assertions on which the whole process of reasoning is based – must be taken on trust as true and incontrovertible. The syllogism 'is not applied to the principles of the sciences, and is applied in vain to the middle axioms, since it is by no means equal to the subtlety of nature' (I.13). Thus the entire current system of reasoning, in Bacon's view, fails. Instead Bacon gives notice that his own logic will be an induction or gradual ascent from sense data to generalisations, though not the 'ordinary induction' of the logic handbooks.[19]

A significant portion of Book One of *The New Organon* is taken up with discussion of what Bacon names the 'Idols', or 'Illusions' – impediments of various kinds which interfere with the processes of clear human reasoning. These so-called Idols are of four kinds: Idols of the Tribe, Idols of the Cave, Idols of the Marketplace and Idols of the Theatre.

The Idols of the Tribe are errors in perception itself, caused by the limitations of the human senses which give access to the data of nature. The Idols of the Cave, by contrast, are errors introduced by each individual's personal prejudices and attachment to particular styles or modes of explanation – as in his fellow-courtier (and personal physician to Elizabeth I) William Gilbert's trying to account for all natural phenomena in terms of magnetism.[20]

[19] On induction in the logic manuals see L. Jardine, 'Humanistic Logic' in C. B. Schmitt, E. Kessler and Q. R. D. Skinner (eds.), *The Cambridge History of Renaissance Philosophy* (Cambridge, Cambridge University Press, 1988), 173–98. On Bacon's rejection of the syllogism see L. Jardine, *Francis Bacon: Discovery and the Art of Discourse* (Cambridge, Cambridge University Press, 1974), 84–7.

[20] William Gilbert (*c.* 1540–1603), personal physician to Elizabeth I, is known for his early studies on electricity and magnetism. He received his M.D. in 1569 from Cambridge University, where he had been made a Fellow of St John's College in 1561; in 1600 he was elected President of the Royal College of Physicians. In the same year he published *De magnete*, in which he propounded the theory that the earth was a giant lodestone with north and south magnetic poles.

The Idols of the Marketplace arise directly from shared use of language and from commerce between people. At the most basic level, the ascription of names to things, in ordinary language usage, fails to discriminate properly between distinctive phenomena, or names abstract entities 'vaguely', so as to give rise to false beliefs about them.

Finally, Idols of the Theatre are the misleading consequences for human knowledge of the systems of philosophy and rules of demonstration (reliable proof) currently in place. These Bacon insists are 'so many plays produced and performed which have created false and fictitious worlds' (I.44). It is here that Bacon expounds his antipathy towards existing philosophies, most notably the Aristotelian system which exercised a virtual stranglehold on contemporary thought, but extending also to Platonism and the methods of philosophical doubt of the Sceptics.[21]

The final aphorisms of Book One deal with the characteristics of a scientific method which will be adequate to handle the proliferation of innovation in practical science, and to process the 'stock and material of natural history and experience' (I.101). It will be based on improved natural histories (to be described in the third part of *The Great Instauration*), and it will employ an entirely new form of induction (the subject of Book Two of *The New Organon*). Used together, these will revolutionise learning and finally give mankind that power over nature of which early scientists such as the alchemists could only dream.

Book One of *The New Organon* contains some shrewd insights, particularly into the shortcomings of burgeoning science as currently practised. Bacon points out, for instance, that the alchemist, attempting to transmute base metal into gold, commits himself to performing a single chain of experimental operations according to secret instructions. When this does not succeed, the practitioner does not discard the recipe; rather 'He accuses himself of not properly understanding the words of the art or of the authors … or of making a slip in the weights or timing of his procedure, and so proceeds to repeat the experiment indefinitely' (I.85).[22] Not only is this a perceptive description of seventeenth-century chemical procedures, it also suggests that Bacon had himself observed contemporary proto-chemists at work in the laboratory.[23]

[21] For Bacon's disdainful attitude to ancient philosophies see *Advancement of Learning*, Book One.

[22] For the accuracy of this account of alchemical practice, compare L. M. Principe, *The Aspiring Adept: Robert Boyle and his Alchemical Quest* (Princeton, NJ, Princeton University Press, 1998).

[23] Bacon's observation of the alchemist's practice anticipates Thomas Kuhn's recognition that the scientist does not generally discard a 'paradigm' or model for scientific practice merely because he is unable to replicate predicted outcomes. See T. S. Kuhn, *The Structure of Scientific Revolutions* (Chicago, University of Chicago, 1962).

The goal of Bacon's inductive method is the 'forms', or essential definitions, of what he terms 'simple natures' – the fundamental building blocks out of which all compound bodies are, in his view, constructed. The procedure for finding the form of a simple nature is clearly set out at the beginning of Book Two of *The New Organon*. The investigator starts by collecting into a History all available occurrences of the nature selected (Bacon chooses the simple nature 'heat' for his worked example). From among these he selects those which provide as clear as possible a picture of the nature's production. These are organised, tabulated and collated and any gaps filled in with examples drawn from specially designed experiments. Together they form a 'table of presence'.

A second table is now drawn up, in which the instances of presence of the selected nature are matched as closely as possible by ones from which it is absent (if the rays of the sun are an instance of presence of heat, the rays of the moon are an instance of absence). These two tables are supplemented by one which lists instances where the increase or decrease of the nature is accompanied by increase or decrease of other properties present, indicating that these may be essential concomitants of the nature under investigation. Bacon's 'induction' is carried out by eliminating extraneous and redundant material between the three tables, to yield an essential physical description of the simple nature – its 'form'. This simple elimination is the unique legitimate use of formal inference in the entire interpretation of nature.[24]

All further steps in the process of refining the 'simple natures' and their essential 'forms' depend directly on the observed outcomes of carefully classified experiments. There will, Bacon makes clear, inevitably be such further stages, until at some yet-to-be-determined date in the distant future a single overarching explanatory theory is arrived at (by years of assiduous practice and experiment).

In the meantime, of the fifty-two aphorisms in Book Two of *The New Organon* only the first twenty are taken up with the inductive method. The remaining aphorisms compile a collection of 'privileged instances' under various categories. These are types of experimental set-up which provide particularly powerful kinds of tool for investigating nature.

'Privileged instances'

At this stage in the presentation of his 'new instrument' for the interpretation of nature, Bacon asks us, with characteristic intellectual candour, to

[24] For a full account of Baconian method see Jardine, *Francis Bacon*, esp. ch. 6.

adopt a vigorously pragmatic approach to achieving a 'true and complete induction'. The process of assembling tables of presence, absence and variation for instances of any given nature and eliminating between them will yield only a 'first harvest', or preliminary interpretation. What follows is a series of types of 'support' for the understanding. It is these 'privileged instances' which will extend and refine the preliminary findings into a valid 'form'. There are a number of types of instance of occurrence of any given simple nature which reveal aspects of that nature with striking clarity. Such instances allow the investigator to move decisively and particularly swiftly towards identifying the fundamental characteristics which make up the 'form' of the nature.

According to Bacon, what makes the twenty-seven types of 'privileged instances' of such significance is that they allow the investigator to guide the later stages of induction by using 'the nature of things' themselves:

> Our logic instructs the understanding and trains it, not (as common logic does) to grope and clutch at abstracts with feeble mental tendrils, but to dissect nature truly, and to discover the powers and actions of bodies and their laws limned in matter. Hence this science takes its origin not only from the nature of the mind but from the nature of things. (II.52)

A preliminary attempt at inductive solution begins the process. Privileged instances direct and steer the investigation further in the right direction.

Those who have looked to Bacon for a genuinely new logic of scientific inquiry have generally ignored the 'privileged instances', since their procedures, and the guidance they yield towards forms of simple natures, are, on Bacon's own admission, observation- and experiment-led and *ad hoc*. Besides, they reach their supplementary conclusions by conventional deduction rather than by any kind of induction. Their relationship to the preliminary 'first harvest' most closely resembles the way individual cases at law are used to refine legal precept in English case law: a broadly applicable rule is agreed upon, and its impact is refined by using the detail of successive cases for clarification.[25]

In the light of developments in natural science later in the seventeenth century and the so-called scientific revolution, however, the 'privileged instances' of *The New Organon* deserve particular attention for the

[25] On the link between Bacon's inductive method for science and the procedures of the contemporary law-courts in which Bacon practised throughout his professional life see D. Coquillette, *Francis Bacon* (Stanford, CA, Stanford University Press, 1992).

evidence they provide of Bacon's being abreast of hotly debated issues in contemporary science, and for his clear sense that they provide proper guidance in a generalised methodology for the sciences. Under 'instances of alliance' (ones which determine whether phenomena which tend to occur together do so as cause and effect or accidentally) he discusses Gilbert's contention that all dense and solid bodies are magnets which move towards the earth (itself a magnet) by attraction as long as they are within the 'circle of its own power' (II.35). The giant waterspouts observed en route to the East and West Indies might suggest that at sufficient height above the earth water escapes from its attractive force. Later, under 'instances of range or furthest limit', Bacon returns to the same topic. Iron within a certain distance of a magnet is drawn towards it, but not beyond. If the earth is a giant magnet, its powers will extend to a great distance; similarly for the moon's attractive force on the waters of the sea, which causes high and low tides:

> But whether the distance at which they work is great or small, all these things certainly work at distances which are fixed and known to nature, so that there is a kind of *No Further* which is in proportion to the mass or quantity of the bodies; or to the vigour or weakness of their powers; or to the assistance or resistance of the surrounding medium; all of which should come into the calculation [be calculated] and be noted. (II.45)

Scattered through the 'privileged instances', observations like these reveal Bacon's clear sense of what it would take methodologically to confirm or disprove a proposed theory.

Certain of Bacon's categories of 'privileged instance' stand out as forerunners of later standard scientific procedures. His 'crucial instances' (the fourteenth of his types) list a selection of carefully designed experimental set-ups on the basis of which the scientist can decide between alternative views concerning the phenomena under investigation. These Bacon also characterises as 'decisive instances', 'instances of verdicts' and 'commanding instances':

> Sometimes in the search for a nature the intellect is poised in equilibrium and cannot decide to which of two or (occasionally) more natures it should attribute or assign the cause of the nature under investigation … in these circumstances crucial instances reveal that the fellowship of one of the natures with the nature under investigation is constant and indissoluble, while that of the other is fitful and occasional. This ends the search as the former nature is taken as the cause and the other dismissed and rejected. (II.36)

It is here that Bacon discusses the nature of the ebb and flow of tides at length, incorporating his exchanges with Galileo and proposing several decisive tests for competing contemporary conjectures.

The systematic guidance afforded by procedures like those itemised under his 'privileged instances' belongs to what Bacon terms *experientia literata* – 'experience made literate'. *Experientia literata* allows the investigator to organise the material gathered together in a given History so as to extend the History itself (to yield a more precise definition of the 'form' under investigation). *Experientia literata* also throws up practical applications and scientific innovations (for trade and commercial benefit) in advance. In both cases, the process of reasoning which leads from particular experiment or instance to generalisation is, according to Bacon, guided by connections intrinsic to nature itself rather than connections imagined by the human mind. *Experientia literata* thus binds together the stages in ratiocination laid down for the 'new instrument' and the material world to which it is to be applied.

Benefits derived during the process of systematic investigation are, however, Bacon stresses, still only provisional. In the end, *experientia literata* is merely a stage on the way to 'forms':

> For although I do not deny that when all the experiments of all the arts shall have been collected and digested, and brought within one man's knowledge and judgment, the mere transferring of the experiments of one art to others may lead, by means of that experience which I term 'literate', to the discovery of many new things of service to the life and state of man, yet it is no great matter that can be hoped from that; but from the new light of axioms [generalisations], which having been educed from those particulars by a certain method and rule, shall in their turn point out the way again to new particulars, greater things may be looked for.[26]

We look in vain for clear guidance in *The New Organon* as to how the methodological derivation of 'forms' and the axioms and rules which connect them will eventually be brought to completion. Towards its close, Book Two becomes a checklist of yet-to-be-investigated possibilities for sharpening the outcome of Bacon's inductive method – a collection of Lord Chancellor's jottings towards a future enlarged project. Like the 'Plan' which precedes *The New Organon* in the first printed edition, and the inventory of 'Natural and Experimental Histories' which follows it, the

[26] *De augmentis scientiarum*; Spedding et al., *Works*, 4, 96.

philosophical method of the 'new instrument' is itself (as the presentation in aphoristic form is supposed to indicate) unfinished.

In many respects Baconian methodology has little relevance to the kinds of debate around epistemology which preoccupy philosophers of science today. Nevertheless, *The New Organon* remains a work of extraordinary intellectual daring – a challenge to the entire edifice of contemporary philosophy and learning. It has left its mark on all subsequent philosophical discussions of scientific method and has shaped accounts of the development, from the seventeenth century onwards, of so-called English empiricism. Bacon's symbolic role as a philosophical founding father, based on his groundbreaking inductive method, is still aptly summed up in the celebratory ode with which Abraham Cowley prefaced Thomas Sprat's early *History of the Royal Society* (1667):

> From these and all long Errors of the way,
> In which our wandring Praedecessors went …
> Bacon, like Moses, led us forth at last,
> The barren Wilderness he past,
> Did on the very Border stand
> Of the blest promis'd Land,
> And from the Mountain Top of his Exalted Wit,
> Saw it himself, and shewed us it.

Science and politics

Sprat gives us the heroic, intellectually uncompromising Francis Bacon. In the end, however, Sir Francis Bacon, Earl Verulam, arch-pragmatist in affairs of state, was prepared to compromise even the intellectual rigour of his *New Organon* for political expediency.

In theory, all existing philosophical systems must be abandoned to make way for the one true inductive method. Still, Bacon relented when it came to the kinds of gentlemanly debates on intellectual matters in which he and his court friends engaged:

> We do not in any way discourage these traditional subjects from generating disputations, enlivening discourse and being widely applied to professional use and the benefit of civil life, and from being accepted by general agreement as a kind of currency. Furthermore, we freely admit that our new proposals will not be very useful for those purposes, since there is no way that they can be brought down to the common understanding, except through their results and effects. But our

published writings (and especially the books On the Advancement of Learning) testify how sincerely we mean what we say of our affection and goodwill towards the accepted sciences. (I.128)

Perhaps this is what William Harvey had in mind as philosophy practised with the political tact of a Lord Chancellor. Here Bacon gives in to those old friends of his, including Henry Wotton and Toby Matthew, on whose support and informed comment on his philosophical writings he relied, but who were deeply sceptical of his desire to start the whole enterprise of science again from first principles.

In 1607, for instance, Bacon's long-time associate and amanuensis Thomas Bodley wrote a detailed set of notes for Bacon on his *Cogitata et visa* – early notes towards *The New Organon*. Bodley expressed broad scepticism at the idea that knowledge grounded in worldwide 'experience', or observed reality, could be a substitute (rather than a supplement) for that accumulated down through the ages. Suppose, he argued, we were 'first to condemn our present knowledge of doubts and incertitude, and disclaim all our axioms, maxims, and general assertions that are left by tradition from our elders unto us, which (as it is to be intended) have passed all probations of the sharpest wits that ever were'. Suppose we were to return, as Bacon suggested, to an alphabet of nature, to rebuild science from first principles – a task which would inevitably take centuries. Then, Bodley concluded, we would be likely to find we had gone in a complete circle and arrived back with the very science passed down to us by the ancients.[27]

The reader of *The New Organon* whom Bacon was keenest not to offend, and for whose sake he was willing to make as many intellectual compromises as necessary, was of course the king himself. James prided himself on being familiar with fashionable scientific debate. He responded in person to Bacon's dedications (both printed and private ones), graciously acknowledging receipt of the presentation copy of *The New Organon*. He intended to participate fully in the further refinement of the 'new instrument'. He was resolved, he wrote,

first, to read it through with care and attention, though I should steal some hours from my sleep; having otherwise as little spare time to read it as you had to write it. And then to use the liberty of a true friend, in not sparing to ask you the question in any point whereof I shall stand in doubt: as, on the other part, I will willingly

[27] *Trecentale Bodleianum: A Memorial Volume for the Three Hundreth Anniversary of the Public Funeral of Sir Thomas Bodley March 29, 1613* (Oxford, Clarendon Press, 1913), 145–63.

give a due commendation to such places as in my opinion shall deserve it. In the meantime, I can with comfort assure you, that you could not have made choice of a subject more befitting your place, and your universal and methodick knowledge; and in the general, I have already observed, that you jump with me, in keeping the midway between the two extremes; as also in some particulars I have found that you agree fully with my opinion.[28]

In his response, Bacon was understandably at pains to indicate that he took the king's offer entirely seriously. This would be a collaborative undertaking between the sovereign and his Lord Chancellor. And even though the guide to the inductive method was supposed to be sensory experience alone, Bacon would stretch a point and allow a special place for the intellectual observations of the king himself:

I cannot express how much comfort I received by your last letter of your own royal hand … Your Majesty shall not only do to myself a singular favour, but to the business a material help, if you will be graciously pleased to open yourself to me in those things, wherein you may be unsatisfied. For though this work, as by position and principle, doth disclaim to be tried by anything but by experience, and the resultats of experience in a true way; yet the sharpness and profoundness of your Majesty's judgment ought to be an exception to this general rule; and your questions, observations, and admonishments, may do infinite good.

Besides, if the king was to assist with framing the new logic itself, perhaps he might be persuaded to put some financial backing behind the 'natural and experimental histories' which were ultimately to underpin the whole work:

This comfortable beginning makes me hope further, that your Majesty will be aiding to me, in setting men on work for the collecting of a natural and experimental history; which is *basis totius negotii* [grounds for the whole enterprise]; a thing which I assure myself will be from time to time an excellent recreation unto you; I say, to that admirable spirit of yours, that delighteth in light; and I hope well that even in your times many noble inventions may be discovered for man's use. For who can tell, now this mine of Truth is once opened, how the veins go, and what lieth higher and what lieth lower?[29]

No doubt James was suitably flattered at the idea that he might be competent to suggest refinements and modifications to the 'Great Instauration'. In private, however, he admitted candidly that Bacon's latest

[28] James to Francis Bacon, 16 October 1620. Spedding, *Letters and Life*, 7, 122.
[29] Francis Bacon to James, 20 October 1620. Ibid. 130–1.

effort was quite beyond his comprehension: 'His last book is like the peace of God, that passeth all understanding.' And as with so many of Bacon's projects, the hoped-for funding, the investment which would make the whole grand scientific enterprise possible, was not in the end forthcoming.

James Spedding, Bacon's devoted nineteenth-century editor and defender of his reputation, was at great pains to separate Bacon the philosopher and thinker from Bacon the political wheeler-dealer and time-server. In his authoritative edition, contextual material has been as far as possible removed from the philosophical and scientific works and is printed at a distance, in the *Letters and Life* volumes.[30] Within *The New Organon* we can, nevertheless, trace the inevitable interconnectedness of the two, and in the process arrive at a fuller understanding of Bacon's ground-breaking philosophy.

Lisa Jardine

[30] See Jardine and Stewart, 'Judge Him According to His Works'.

Chronology

1561	22 January, Bacon born at York House in London, fifth son of Sir Nicholas Bacon (Lord Keeper of the Great Seal) and his second wife, Anne Cooke, sister-in-law of Lord Burghley and a notable intellectual with radical Protestant leanings
1573–5	Attends Trinity College, Cambridge, with brother Anthony, where they are private pupils of John Whitgift, later Archbishop of Canterbury
1576	Enters Gray's Inn, London, with Anthony, to train in the law
1576–9	Travels abroad with Sir Amias Paulet, ambassador to Paris, returning as a trusted courier on several occasions; continues his studies and meets Continental intellectuals; while he is in Paris, Hilliard paints the well-known miniature of him
1579	Returns to England and sets up chambers at Gray's Inn; his father's unexpected death leaves him unprovided for, so he is obliged to follow a career in the law. Anthony leaves England for a career in espionage for the English Crown
1580	MP for Bossiney in the brief Parliament of that year
1584	MP for Weymouth and Melcombe Regis (a seat sponsored by the earl of Bedford, to whom he was related via his aunt Elizabeth)
1585	Delivers maiden speech in Parliament on a bill concerning wards
1586	Becomes Reader at Gray's Inn; sits as MP for Taunton; speaks in favour of the execution of Mary Queen of Scots (held in the custody of Sir Amias Paulet)
1588	Death of the earl of Leicester. Francis enters the circle of the

earl of Essex; Anthony joins him in 1592 after his return from France following the death of Elizabeth's spymaster, Walsingham

1589 MP for Liverpool (sponsored by Walsingham). Commissioned to write *An Advertisement Touching the Controversies of the Church of England* in response to the Marprelate controversy; Burghley grants Bacon the reversion of the Clerkship to the Council of the Star Chamber (a post worth a substantial annual sum, but which he did not actually obtain for twenty years)

1592 Commissioned to write *Observations upon a Libel* in response to a Jesuit anti-government invective; composes a performance piece for four speakers, 'Of Tribute', possibly as an entertainment at Gray's Inn, probably on Essex's behalf

1593 Anthony Bacon moves into Francis's chambers at Gray's Inn. Essex joins the Privy Council. Francis speaks in Parliament, opposing the granting of a subsidy to Queen Elizabeth; Burghley informs him that Elizabeth is furious. Subsequently she fails to promote him

1594 Becomes Learned Counsel (personal legal advisor) to Elizabeth; composes *Gesta Grayorum* for the Gray's Inn revels.

1595 Vigorous but unsuccessful campaign by Essex to have Bacon made Solicitor General. Bacon writes *Accession Day Device* on behalf of Essex for the queen's birthday on 17 November, but begins to distance himself publicly from the earl thereafter

1596 Writes *Maxims of the Law*

1597 First edition of Bacon's *Essays*, which have been circulating in manuscript, published together with his *Meditationes sacrae* and *Colours of Good and Evil*. Dedicated to Anthony Bacon but presented to Essex with an effusive private dedication, 'to whose disposition and commandment I have entirely and inviolably vowed my poor self, and whatever appertaineth unto me'

1601 Following Essex's rebellion, Bacon escapes prosecution when others in Essex's service are implicated and executed with him. Bacon is appointed one of the prosecutors at his trial for treason and writes *A Declaration of the Practices and Treasons Attempted and Committed by Robert, Late Earl of Essex*. Anthony Bacon is not prosecuted because of his ill health; he dies shortly thereafter

1603 Knighted by James I upon his accession to the throne after the