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GEORGE SARTON CHAIR

of the

HISTORY OF SCIENCES

1996-1997

SARTON CHAIR LECTURES

LAUDATIO LAURENCE W.B. BROCKLISS

H. De Ridder - Symoens

It is my great pleasure as *collega proximus* to introduce Dr Laurence Brockliss as the eleventh Laureate of the Interfaculty Sarton Memorial Chair of the History of Sciences on the proposal of the Faculty of Philosophy and Letters.

For George Sarton 'History of Science' was 'History of Culture'. Therefore the history of sciences has to be interwoven with that of arts, literature, politics, religion, etc.

Dr Brockliss' research and his publications can be considered a perfect realisation of Sarton's conceptions of 'History of Science'. In his work natural sciences, liberal arts and society are harmoniously integrated. The scope is European, even if the actual subject may be French or English.

Laurence William Beaumont Brockliss, born in 1950 in the County of Kent is a pure Oxbridge academic. He studied history at the University of Cambridge and graduated in 1976 with a Ph.D. on *The University of Paris in the Sixteenth and Seventeenth Centuries*. I read his thesis in the Library of Cambridge long before I knew the author personally.

After an intermezzo of some years as Lecturer in History at the University of Hull, he was appointed fellow of Magdalen College Oxford and Reader in Modern History at the University of Oxford. At present he is chairman of the Faculty of Modern History.

In the twenty years since his graduation Dr Brockliss has been a prolific author. I shall not attempt to enumerate all his publications. Rather I shall restrict my account to the fields our Laureate has covered in the history of science and stress the originality of his work.

Speaking in broader terms, Brockliss' fields of research are the history of academic teaching and the history of the natural sciences, with a focus on medicine. He is especially interested in their mutual dependence and interaction; and he has explored these matters in relation to particular societies.

Till the seventies the conception historians had about the European universities in the early modern period, roughly from 1500 till 1800, was one of decline and uselessness. The Scientific Revolution happened outside the universities; teaching subjects were outdated, the deontology of the professors was poor and the academic degrees were sold to students who were uninterested in science. Instead, they cherished the more social side of academic life, fencing, dancing, etiquette and conversation. University education was represented as more of an occupational therapy for the *jeunesse dorée* than a preparation for their future tasks, for which they were already destined.

The *nouvelle histoire* of the sixties and the seventies of this century with its new approach and new methods has not bypassed the history of universities and the history of the sciences. New types of questions were suggested through the influence of the social sciences and the pursuit of an integrated history. As a result the standard caricature of the role of universities in the scientific movement during the *ancien régime* has totally changed.

To this historiographical renewal and adjustment Dr Brockliss has made an important contribution with his work on the form and contents of the educational system. In his highly appreciated *French Higher Education in the Seventeenth and Eighteenth Centuries*, edited by Oxford U.P. in 1987, the author analyses the subjects taught in French colleges and universities in the period of the Scientific Revolution and the Enlightenment. On the basis of previously rarely consulted student notes (*cahiers*) and professorial textbooks he reconstructs the curriculum of each of the four faculties, arts, theology, law and medicine, with the emphasis on the teaching of natural sciences. These courses are, of course, very relevant in the age of Descartes and Newton. They give information of the level to which professors integrated in their lectures the actual scientific findings and discoveries. This research is the more relevant as it reflects the educational level of France, a country under an absolutist regime which might have made higher education rather conservative and of a low standard.

The results of his research convey a totally different impression of the previously despised and underrated French universities on the eve of the French Revolution. They demonstrate how essential the impact of higher education has been on social, political and intellectual life of the *ancien régime*. The dichotomy in university teaching between the establishment-reenforcing ethical and metaphysical sciences and the more dynamic and innovative natural sciences led to two different educational results. On the one hand, the academics developed and promoted a justification for the divine right of the French absolute monarchy, which helped to secure and defend that monarchy. On the other hand, they stimulated new scientific and philosophical ideas and transferred these to generations of students which resulted in the breakdown and final collapse of this absolute monarchy.

Notwithstanding the fact that only certain professors of medicine had an international reputation and contributed personally to the advancement of medicine, they also played an important - indeed crucial - role in the contemporary scientific movement. This aspect will be explained more fully in the book that is in press, namely *The Medical World of Early Modern France* (Oxford U.P. 1997).

In many of his articles L. Brockliss has penetrated more deeply into topics related to the Scientific Revolution in France; there he has explored in particular the place of logic, mathematics and the natural sciences in the philosophical curriculum of the University of Paris.

Besides that, he has contributed to several volumes dealing with the history of the *curriculum studiorum* and the evolution of science in England in the early modern period.

Thanks to his profound knowledge of the situation both on the Continent and in the British Isles, Dr Brockliss is the right person to contribute to books covering the whole of Europe. In the recently published second volume of *A History of the University in Europe*, sponsored by the Standing Conference of Rectors, Presidents and Vice-Chancellors of the European Universities (CRE), he gives a remarkable, skilfully presented overview of the curricula of early modern universities in Europe. It is the first synthesis ever written on that theme. That chapter confirms his broad knowledge of the content of teaching and of the ways of knowledge transmission in preindustrial Europe.

Ladies and gentlemen,

Not only as an author but also as the general editor between 1988 and 1993 of the international journal *History of Universities*, published by Oxford U.P. Dr Brockliss has justified his position at the forefront of the new approach to the history of universities that is linked to the history of sciences and committed to placing higher education in its intellectual, social, political and religious environment.

It is for all these reasons that the Sarton Committee at the proposal of the Faculty of Philosophy and Letters unanimously decided to appoint Dr Brockliss to the Sarton Memorial Chair 1996-1997. Today and tomorrow we will have the opportunity to become familiar with the ideas and views of this outstanding scholar. The lecture of tomorrow on *Civility and Science: From Self-Control to Control of Nature,* about the connections between the Renaissance and the Scientific Revolution will reflect the fresh and innovative concepts of our Laureate on the significance of the civilization process in the creation of new science.

And now, Ladies and Gentlemen, it gives me very great pleasure to ask my Colleague, Dr Laurence Brockliss, to give his public lecture on Medicine and the Church in the Age of the Enlightenment.

'EXTENDING THE MEDICABLE' : MEDICINE AND THE CHURCH IN THE ENLIGHTENMENT

Laurence W.B. Brockliss

Rector Magnificus, members of the Sarton Committee, ladies and gentlemen: I am greatly honoured to have been elected to hold the George Sarton Memorial Chair of the History of Sciences for the academic year 1996-7. The theme of my lecture this afternoon is the changing and increasingly tense relationship between the Church and medical science in the era of the Enlightenment. As my research at present into the history of the sciences is predominantly concentrated on medicine, it seemed appropriate that my lecture should have a medical theme. As the Chair to which the Sarton Committee has so kindly elected me has been established in memory of a great positivist as well as one of the founding-fathers of the history of science, it seemed equally appropriate to choose a theme with which George Sarton would have easily related. Sarton looked forward to a future where man through the development and popularization of the sciences would be freed from the superstition of traditional religion and fully in control of nature and his own destiny. His positivist vision of the world was anticipated in many respects by the medical scientists and practitioners of the Enlightenment. As we will see, the eighteenth century was an age in which many physicians and surgeons sought to escape from the cloying shadow of the Church and create a perfected and more broadly defined medical science. Sarton could not but have applauded their endeavour and hailed the emergence of an independent, progressive medical science in the nineteenth century as a significant step on the road to his positivist future.[1]

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In the historiography of the Scientific Revolution medicine and the biological sciences have always played an ambiguous and limited role. Although historians have accepted that the period 1500 to 1800 witnessed significant developments in the understanding of human and animal anatomy - notably, of course, the discovery of the circulation of the blood - they have been reluctant to identify the classic age of the Scientific Revolution with a truly profound reorientation in the life sciences. Whereas the physical and, belatedly, the chemical sciences were undisputedly 'revolutionized' in the course of this period, the birth of modern medicine is deemed to have been a nineteenth-century phenomenon, perhaps only really created at the turn of the twentieth century with the acceptance of the role of bacteria in disease. The most recent scholarly account of the history of medicine in English even suggests that before 1800 there was little radical change in the fundamentals of European medical science from the time of Hippocrates and Galen.[2]

This reluctance to see medicine as part of the Scientific Revolution is quite understandable. Without too great an oversimplification, the movement had three major characteristics. In the first place, it involved the development of a novel and rigorous experimental methodology for obtaining an everincreasing amount of data about the natural world, albeit one where initially social as much as scientific factors helped to validate new observations.[3] Secondly, though only to a limited extent, the movement concerned the mathematization of nature, in particular the expression of the relationship of natural effects in terms of mathematical ratios (or laws).[4] Finally, the Scientific Revolution saw a radical epistemological shift in the way nature was conceived: it ceased to be an organism and became a machine, as the Aristotelian and Neoplatonic belief that natural phenomena had the innate capacity through their peculiar form to move themselves gave way to the Cartesian view that matter was ultimately inert and all motion potentially the result of percussion. Indeed, so deep a prejudice was this in the eighteenth century that few continental natural philosophers apart from committed materialists could ever accept that Newtonian attraction was a property of matter: either its mechanical basis would ultimately be discovered (as Newton himself suggested with his ether theory) or attraction was a continual divine act, a perpetual miracle, as Maupertuis would have it, which overrode the inert nature of God's creation.[5]

The medical sciences in the period 1500 to 1800, however, were only tangentially affected by these methodological and epistemological developments.[6] Admittedly, there was a great deal of medical research. In the sixteenth and seventeenth centuries, anatomists following in the footsteps of Harvey and the Paduan School became ever more knowledgeable about the internal contours of the human body, while in the eighteenth century another Paduan, Giovanni Battista Morgagni (1682-1771), laid the foundations of the science of pathological anatomy.[7] In the eighteenth century, too, physicians began to prepare much more sophisticated accounts of the symptoms and course of particular diseases through the close observation of their patients. Furthermore, contemporary neo-Hippocratic interest in the effect of the environment on health led to a host of studies charting the connection between climatic change and disease in the wake of the earlier work of Thomas Sydenham (1624-89) on smallpox.[8] Nevertheless, for all its vitality, medical research was always far less conclusive and much more contested than research in other scientific fields for the simple reason that medical scientists never formulated a rigorous research paradigm. There was no attempt to define a set of agreed research procedures, no concept of statistical significance, and no single institutional focus, akin to the laboratory, where research was located. Patients were observed wherever the physician happened to be: in a village struck down by an epidemic, at a spa, in a hospital housing the poor. The result was that medical research was either little more than random observation or it was inconsequential.[9]

More importantly, given that historians today place question marks against the rigour of much of the experimental work in the physical sciences too, at least in the seventeenth century, the medical sciences were in no way mathematicized before 1800. A few French examples make this abundantly clear. Throughout the period physicians diagnosed disease and offered a prognosis from the presence or absence of conventional signs. But these signs were always qualitatively and only exceptionally quantitatively assessed. At the beginning of the seventeenth century, a Paris student called François Mandat derided those who wished to weigh a patient's urine rather than inspect its colour and consistency.[10] A hundred and fifty years later, a much more famous Paris physician, the Montpellier-trained Théophile de Bordeu (1722-76), was just as caustic at the expense of those who wanted to measure a patient's pulse-rate using watches or metronomes : in his opinion, pulses were fast or slow, hard or soft, and so on.[11] Significantly, too, although the Italian Santorius invented the thermometer in the early seventeenth century, it was never used in diagnosis. It was rather the primary instrument of physician-meteorologists. Indeed, it was often their only instrument. A physician at Beaune, for instance, one Vivant-Augustin Ganiare, kept a detailed account of the weather and diseases he encountered in the town for a forty-year period from 1736 to 1777. Ganiare certainly measured the daily temperature, but his diary contains no accurate reference to wind-direction and no reference at all to wind-speed, barometric pressure or rain-fall.[12] What instruments were available to the likes of Ganiare were also frequently flawed. Convinced rightly (albeit for the wrong reasons) that there was a connection between foul-smelling air and disease, an Italian in the mid-eighteenth century called Felice Fontana (1730-1805) invented an instrument called a eudiometer which supposedly registered stench-levels mathematically. For a time towards the end of the eighteenth century, the instrument was very much in vogue but there was never any evidence it was any more discerning than the common-or-garden nose.[13] Medicine before the turn of the nineteenth century, then, remained a qualitative science and one whose language was commonplace, imprecise and untechnical. It was decidedly not the property of experts. As the great comparative anatomist and court physician of the reign of Louis XVI, Félix Vicq d'Azyr (1748-94), bemoaned, its language was too often metaphorical. Physicians talked airily, for instance, of the animal spirits, implying thereby that the nerves were filled with liquid. In so doing, Vicq insisted, 'là l'on a commis une grande faute, en donnant un nom individuel [i.e. concrete] au lieu d'un nom abstrait à une propriété peu connue'.[14]

Even the promotion of the mechanical philosophy had a limited impact on the medical sciences. True, the medical theory taught in Europe's medical faculties did come under the influence of Cartesianism. Although few medical philosophers were willing to accept that animals were no more than hydraulic machines as Descartes himself had argued in his posthumous, *De l'homme* (1662), there was widespread agreement at the turn of the eighteenth century that the Galenic facultative model of physiology and pathology was now redundant. Instead, the medical mainstream opted for a theory of health and disease that married the hydraulic Cartesian model with the iatrochemical ideas of Van Helmont and his followers. This was a mechanical medical philosophy to the extent that chemical reactions in the body were deemed to be the result of the interaction of particulate matter in motion, but it was still a theory that drew on a neo-Paracelsian, non-mechanical tradition. Its leading exponent, the highly influential Hermann Boerhaave (1668-1738), who taught at Leiden for the first thirty years of the eighteenth century, prided himself on being an eclectic and non-dogmatic.[15] Moreover, as the century wore on, an increasing number of medical professors jettisoned the mechanical model altogether. From the turn of the eighteenth century, Georg-Ernst Stahl (1660-1734) at the new Prussian university of Halle, insisted that physiological processes could not be completely explained mechanically; they must in some way be governed by the soul. But Stahl's animist medical philosophy was at least metaphysically Cartesian: he retained a strict definitional separation between mind and body and accepted that matter was inert. Later critics of the mechanical model were much more radical and espoused an uncompromising vitalist philosophy that teetered on the brink of materialism.[16] Vitalism in the second half of the eighteenth century was particularly associated with the Montpellier faculty. Its most important promoter there was Paul-Joseph Barthez (1734-1806) who argued that each living body was endowed with a vital principle whose activity alone could explain why in animal physiology large effects frequently seemed to flow from trivial motions. This principle had nothing to do with the soul but was a characteristic of living matter.[17] Thereby, in the eyes of Barthez and his followers, the life sciences (or biology as they came to be termed) and the physical sciences were epistemologically distinct and could not be erected on the same principles. His position was admirably summed up by his pupil, the later chemist and revolutionary, Jean-Antoine-Claude Chaptal (1756-1832).

> Sans doute, les lois de la mécanique, de l'hydraulique et des affinités chimiques s'exercent sur toute la matière; mais, dans l'économie animale, elles sont tellement subordonnées aux lois de la vitalité que leur effet est presque nul; et les phénomènes de la vie s'éloignent d'autant plus des résultats calculés d'après ces lois, que la vitalité est plus intense, de sorte que leur pouvoir est presque insensible dans les fonctions dévolues aux animaux.[18]

With a growing number of medical professors turning their backs on the model of the physical sciences, it was scarcely surprising that there had been no Scientific Revolution in medicine by 1800. In many respects vitalist medical scientists resurrected Galenic, pre-Cartesian ways of thinking about the body. Significantly, one daring medical student at Caen, Jean-François Denise, was even ready to argue that Harvey's discovery of the circulation of the blood had had deleterious consequences for the development of medicine.[19] Harvey, then, was not the starting--point of modern medicine in the vitalists' eyes: the beginning still had to be made.[20] Leading vitalists even played down the one really important eighteenth-century development for the history of modern medicine - pathological anatomy. According to Barthez:

> L'anatomie pratique [i.e. pathological anatomy] est utile, mais elle a beaucoup d'inconvénients. L'ouverture des cadavres ne démontre que le dernier terme des effets de la maladie, à laquelle nous devions nous opposer, et ne nous fait pas connoître les premières laesions qu'elle a faites. Souvent même, elle ne nous en fait pas connoître le dernier terme.[21]

Admittedly, this scepticism was not necessarily shared by the second generation of vitalists in France who reached maturity during the Revolutionary and Napoleonic eras. After all, it was the vitalist, Marie-François-Xavier Bichat (1771-1802), who is generally credited with the foundation of the first great school of pathological anatomy at Paris at the turn of the nineteenth century, just as it was a vitalist member of that school, René-Théophile-Hyacinthe Laënnec (1781-1826), who successfully solved the problem Barthez raised: his invention of the stethoscope made it possible to study the progress of an internal lesion prior to death.[22] Nevertheless, vitalism was not usually the engine of medical progress. The future was to lie with sceptical mechanists, such as Vicq d'Azyr, who sought to maintain the traditional link between physics and medicine and deplored the vitalists' dogmatic rejection of the mechanical model.[23]

Yet if it is easy to concur with the traditional view that medicine and the life sciences were of marginal importance in the Scientific Revolution, there remains good reason for regarding their contribution in a more positive light. To do this it is necessary to look beyond the Scientific Revolution as essentially an internalist methodological and epistemological event and reexamine its potential as a movement of religious subversion. This is to reopen a debate that has been largely closed for the past twenty years.[24] In the nineteenth and the first part of the twentieth centuries the Scientific Revolution was viewed Whiggishly as a force for secularization and modernity. Whereas in the late Middle Ages Aristotelian science and Christian theology had been comfortable bedfellows thanks to the success of the Thomist synthesis, the replacement of the qualititative by the mechanical universe was assumed to have inevitably placed science and religion on a collision course. In the age of scholasticism Christianity had been rationally underpinned by the concepts of Aristotelian physics and metaphysics. In the Scientific Revolution those concepts were discredited and the Christian religion was left exposed in its true colours as a set of unprovable prejudices. The trial of Galileo was the beginning of a battle that would rage until the triumph of Darwinianism.[25]

Modern historians of science, in contrast, have all but abandoned the belief that religion and the new science were at odds. Anxious to place the Scientific Revolution in its historical context, they have had no difficulty in demonstrating that the leading members of the movement were confirmed, if sometimes unorthodox Christians, whose faith greatly affected their work as experimental philosophers.[26] At most a Galileo was making a space for a study of the natural world independent of Scripture: he in no way threatened the Church's own domain of ethics and theology.[27] Descartes, too, in his metaphysics was merely demonstrating to the Church that there was nothing unorthodox about the mechanical philosophy : in urging contemporaries to embrace his sceptical method with regard to natural philosophy, he was not encouraging his contemporaries to question their religious inheritance.[28] In fact, since the appearance of Robert Merton's work on the relationship between Protestantism and science, historians have been more interested in discovering whether the Scientific Revolution was the property of a particular confession or sub-confession than in tracing its anticlerical character.[29] In recent years, even Counter-Reformation Catholicism has been seen as a positive force on the movement. The Jesuits in particular have been hailed as pioneers of the experimental philosophy, especially in the relatively *recherché* areas of magnetism and electricity, whatever their doubts about the mechanical philosophy.[30] The Jesuits, too, have been acclaimed as 'modern' scientists *avant la lettre*. Whereas Galileo was a dogmatist, insisting on the fact of heliocentricity which he could not prove, his adversary, Cardinal Bellarmine, was the model of cautious open-mindedness. The Church was not implacably wedded to geocentricity: it would abandon the position as soon as the Copernican theory was evidentially confirmed.[31]

However, it would be unwise to assume there was no conflict between science and religion in this period, as becomes clear when the focus is switched from the physical to the medical sciences. Although the investigations of experimental philosophers into inert nature were often derided by both clerics and laymen - one recalls in particular the satirical portrait of Laputa in *Gulliver's Travels*, penned by Jonathan Swift, Dean of St Patrick's Dublin - there was seldom any deep objection to the physical scientist 'torturing' the natural world to reveal its secrets.[32] Significantly, the Jesuits, guardians of Catholic Counter-Reformation orthodoxy, had been among the first to replicate Galileo's telescopic discoveries. Research into the life sciences, on the other hand, was viewed far less charitably and the Church, both Catholic and Protestant, frequently stymied, if it never successfully prevented, medical experimention. Organic nature, especially animal and human life, was accorded a dignity and status which the intrusive and inquisitive probings of the medical scientist were deemed to devalue.

This suspicion of medical research was reflected in the first place in the Church's attitude to the dissection of human cadavers. Admittedly there was little or no attempt to prohibit human dissection, provided the anatomy was properly organized under the auspices of a faculty and the occasion was seemly. The faculties, too, did their best to court the Church's approval by playing down any voyeurist public element in the proceedings and turning the dissection into a moral event. The Leiden anatomical theatre was designed to remind the audience constantly of the closeness and inevitability of death: inside its walls, skeletons were placed round the edges decorated with moral saws.[33] What the Church did dislike was the commonplace practice of unsupervised anatomies where medical students, often illegally, purloined bodies or parts of bodies and dissected them in their lodgings. The existence of this practice, though, reflected the Church's ambivalent attitude to dissection *tout court*. Although it did not prohibit official dissections, it scarcely encouraged them, for it insisted all over Europe that only the bodies of executed criminals could be thus defaced and ensured that the state made it extremely difficult for faculties to obtain female cadavers especially. Even in the second half of the eighteenth century, a leading faculty like Montpellier was known to suspend its anatomy lectures for lack of a specimen.[34] Inevitably, therefore, medical students anxious to gain a fuller acquaintance with human anatomy were forced to rely on their own initiative. As early as the mid-sixteenth century Montpellier medical students had turned to grave-robbing. In Paris by the early eighteenth century student lodging-houses had become veritable butchers' shops.[35]

If the Church looked with a jaundiced eye on dissecting corpses, it inevitably ruled vivisection beyond the pale. Human vivisection, of course, was completely outlawed, but animal vivisection, too, was heavily criticized. The Cartesian belief that animals were machines that could feel no pain won few clerical supporters and the Church remained wedded to the traditional Franciscan view that mankind could use but not abuse the animal world. This, it must be said, was an opinion shared by some leading medical men. Europe's most famous anatomist in the first half of the seventeenth century, the Parisian Jean Riolan the Younger attacked Harvey for his cruelty in experimenting on animals.[36] In the eighteenth century, the ardent vivisectionist, the Swiss Albrecht von Haller (1708-77), was overcome by remorse in later life and became deranged.

The Church, too, did not appreciate medical experimentation of any kind when it involved human subjects. Although early attempts at transfusing the blood of humans and sheep in London and Paris in the 1660s were never formally challenged, the fact that they ceased so quickly (despite apparent success!) suggests their proponents, notably the Parisian Jean Denis, sensed the ecclesiastical axe was about to fall.[37] Certainly the Church continually frowned on far less graphic forms of therapeutic experimentation. In the eighteenth century the hospital, traditionally an institution for sheltering the homeless and indigent, began to be seen as a plausible site for medical research. In Catholic countries in particular, where the hospitals were usually controlled by one of the regular orders, the institution became a battleground. The Church did everything it could to protect the dignity of the poor from an intrusive medical profession. Not only did the hospital authorities do their best to prevent the bodies of their charges falling into the hands of the medical profession on death, but they continually frustrated physicians or surgeons anxious to use the inmates as medical guinea-pigs on whom to try out new remedies or new invasive techniques. Female nursing orders were notoriously uncooperative even in the day-to-day care of patients. Convinced that the best form of treatment for the sick poor was a good meal, they frequently refused to starve their charges on the doctors' orders or administer prescribed remedies.[38]

In other words, there is good reason to think that the speed of advance of medical science in the early modern period was seriously curtailed by the antagonism of the Church to medical research. Although there may have been good 'internal' reasons for the absence of a Scientific Revolution in medicine before 1800, a contributory 'external' factor must have been the continuing power of the Church over European society and culture, even in the Age of the Enlightenment. This is not to say that individual members of the Church were necessarily hostile to medical research. There were always some clerics who were enthusiastic supporters of medical novelty. The leading advocate and practitioner in France in the second half of the eighteenth century of the extremely contentious and novel remedy of electrotherapy in cases of paraplegia was a Perpignan abbé, one Jean-Joseph Sans.[39] But such exceptions are of scant significance : they merely reflect the fact that many clerics entered the Church throughout the period on parental command and without any sense of vocation. What is important is the Church's generally negative attitude. In France at least it is not surprising that medical research first became vibrant and positive in the years following the Revolution. It was only then that the hospitals were secularized and their inmates became 'citizen-patients'. In the Brave New World of the Revolution the poor were expected to donate their bodies to science in return for being looked after at society's expense.[40]

Lying behind the Church's understandable concern about human and animal dignity lay a deeply embedded Augustinian outlook on life, shared as much by Catholics as Protestants. Human beings were fallen creatures born to suffer and die. God might have given us a great enough rational capacity to grasp the beauty and magnificence of the Creator through His creation, but there was only limited room for human improvement, material or moral. 'Torturing' inert nature to reveal her secrets could be justified to the extent it might provide a fuller knowledge of the creation and divine greatness. Probing the secrets of organic nature might be similarly insightful but had to be balanced against the pain, moral and physical, it might engender. In the sixteenth century most physicians would have accepted this Augustinian world view. Theirs was a very God-centred universe. Medicine was an uncertain science, not because doctors were ignorant, but because their endeavours were ultimately dependent on divine grace. If He chose, God could frustrate for His own reasons the efforts of the most talented of physicians to cure disease. According to the Montpellier professor, the Protestant Laurent Joubert, the physician's duty was to do his best, then entrust 'l'issuë & évenement à Dieu, qui donne & oste, augmente & diminue la force audits remèdes, comme il luy plaist'. As a result a physician was not to be blamed if he failed, or dismissed as ignorant. Rather, Joubert went on, 'pourveu qu'il ait bien fait son devoir, [il] ne doit estre moins estimé, que si le malade fût eschapé.'[41]

By the eighteenth century, in contrast, medical men had a much more Pelagian mentality.[42] By and large they were now medical optimists who believed in the possibility of improving and maintaining the population's health. This was the great age of the medical self-help book, such as the constantly reprinted *Avis au peuple sur sa santé*, the work of the Lausanne physician Samuel-Auguste-David Tissot (1728-97), first published in 1761. Thanks to the power of the printing-press and the spread of popular literacy, even those out of reach of a doctor could benefit from the physician's wisdom.[43] In the physicians' eyes, medical research was now not gratuitous but purposeful, its aim to improve man's knowledge of health and disease so that the quality of life could be improved and its length extended.[44] Medical guinea-pigs were soldiers in the cause of a better future. In hymning the possibilities of medicine, therefore, medical scientists were advancing an alternative man-centred world view, one that was not necessarily anti-Christian but one that rejected an interpretation of Christianity which had dominated European culture for one and a half millenia and insisted instead that life on this earth need not be a permanent vale of tears. It was inevitable that medicine would be the favoured science of the French *philosophes*.

Promoters of a philosophy of life which stressed human potential and secular values, they saw in medicine the science of human improvement and emphasized its particular utility.[45]

Of course, medical scientists in the Enlightenment were not the first to have justified research in such optimistic terms. Renaissance humanists in the fifteenth and early sixteenth centuries, notably Sir Thomas More, had turned their back on Aristotle and Augustine and glimpsed the possibility of material and moral amelioration.[46] Indeed, a vision of progress was a part of the rhetoric of the wider Scientific Revolution. According to its twin ideologues, Bacon and Descartes, the new experimental philosophy, in contrast to the Aristotelianism of the Schools, was justified as 'worker-science' : it would provide knowledge which could be used to improve man's lot.[47] In this respect, then, the new science *tout court* was a challenge to the traditional worldview of the Church. Nevertheless, even before the eighteenth century medical science had a privileged position in this novel utilitarian discourse. In the form of Paracelsianism, the sixteenth and early seventeenth centuries had witnessed the appearance of an anti-Galenic medical philosophy whose roots lay in Neoplatonism, hermeticism and popular culture. As justification for rejecting the medicine of the ancients, Paracelsus and his followers, such as the Basle physician Joseph Duchesne (called Quercetanus), developed a much more positive conception of the potential of healthcare and insisted they possessed the secret to longevity.[48] Mechanical philosophers, although seldom sympathetic to Paracelsianism, pointedly adopted its rhetoric. In extolling the utility of the new science, little was ever said about its technological possibilities; the emphasis lay rather on the benefits that would accrue to human health. Descartes's vision of progress outlined in his 1637 *Discours de la méthode* perfectly exemplifies the trend. He looked forward to perfecting the mechanical philosophy not so as to improve material prosperity but to prolong life. 'J'ai resolu de n'employer le temps qui me reste à vivre à autre chose qu'à tâcher d'acquérir quelque connaissance de la nature, qui soit telle qu'on puisse tirer des règles pour la médecine, plus assurées que celles qu'on a eues jusques à présent'.[49]

It is not difficult, therefore, to understand the Church's misgivings about medical research. Even if medicine was the one area of natural philosophy wherein little was achieved in the course of the Scientific

Revolution, it was the one of which most was expected. However, the tension between the Church and the medical profession in the eighteenth century was not simply engendered by a clash of world-views. The tension was exacerbated by the knock-on effect a more positive world-view had on the practice of medicine. In the sixteenth century physicians had not only believed that ultimately their patients were in the hands of God. They had also accepted, in consequence, that the physician should play second fiddle to the priest: ministering to the patient's soul was more important than ministering to his health. The physician, too, should pray to God for the cure of his charge.[50] By the turn of the eighteenth century, physicians and surgeons were more confident in their own abilities. French physicians in the Age of the Enlightenment may not have been irreligious - some like Voltaire's doctor, the Genevan Théodore Tronchin (1709-81), were exceptionally pious[51] - but they no longer automatically reached for a priestly crutch. In particular, doctors in Catholic France no longer bothered to ensure that their patients had confessed before beginning treatment, so much so that as early as 1712 the crown, on the request of the archibishop of Paris, had to remind them forcibly of their duty on pain of losing their right to practise.[52]

More importantly, as the eighteenth century progressed physicians and surgeons began to invade the Church's own territory. In the sixteenth and seventeenth centuries the province of medical practice was narrowly defined. Physicians in particular concentrated their attention on treating the maladies of the rich. They also usually drew the line at attending the victims of the most virulent and lethal epidemic disease, the plague. When plague struck physicians notoriously followed their own prophylactic advice : they left early and returned late. Physicians such as the Montpellier professor, François Ranchin (died 1641), who as mayor stayed and organized the fight against the 1629-30 epidemic in the city, were uncommon heroes.[53] So, too, were physicians who aped the Jansenist Port-Royal doctor Jean Hamon and willingly sought a medical clientele among the poor.[54] All over western Europe, the resultant gaping hole in medical provision was supplied by a bevy of untrained and part-time healers - charlatans, wise-women, midwives, seigneurs, above all clergy. Many members of the secular and regular clergy must have always ministered to the body as well as the soul, but in the age of the Reformation and the Counter Reformation, where a novel emphasis was placed on practical charity, the role of the minister or priest as a medical practitioner took on a heightened importance. In Catholic countries the new regular orders were particularly active in this respect. Throughout the towns of France regular convents became medical centres for treating the poor and sometimes even the rich. The Frères de la Charité even extended their activities to surgery, a number of members of the order becoming skilful lithotomists. Moreover, despite the concerns of the Church about therapeutic experimentation, it was commonplace for regulars to peddle their own specific remedies. The Fench crown even encouraged the practice: part of the Louvre was handed over to the Capuchins as a pharmaceutical laboratory.[55]

From the beginning of the eighteenth century, however, physicians began to extend their field of activity. In the last great outbreak of the plague in western Europe that hit Marseilles and Provence in 172O a number of trained medical practitioners on royal prompting actually went into the stricken region and performed heroically.[56] This was the catalyst for the emergence in the second half of the century of a new breed of enlightened physician who deliberately risked his life going out into the countryside to treat peasants struck down by epidemics. In France, the icon of the breed was the Dijon physician, Hugues Maret (1728-85), who died as a result of attending an epidemic in the village of Fresne-Saint-Masmes (near Vesoul). According to his memorialist, Vicq d'Azyr, even on his death-bed and in delirium he thought only of his peasant patients.[57]

But the eighteenth-century physician not only turned his attention to the poor and lethally infectious. He began, too, to extend the conception of the medicable. In the first place he took a novel interest in hygiene. Prior to 1700 the physician had primarily concerned himself with the body in a state of disease. The preservation of health was considered a commonsense matter that could be left to the individual. All that was required was a basic knowledge of the Hippocratic non-naturals, an understanding of the Aristotelian doctrine of the mean and awareness of one's temperament.[58] In the eighteenth century in contrast, hygiene became the province of the medical expert. Good health was still deemed to depend on the proper use of the non-naturals, but its preservation was now a complex matter, especially given the novel emphasis placed on the role of the air as the fundamental external cause of disease. Every man or woman might be able to perceive the presence of corrupt food and drink, but air was an invisible quality whose mephitic potential could only be properly judged by the medical scientist. The individual, too, could only inadequately control his or her environment. The maintenance of the people's health was a state matter. Taking up themes developed in the Holy Roman Empire by German cameralists, French physicians from the mid-eighteenth century, like the Lyons doctor Jean-Emmanuel Gilibert (1741-1814), began to demand a role for themselves as public-health counsellors.

> C'est d'eux seuls [physicians] que les magistrats apprendont l'art d'assainer les grandes villes. Ils leur feront entretenir les funestes effets de la mauvaise disposition des cimetières, des boucheries, des manufactures; ils leurs découvriront les moyens de purifier les maisons, les hôpitaux; ils leur feront sentir l'importance des règlemens sur les denrées falsifiées; ils démontreront les maladies que toutes ces causes peuvent produire & les moyens de les prévenir.[59]

Moreover, even a sophisticated knowledge of the non-naturals was now deemed insufficient to ensure continued health, especially the health of the young. Too many contemporary customs, especially prevalent in child-rearing, were felt to be dangerous. The physician took on an additional role as paediatrician. Under the influence of the Enlightenment's concern with the natural, physicians began to wage a campaign against parents who put their children out to nurse, swaddled them too tightly, cut their gums to encourage teething, and so on.[60] From the mid-century - Tissot and Tronchin in the van - an increasing number also promoted the value of another novel practice, smallpox inoculation.[61] Children in the age of the Enlightenment were precious vessel, whose raising could no longer be trusted to parents. The physician had become a hygienist, even a beautician. In the 1730s, the Parisian physician Nicolas Andry de Boisregard (1658-1742), the first Frenchmen to discuss child-rearing in detail, invented the term orthopedics. In a work published in 1738, he not only instructed parents in how to deal with children's diseases, such as smallpox, the king's evil (scrofula), rickets and ringworm but also how to cure and avoid bodily imperfections like round-shoulders or pigeon-toes. Parents, he insisted, had a moral duty to look after their children's appearance and mocked mothers who tried to disfigure beautiful daughters lest they became vain:

> We are born for one another, and ought to shun having anything about us that is shocking; and even though a person should be left alone in the World, he ought not to neglect his Body, so as to let it become ugly; for this would be contradicting the intention of the Creator.[62]

Finally, eighteenth-century physicians and surgeons began to interest themselves in physical states they had largely hitherto ignored. The most significant development in this respect was the 'medicalization' of pregnancy. In the sixteenth and seventeenth centuries this was the province of the midwife, usually poorly trained and semi-literate. Physicians and surgeons only became involved, and not always then, when the delivery was difficult.[63] In the eighteenth century, however, the midwife became demonized as ignorant and a threat to mankind. According to the Parisian Antoine Louis (1723-92), the surgeon-author of the article 'accoucheur' in the *Encyclopédie*, it was not unknown for midwives deliberately to turn a simple into a complicated birth merely to draw a crowd.[64] At the very least physicians demanded that midwives should now be properly trained. Many went further and called for their replacement altogether. The Paris physician, Antoine Petit (1718-94), could not wait for the day when women were removed from the birthplace. He did not envisage babies being delivered by graduate physicians like himself, although he certained believed that medical students should be able to perform the task if necessary and gave private lectures on the subject. Rather he promoted the practice of employing surgeons as midwives.[65] This was a development that had first taken root in France in the late seventeenth century at the court of Louis XIV and then spread throughout Europe. Thanks to the blessing of prominent physicians, like Petit, on the eve of the Revolution in France it was commonplace even among the poor. A Reims surgeon, for instance, Pierre Robin (1725-1804), seems to have personally delivered 15 per cent of the city's babies in the 1780s.[66]

It is not difficult to see why the emergence of the physician as epidemic doctor, hygienist, beautician and gynaecologist led to friction with the Church. By pushing back the boundaries of their profession, medical men were often seriously invading the Church's space, claiming as their own territory the Church had successfully colonized. The Church had always been more than a spiritual institution: by extending the medicable, physicians were reducing its presence in the material domain and threatening its influence over the poor majority of the population. On the eve of the Revolution in Catholic France, physicians were even beginning to interest themselves in the care and treatment of the insane, a province they had traditionally left completely to the regular orders.[67] Admittedly, some physicians did not envisage a future where every man or woman would have easy access to a trained medical practitioner. The purpose of Tissot's manual was to link the world of learned medicine with the bevy of untrained practitioners by offering simple instruction in how to recognize and treat common diseases. This was a programme of accommodation, where the clergy would have continued to occupy an important role as healers.[68] By 1789, however, reformist physicians in France were much more radical. The programme Vicq d'Azyr offered to the Health Committee of the National Assembly sought to remove the clergy and their fellow irregulars from the field of medical practice altogether. Instead, the poor would be served by state-funded cantonal doctors, less well-trained than graduate physicians but still lay and professional.[69]

The physicians putsch, however, was also, if less obviously, a threat to the Church's guardianship of moral order and thereby effected its spiritual authority as well as its secular interests. To the Church, the new concern with hygiene could not but seem to place an unseemly, un-Augustinian emphasis on the body, especially when, in Andry's case, the concern seemed to be less about raising a healthy child than in rearing a marriagable daughter. The Catholic Church was particularly threatened. Although the Counter-Reformation Church had embraced to a degree the Erasmian enthusiasm for cleanliness and table-manners, it had never fully subscribed to the new Renaissance aesthetic. The Jesuits may have presented a smart and fragrant appearance but Franciscan asceticism still retained its appeal among many of the leading regular orders, especially the Capuchins. The physicians' promotion of a similar aesthetic on health grounds inevitably met with suspicion among the most-Augustinian minded Catholics in the Church, all the more that it turned unwashed, scantily-clad and under-fed clerical saints into potential cesspools of disease. To those who swallowed the new rhetoric, the holy Capuchin became a figure of fun.[70] The enthusiasm for hygiene, moreover, did not just undermine the authority of many regular clerics. To the extent it led to calls for the closure of cemeteries and an end to burials in church, or queried the healthiness of certain rituals, like flagellation, it challenged the Catholic Church's sacred space and undermined the commitment to baroque piety. The attack on midwifery was just as alarming. The Counter-Reformation promoted a much more gendered society than had been the case in the late middle ages : women and men had distinctive roles, epitomized in the Church's patronage of separate male and female confraternities. Delivering babies was women's work. To replace the midwife by the surgeon was to intrude a male presence into the delivery room : for a man to explore the female genitalia broke a powerful taboo and raised the spectre of immodest feelings on the part of both doctor and patient.[71]

In conclusion, then, there may not have been a scientific revolution in medicine before 1800, but in Catholic countries especially, the developments that did take place helped to establish a genuine tension between science and religion which in part remains unresolved today and contributed powerfully to the secularization of European society. Of course, this tension must not be overdrawn. Many enlightened physicians in Catholic states had no desire to desacralize the medical space completely. In 1774, Antoine Petit, the most famous private medical teacher in Paris in the second half of the century, submitted a plan for a new hospital in the capital after fire had damaged the overcrowded Hôtel-Dieu. Significantly, the building was carefully designed in a star shape so that every ward would open onto a central domed space housing an altar. Petit, an enlightened physician par excellence, was in no doubt about the importance of the provision of spiritual comfort in the healing process :

> Dans cette disposition, il est aisé de sentir que la première des choses nécessaires à tous sera sans embarras mise à la portée de tous, puisque de chacun des points de l'intérieur de l'édifice, l'Autel sera vu, & tous les malades pourront en même-temps assister à l'Office divin.[72]

Nonetheless, the tension between Church and medicine in the Age of the Enlightenment was real. In Catholic France undoubtedly, the period witnessed the germination of a division that would become increasingly marked in the post-Revolutionary era when the majority of physicians would identify with the secularizing and nationalizing ambitions of the nineteenth-century French state. In the French countryside especially, the doctor, along with the schoolmaster, would become the nineteenth-century government's primary agent in its war against superstition and clerical influence. Balzac's portrayal of Dr Benassis in *Le Médecin de campagne* (1833) has a satirical edge but his account of the heroic idealist confronting the idiocy of rural life is an appropriate rendering of the French profession's nineteenth-century self-image.[73] In the light of this future anticlerical alliance between medicine and the state, it was fitting therefore that the Revolutionaries should have housed the new Montpellier medical school, opened in 1794, in the bishop's palace (where it remains today). Equally, it was appropriate that the Revolution's instrument of vengeance that sent so many of its clerical opponents to an early grave was the invention of a leading Parisian Enlightenment physician, Monsieur Guillotin, who claimed to have discovered a humane way of killing the people's enemies.

Notes

1. Useful introductions to Sarton's positivism are Arnold W. Thackray and Robert K. Merton, 'On Discipline Building : The Paradoxes of George Sarton', *Isis*, 63 (1972), 473-95; and Töre Frangsmyr, 'Science or History : George Sarton and the Positivist Tradition in the History of Science', *Lychnos* (1973-4), 104-44.
2. Lawrence I. Conrad, Michael Neve, Vivian Nutton, Roy Porter, Andrew Wear, *The Western Medical Tradition 800 BC to AD 1800* (Cambridge University Press : Cambridge, 1995). The most accessible account of the Scientific Revolution as a long-term (not just seventeenth-century) phenomenon remains H. Butterfield, *The Origins of Modern Science* (New York, 1952).
3. The manner in which novel experimental findings gained credence has attracted much attention among Anglo-American historians of

science in recent years : see especially S. Shapin and S. Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, NJ, 1985); and S. Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England* (Chicago, 1994).

4. Historians who tend to identify the Scientific Revolution with the establishment of the Newtonian universe have inevitably privileged this particular aspect : e.g A. Koyré, *From the Closed World to the Infinite Universe,* Eng. trans. (Baltimore, MA, 1957).

5. Still serviceable on the development of the mechanical philosophy is P. Mouy, *Le Développement de la physique cartésienne, 1646-1712* (Paris, 1934). On Newtonianism in France, see J. Ehrard, *L'Idée de nature en France dans la première moitié du XVIIIe siècle* (2 vols.; Paris, 1963), ch. 3; also, L.W.B. Brockliss, *French Higher Education in the Seventeenth and Eighteenth Centuries* (Oxford, 1987), pp. 360-71 (on Cartesian mechanism in the classroom).

6. There is no really good account of medical science in this period. Useful is Lester King, *The Philosophy of Medicine : The Early Eighteenth Century* (Cambridge, Mass., 1978); this is broader in scope than it appears from the title. See also for embryology in particular : Jacques Roger, *Les Sciences de la vie dans la pensée francaise du XVIIIe siècle* (Paris, 1963).

7. One historian even talks of a Harveian research school at mid-seventeenth century Oxford : see Robert G. Frank Jnr., *Harvey and the Oxford Physiologists* (Berkeley, Calif., 1980).

8. J.C. Riley, *The Eighteenth-Century Campaign to Avoid Disease* (London, 1987).

9. For a good idea of the random nature of much research, even when undertaken by medical pioneers, see the *livre de raison* of the famous Montpellier physician and nosologist, François Boissier de Sauvages : Archives Départementales de l'Hérault 10F 51.

10. Bibliothèque de la Faculté de Médecine, Paris, *Theses medicae Parisiensis,* folio collection, vol. 3, no. 559, 'An urinae inspectio, certior quam pondus, et distillatio?'

11. T. de Bordeu, *Recherches sur le pouls. par rapport aux crises* (Paris, 1756), pp.12-13.

12. Bibliothèque Municipale Dijon, MSS 425-32.
13. S. Schaffer, 'Measuring Virtue : Eudiometry, Enlightenment and Pneumatic Medicine', in A. Cunningham and R. French (eds.), *The Medical Enlightenment in the Eighteenth Century* (Cambridge, 1990).
14. 'Discours sur l'anatomie: deuxième discours', in Felix Vicq d'Azyr, *Oeuvres*, ed. J.-L. Moreau de La Sarthe (6 vols.; Paris, 1805), vol. iv, esp. p. 216.
15. For a brief account of the changing content of faculty medical theory over the period, see L.W.B. Brockliss, 'Curricula', in H. De Ridder-Symoens, (ed.), *A History of the University in Europe* (Cambridge, 1996), pp. 613-15. For France in particular, see Brockliss, *Higher Education,* pp. 400-440, *passim*; and Laurence Brockliss and Colin Jones, *The Medical World of Early Modern France* (Oxford, 1997), pp. 107-50, 418-41. On Boerhaave and his influence, see G.A. Lindeboom, *Hermann Boerhaave: The Man and His Work* (London, 1968).
16. For vitalism in Europe generally, see F. Duchesneau, *La Physiologie des lumières: empirisme, modèles et théories* (The Hague, 1982), especially pp. 1-64, 103-71; also E. Haigh, *Xavier Bichat and the Medical Theory of the Eighteenth Century (Medical History*, supplement 4: London, 1984).
17. The most recent study of the Montpellier school is Elizabeth A. Williams, *The Physical and the Moral: Anthropology, Physiology and Physical Medicine in France, 1750-1850* (Cambridge, 1994). Other vitalists (e.g. Bordeu) believed that each organ had its separate vital principle.
18. Jean-Antoine-Claude Chaptal, *Mes souvenirs*, ed. A. Chaptal (Paris, 1893), pp.19-20.
19. Archives départementales du Calvados 1D 996, fos. 351-7, 'An detectus ab Harveo sanguinis circuitus ad medicinae progressus fecerit?'
20. This was particularly true of the science of therapeutics. See Barthez, 'Cours de thérapeutique' (n.d.), Bibliothèque Municipale Montpellier, MS 256, fos. 24-5, where he claims therapeutics to be on the eve of a medical 'revolution' [his term].
21. ibid., fo. 9.

22. On the Paris School, see M. Foucault, *Naissance de la clinique* (Paris, 1963); E. Ackerknecht, *Medicine at the Paris Hospital, 1794-1848* (Baltimore, MA, 1967); J.E. Lesch, *Science and Medicine in France: The Emergence of Experimental Physiology, 1790-1835* (Cambridge, Mass., 1984). Some historians have begun to argue that the Paris school was not so important as has been previously thought: see esp. O. Keel, 'Cabanis et la généalogie épistémologique de la médecine clinique', Ph. D. dissertation, McGill University, Canada, 1977.
23. Félix Vicq d'Azyr, 'Discours sur l'anatomie: premier discours', in *Oeuvres*, vol. iv, esp. p. 15.
24. For an introduction to the debate, see R. Hooykass, *Religion and the Rise of Modern Science* (London, 1972).
25. A view particularly championed by Marxists and popularized in Brecht's *Galileo*.
26. Newton seems to have been an anti-Trinitarian: see Frank Manuel, *The Religion of Isaac Newton* (Oxford, 1974).
27. See his 'Letter to the Grand-Duchess Christina' (1615), English trans. published in *The Galileo Affair: A Documentary History*, ed. M.A. Finocchiaro (Berkeley, 1989), document 3.
28. Descartes's *Meditationes* (1640) in which his metaphysics was fully developed were dedicated to the Paris Faculty of Theology, the fount of Catholic orthodoxy.
29. The role of English Puritans in promoting the new science has been a particular centre of controversy: see especially the rich study of Charles Webster, *The Great Instauration: Science, Medicine and Reform 1626-1660* (London, 1975). For Merton's original contribution to this debate, see Robert K. Merton, 'Science, Technology and Society in Seventeenth-Century England', *Osiris*, 4(1938), 360-632.
30. 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; Robert J.W. Evans, *The Making of the Habsburg Monarchy, 1550-1700 : An Interpretation* (Oxford, 1979), part iii, *passim*; some of the essays in Luce Giard

(ed.), *Les Jésuites à la Renaissance: système éducatif et production du savoir* (Paris, 1995); and John W. Witek (ed.), *Ferdinand Verbiest (1623-1688). Jesuit Missionary, Scientist, Engineer and Diplomat* (Monumenta Serica Monograph Series, no. 30: Leuven, 1994).

31. As it did in 1822 once stellar parallax had been confirmed.
32. This grim metaphor was the brain-child of Francis Bacon, who had spent the 1590s overseeing the torture of suspected English Catholic traitors and knew all about extracting information from recalcitrant material: see the comment in Julian Martin, *Francis Bacon, the State and Natural Philosophy* (Cambridge, 1992), p. 166.
33. T.H. Lensingh-Scheurleer, 'Un amphithéâtre d'anatomie moralisé', in id. and G.H.M. Posthumus Meyjer (eds.), *Leiden University in the Seventeenth Century : An Exchange of Learning* (Leiden, 1975).
34. Chaptal, *Mes souvenirs*, pp. 16-17.
35. Felix Platter, *Beloved Son Felix : The Journal of Felix Platter, a Medical Student in Montpellier in the Sixteenth Century*, trans. and intro. S. Jeannett (London, 1961), pp. 89-93; *Johannes Gessners Pariser Tagebuch: 1727*, ed. V. Boschung (Bern, 1985), pp. 104-5.
36. N. Mani, 'Jean Riolan II (1580-1657) and Medical Research', *Bulletin of the History of Medicine*, 42 (1968), 127-8.
37. Harcourt Brown, Jean Denis and the Transfusion of Blood, Paris 1667-1668', *Isis*, 39 (1948), 15-28. The first sheep to human transfusion occurred in England in November 1667 and was performed by Richard Lower and Edmund King : see *Philosophical Transactions*, 2(1667), 517-25, 557-64, 617-24.
38. Brockliss and Jones, *The Medical world of Early Modern France*, pp. 671-8, 701-17.
39. ibid., p. 575.
40. Dora Weiner, *The Citizen-Patient in Revolutionary and Imperial Paris* (Baltimore, MA, 1993), especially pp. 181-3, on the availability of bodies for dissection.
41. Laurent Joubert, *Première et seconde partie des erreurs populaires et propos vulgaires, touchant la médecine & le régime de santé,*

refutuez et expliquez (Lyons, 1608), premier livre, pp. 47 and 81. This work first appeared under a slightly different title in 1578.

42. Pelagius, fourth and early-fifth century opponent of Augustine, had argued that what human beings ought to do, they can do. He stressed the freedom of the will and human potential.

43. A. Emch-Dériaz, *Tissot: Physician of the Enlightenment* (New York, 1992), ch. 5. On the phenomenon generally, see R. Rey, 'La Vulgarisation médicale au XVIIe siècle : Le cas des dictionnaires portatifs de santé', *Revue d'histoire des sciences*, 44 (1991), 413-33.

44. There were still medical men with an Augustinian outlook: see L.W.B. Brockliss, 'The Medico-Religious Universe of an Early Eighteenth-Century Parisian Doctor: The Case of Philippe Hecquet', in Roger French and Andrew Wear (eds.), *The Medical Revolution of the Seventeenth Century* (Cambridge, 1989), especially pp. 204-18.

45. For a good discussion, see Peter Gay, 'The Enlightenment as Medicine and Cure', in W.H. Barber (eds.), *The Age of the Enlightenment : Essays Presented to Theodore Besterman* (London, 1967).

46. Thomas More, *Utopia,* English translation by Paul Turner (London, 1965), pp. 97-101.

47. 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). 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).

48. Joseph Duchesne, Le Pourtraict de la santé où est au vif représentée la règle universelle et particulière de bien sainement, et longuement vivre (Saint-Omer, 1618). Paracelsus's treatise *De longa vita* appeared in a 1567 French compendium of his works.

49. 'Discours de la méthode', sixième partie, in R. Descartes, *Oeuvres philosophiques,* ed. F. Alquié (3 vols.; Paris, 1963-73), i. 649-50. Descartes also hinted that he would not use his new science to develop military technology.

50. Joubert, *Erreurs,* premier livre, pp. 12-13, 79-83. General comment in Brockliss and Jones, *Medical World,* pp. 80-4.
51. Tronchin took a very unChristian delight in his patient's purportedly wretched demise. See R. Pomeau, *Voltaire en son temps* Vol.5. *On a voulu l'enterrer* (Oxford, 1994), pp. 321-3.
52. F.A. Isambert, *et al., Recueil général des anciennes lois françaises depuis l'an 420 jusqu'à la Révolution de 1789* (29 vols.; Paris, 1822-33), xx. 573, 'Déclaration portant que les médecins seront tenus d'avertir leurs malades attaqués de maladies graves de se confesser'.
53. Brockliss and Jones, *Medical World,* ch. 1. For Ranchin, see L. Dulieu, *La Médecine à Montpellier,* iii. *L'Epoque classique* (2 vols., Avignon, 1983-6), i. 785-6 (biographical notice).
54. Nicolas Fontaine, *Mémoires pour servir à l'histoire de Port-Royal* (4 vols.; Cologne, 1753), iv. 393-400.
55. Brockliss and Jones, *Medical World,* pp. 255-62. For recent accounts of clerical healers in other parts of Europe, see especially Hans de Waardt, 'Chasing Demons and Curing Mortals : The medical Practice of Clerics in the Netherlands', in Hilary Marland and Margaret Pelling (eds.), *The Task of Healing : Medicine, Religion and Gender in England and the Netherlands, 1450-1850* (Rotterdam, 1996).
56. Brockliss and Jones, *Medical World of Early Modern France,* ch. 6, section 1.
57. Vicq d'Azyr, 'Eloge de Maret'. *Oeuvres,* iii. 135. Vicq, secretary to the Société Royale de Médecine, founded in 1778, wrote a number of eulogies of members of the society stressing their role as new physicians : see Daniel Roche, 'Talents, raison et sacrifice: L'image des médecins des lumières d'après les éloges de la Société Royale de Médecine', *Annales, économies, sociétés, civilisations,* 32 (1977), 866-86.
58. Few hygiene manuals were printed in the sixteenth and seventeenth centuries and the subject was hardly ever taught as part of the faculty course : see Brockliss and Jones, *Medical World,* p. 460.
59. Emmanuel Gilibert, *L'Anarchie médecinale, ou la médecine considérée comme nuisible à la société* (3 vols.; Neuchâtel, 1772), i. 185. On the new interest in hygiene, see Brockliss and Jones,

Medical World, pp. 461-7; for developments of public health in eighteenth-century France, see ibid., pp. 750-8. The leading eighteenth-century exponent of the role of the state in hygiene was the Austrian, J.P. Frank.

60. The leading French work on child-rearing was written by the Parisian physician, Jean-Charles Desessartz (1729-1811), *Traité de l'éducation corporelle des enfans en bas âge, ou réflexions pratiques sur les moyens de procurer une meilleure constitution aux citoyens* (Paris, 1760), especially 'discours préliminaire'. The work was used by Rousseau in preparing his educational treatise, *Emile* (1762): see English trans. (London, 1969), pp. 10-12.

61. Brockliss and Jones, *Medical World*, pp. 470-2: initially there was hostility in the French medical world especially to accepting inoculation, introduced into Europe in 1718 from the Near-East by an Englih gentlewoman.

62. *L'Orthopédie, ou l'art de prévenir et corriger dans les enfants les difformités du corps* (Paris, 1738); citation from the Eng. trans., *Orthopaedia, or the Art of Correcting and Preventing of Deformities in Children* (2 vols.; London, 1743), i.37.

63. Brockliss and Jones, *Medical World*, pp. 262-73. The one midwife before 1700 to have a public profile was Louise Bourgeois, who delivered the children of Marie de' Medici, and wrote a number of books about her art: see the recent study by Wendy Perkins, *Midwifery and Medicine in Early Modern France : Louise Bourgeois* (Exeter, 1996). Bourgeois deplored the ignorance of midwives.

64. *Encyclopédie, ou Dictionnaire raisonné des arts et sciences*, ed. D. Diderot (16 vols. 1751-1765), i.85.

65. Antoine Petit, 'Accouchemens', Wellcome Institute for the History of Medicine, MS 3847 (n.d.), 'Discours préliminaire'; Jean Verdier, *La Jurisprudence de la médecine en France* (2 vols.; Alençon, 1763-3), i. 287.

66. Brockliss and Jones, *Medical World*, pp. 610-17. Male midwifery became common all over northern Europe in the eighteenth century: see Jean Donnison, *Midwives and Medical Men: A History of Interprofessional Rivalries and Women's Rights* (New York, 1977), especially chs. 2 and 3 (on England).

67. Brockliss and Jones, *Medical World,* pp. 443-5. The medication of the mad would only fully attract the physicians' attention during the Revolution : see Weiner, *Citizen-Patients,* ch. 9. For the most detailed, albeit biassed, account of the care and treatment of the insane in France, see M. Foucault, *Folie et déraison. Histoire de la folie à l'âge classique,* 2nd edn. (Paris, 1972). In Protestant England the medical profession seems to have taken a greater interest in madness throughout the eighteenth century : see Roy S. Porter, *Mind-Forg'd Mancles : A History of Madness from the Restoration to the Regency* (London, 1987).
68. Tissot, *Avis au peuple sur sa santé* edn. (2 vols; Lyons, 1763), i. introduction, p. 21 preface.
69. Félix Vicq d'Azyr, 'Nouveau Plan de constitution pour la médecine en France', in *Histoire et Mémoires de la Société Royale de Médecine :* Années 1787-8, volume 9 (Paris, 1790), especially pp. 59-73.
70. Cf. comments in Carl-Ludwig Poellnitz, *Amusemens des eaux de Spa : Ouvrage utile à ceux qui vont boire ces eaux minérales sur les lieux* (2 vols.; Amsterdam, 1734), i. 349-82. Capuchins established convents in most spa towns in Catholic countries to offer spiritual aid to the suffering and created gardens where they could relax : see ibid., pp. 14-16, 64, 284.
71. Cf. the arguments against the man-midwife in Philippe Hecquet *De l'indécence aux hommes d'accoucher les femmes et de l'obligation aux femmes de nourrir leurs enfants* (Trévoux, 1708), especially p. 5. Hecquet, it will be recalled, was a Jansenist : see above note 44. In England a number of man-midwives became the confidantes and even lovers of their clients, suggesting conservative suspicions were not necessarily misplaced: see Roy S. Porter, 'William Hunter : A Surgeon and a Gentleman', in W.F. Bynum and Roy S. Porter (eds.), *William Hunter and the Eighteenth- Century Medical World* (Cambridge, 1985), p. 17.
72. Antoine Petit, *Mémoire sur la meilleure manière de construire un hôpital de malades* (Paris, 1774), p. 10: Petit's capitalization.
73. Benassis is a good man but, like so many of Balzac's creations, an obsessive: the villagers suffer from a disease which he cannot cure; hence his endeavours are fruitless. The best account of

nineteenth-century French medicine is J. Léonard, *La Médecine de l'Ouest au XIXe siècle* (3 vols.; Lille, 1978), much more wide-ranging than the title suggests.

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

Laurence W.B. Brockliss

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 Gabled, 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 machine[9].

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] Bagioli'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 Ralegh 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 signifance) 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 throught 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 ln 1504) and gave it a particular institutional spin.[31] The Christian humanist ethic was founded on a positive, Neo-platonic 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 Agothocles 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 1 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 appartments, 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 expalin 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 deceasing 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 anthopocentric 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 atempt 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 explanatlon 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 francaise 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 Mikulás 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 detailled 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 Fançois 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 158O). 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 Broeke.

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 electrictity 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-Centurv 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 longtitude problem was eventually solved by a Lincolnshire carpenter's son, John Harrison, in the eighteenth century : see Dava Sobel, *Longtitude : The True Storv 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 Artistotelian 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.

SARTON MEDAL LECTURES

LAUDATIO CONSTANT HUYGELEN

Jos Hoorens

The members of the Sarton Committee, on the proposal of the Faculty of Veterinary Medicine, have elected Dr. Huygelen as a recipient of the George Sarton Medal and diploma for the academic year 1996-1997. It is my pleasure to introduce my colleague and friend to this audience.

Dr. Constant (Stan) Huygelen was born in Aartselaar on the 8th of October, 1929. He obtained his doctor of Veterinary Medicine degree in 1954 at the Faculty of Veterinary Medicine of the University of Ghent. During the following year he studied tropical medicine at the Institute of Tropical Medicine at Antwerp.

From 1955 till 1960 he worked in the former Belgian Congo (Zaïre), initially as State Veterinarian at Elisabethstad and Luapula-Moero, later as Head of the virology department of the Veterinary Laboratory of Astrida (Butare), Rwanda.

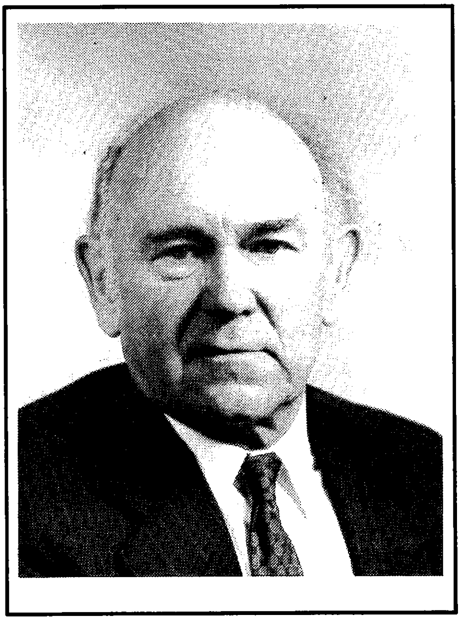
He returned to Belgium in 1960 and became researcher in the pharmaceutical industry : R.I.T. and SmithKline-R.I.T.. During more than thirty years Dr. Huygelen was involved in the research, development, production, and control of vaccines, both for human and veterinary use. At the end of his career he was Director-General of SmithKline Beecham Biologicals where he was involved mainly in the production of vaccines against polio, rubella and hepatitis A and B as well as poulty (Marek) and cattle vaccines (I.B.R.).

Dr. Huygelen is Past-President of the International Association for Biological Standardisation, member of the World Health Organization and expert of the Advisory Panel for Biological Standardisation.

During the academic year 1973-1974 he held the Francqui-chair at the Faculty of Veterinary Medicine of our University and lectured on "Viral infections and host response". In 1987 he was awarded the "Prix de l'innovation technologique" of the Walloon Region and the "Galenus award" for the development of the hepatitis B vaccine.

Dr. Huygelen is author or co-author of 140 scientific papers, mostly on

vaccinology.
His lifelong interest in the history of medicine prompted him, once time became available, to focus on the historical background of vaccinology, especially in the prepastoral era.



THE EARLY YEARS OF VACCINOLOGY: PROPHYLACTIC IMMUNIZATION IN THE EIGHTEENTH AND NINETEENTH CENTURIES

C. Huygelen

About three centuries ago Europe started experimenting with a procedure that would become one of the most successful chapters in the history of medicine : prophylactic immunization against infectious diseases. The principle was of Asian origin and the Chinese experience with it was recently summarized by Ki-Che Leung (1996); I would like to limit this presentation to the Western world and to the history based on written documents which are accessible to us.

In the eighteenth and nineteenth centuries four important basic approaches were developed in the field of immunization; they can be summarized as follows :

- inoculation of homotypic natural virus : this procedure started in the beginning of the eighteenth century with variolation;
- use of heterotypic natural virus : this was an application of the discovery of vaccinia by Jenner in 1796 (Jenner, 1798);
- artificial attenuation of pathogenic agents : this phenomenon was demonstrated scientifically for the first time by Pasteur with fowl cholera in 1880;
- use of killed antigens starting with the work of Salmon and Smith on Salmonella cholerae suis in 1886 (Salmon & Smith, 1886).

These basic approaches were all known before 1900. The discoveries in the twentieth century were predominantly refinements of these techniques, like the use of toxoids and subunits; virus vaccines enjoyed a significant expansion in the middle of this century as a result of the discovery of new cultivation techniques.

Immunization against infectious diseases is based on two sciences, i.e. microbiology and immunology, both of which were inexistent in the beginning of the eighteenth century; it lasted until the latter part of the nineteenth century before they started developing. The term "virus" had been in common use for a long time, but it referred to undefined poisons. The contagionists saw these poisons as being contagious, but others attributed epidemics to so-called miasmatic phenomena; the discussions between these two opposing groups continued for several decades in the nineteenth century. In his description of the cholera epidemics Rosenberg emphasized that few physicians thought it was a contagious disease, they were of the opinion that the cause had to be sought in atmospheric changes (Silverstein, 1989). Ferguson in England (Wilkinson, 1992) and Clot-Bey (1840), a French plague specialist, working in the Middle-East in the first half of the nineteenth century, denied the contagiousness of plague and wanted to abolish quarantine measures. The Metropolitan Sanitary Commission in London stated in its 1848 report that cholera was not contagious (Winslow, 1943).

On the immunological side knowledge stood if possible, at an even lower level. The most widely accepted concepts were based on the so-called depletion theories : a first invasion by a pathogen was thought to expulse an undefined "principle" from the body, so that on subsequent exposure the same agent could not encounter this principle any more in the body and thus became unable to cause illness. According to Thomas Fuller's depletion theory, all human beings were born with a kind of ovula, which were specific for e.g. smallpox or measles, they had no effect as long as they were not fertilized by a male element (afflatus genitalis) coming from outside; once fertilized and germinated, these ovula disappeared from the body for ever and, on a new exposure, the external male elements fell on sterile ground (Fuller, 1730). The lack of progress in immunology during the nineteenth century is illustrated by the thesis Pasteur developed in 1880 : he thought that the nutrients which microbes needed for their multiplication in the body, were exhausted by a first infection, so that on a second invasion by the same microbes, the latter were unable to find the nutrients required for their multiplication

(Pasteur et al, 1880).

While on the one hand the theoretical knowledge was completely lacking in those days, practical experience gathered over the centuries, had nevertheless taught a few important lessons : it was commonly accepted that one attack of smallpox led to immunity and during a plague epidemic those persons who had recovered from the disease were employed preferentially to take care of the sick. The same practical experience had shown the specificity of the resistance to infections : smallpox protected only against itself and not against other diseases.

In the period before Pasteur the following approaches to immunization were explored :

- inoculation of the causal agent via a non-natural route of infection : this was applied to smallpox, rinderpest, measles, sheeppox and contagious bovine pleuropneumonia;
- the use of heterotypic virus : the only application was vaccinia virus against smallpox;
- attempts to attenuate homotypic virus by serial passage via a non-natural route of infection : this approach was explored in sheep pox.

Smallpox

The first publication on smallpox inoculation appeared as a letter from Constantinople, written in December 1713 by a Greek named Timonis or Timonius who had studied in Oxford. It was addressed to the Royal Society of which Timonis was a member; the letter was published in the Philosophical Transactions of the Society (Timonius, 1714). Timonis reported in the letter that the Circassians had introduced the inoculation method against smallpox in Constantinople about forty years earlier. This novelty had understandably been looked upon with suspicion in the beginning, but had become more popular with time. The inoculation was done through an incision in the skin, mostly of the arm, with material from a smallpox patient. Timonis had had the opportunity to observe about fifty inoculated patients himself, of whom none had died.

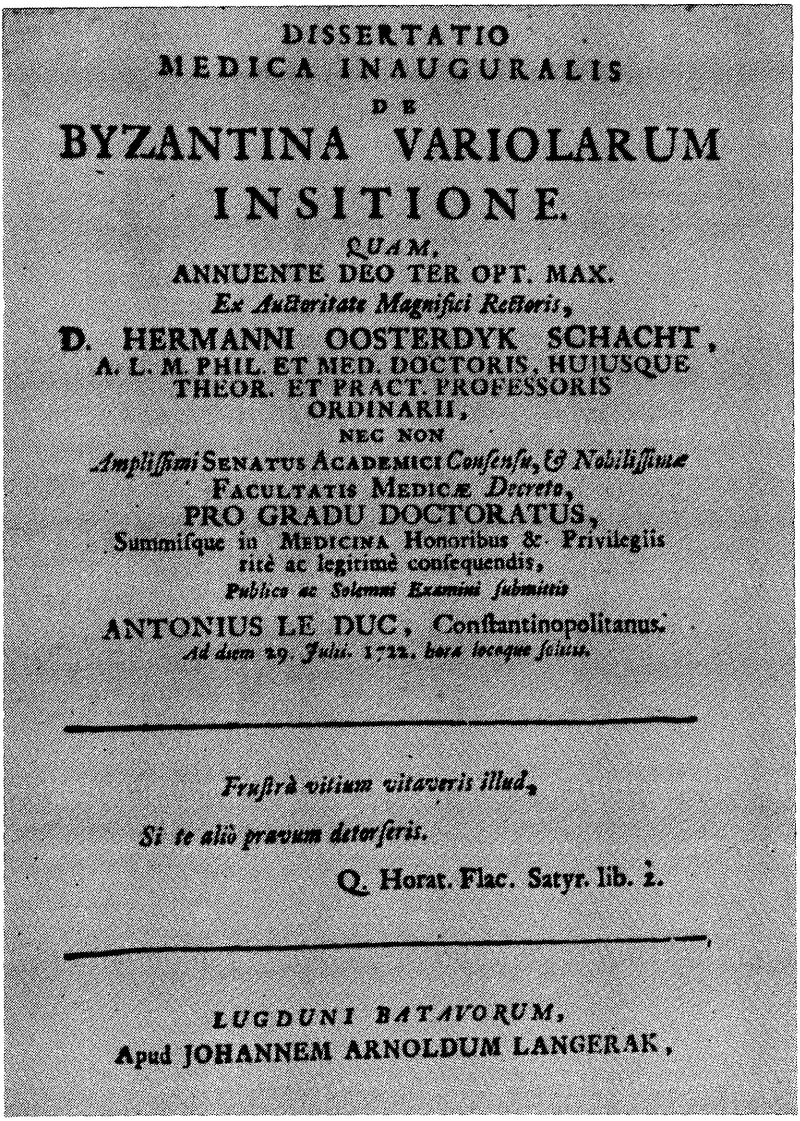
In the same volume of the Philosophical Transactions a letter was published from a Venetian physician, Jacob Pylarini, working in Smyrna. He reported that a Greek friend of his had discussed this novelty with him back in 1701 and wanted his own children to be variolated. A Greek woman explained the procedure to Pylarini, who had the opportunity to follow up the results. He then started to apply it himself in several Greek families in Smyrna and described in detail the symptoms and the course of the illness after inoculation (Pylarinus, 1716).

Around the same time Lady Mary Wortley Montagu was staying in Turkey. She was the wife of the British ambassador and showed a great interest in local habits and events. She used to describe them in her many letters, which were later published in book form (Wortley Montagu, 1800). In a letter from 1717 she reported how an old woman came every year in September to inoculate smallpox with a needle in four or five sites of the body. Each time thousands underwent this operation, apparently without much risk. In the same letter she announced that she wanted her son to be inoculated and that she would like to propagate the procedure in England. She feared, however, that she would not succeed because the physicians would lose a major part of their income and would not collaborate. Smallpox infected almost everybody in those days and the mortality was about 1 in 14, but sometimes it was much higher. Lady Mary, one of the female stars at the English court, had had smallpox herself; it had ruined her beauty and this explained her hatred and contempt for the medical profession. She had her son inoculated on 19 March 1718 (Parish, 1965).

After a trial on six prisoners sentenced to the death penalty and on a group of orphans, the Prince and Princess of Wales also had their children inoculated in April 1722 and, not surprisingly, this royal example did much to propagate the procedure in England (Miller, 1981). In the meantime the first inoculations had also been initiated in the British colonies in America (Kahn, 1963). Compared to the natural disease, the results were generally favourable, but there were also some failures resulting in death of the patients. A bitter struggle started between advocates and opponents of inoculation (Miller, 1957). The mortality after inoculation was 1 in 60 or lower versus a death rate after natural smallpox that varied at the time between 7 and 19 percent.

Meanwhile the procedure had also received attention on the continent. The Greek Antonios Doucas or Le Duc (1722) defended a thesis in Leiden on 29 July 1722 on "de Byzantina variolarum insitione". (Fig. 1) In the beginning the influence of the publications on variolation remained restricted to the small groups of learned men who had contacts with the Royal Society or with similar organisations, open to new scientific discoveries. The masses remained suspicious and this suspicion was kept alive by groups of physicians, theologians and others who were opposed to the novelty for a variety of reasons. On the continent the great debate started several years after that in England. In France de la Condamine and Voltaire became the best known defenders of inoculation. Voltaire had known Lady Montagu during his stay in London between 1726 and 1729 and he shared her enthusiasm (Rowbotham, 1935). All these discussions and publications lifted inoculation out of the sphere of mystery and darkness. Variolation had many imperfections and was attended by relatively high risks but it allowed man to decide rationally for himself whether to take that risk in order to acquire a lifelong immunity against one of the most terrifying diseases. This concept fitted well the thinking of the Enlightenment and enlightened monarchs such as Catherine II of Russia and Joseph II af Austria strongly supported variolation.

Kirkpatrick, Sutton and Dimsdale introduced smaller scarifications and more adequate care for the inoculated in specialized hospitals and made inoculation more popular (Klebs, 1913; Leikind, 1942; Kahn, 1963). According to Miller (1957) this increased popularity was mainly attributable to the activity of more promotionally oriented inoculators like the three mentioned above. Interest in inoculation also went up and down as the risk of epidemics increased or decreased. Mortality post inoculation had been reduced to 1 in 400 or lower and the debate between proponents and opponents evolved in favour of the former. In the Austrian Netherlands intense discussions were held between F.C. Cremers of the University of Louvain as a violent opponent, and P.C. de Brabant from Ghent, member of the Paris medical association, as an advocate of variolation (Cremers, 1778, 1781; de Brabant, 1777, 1778). From the



DISSERTATIO
MEDICA INAUGURALIS
DE
BYZANTINA VARIOLARUM
INSITIONE.
QUAM,
ANNUENTE DEO TER OPT. MAX.
Ex Auctoritate Magnifici Rectoris,
D. HERMANNI OOSTERDYK SCHACHT,
A. L. M. PHIL. ET MED. DOCTORIS, HUJUSQUE
THEOR. ET PRACT. PROFESSORIS
ORDINARII,
NEC NON
Amplissimi SENATUS ACADEMICI *Consensu, & Nobilissimae*
FACULTATIS MEDICAE *Decreto,*
PRO GRADU DOCTORATUS,
Summisque in MEDICINA Honoribus & Privilegiis
ritè ac legitimè consequendis,
Publico ac Solemni Examini submittit
ANTONIUS LE DUC, Constantinopolitanus.
Ad diem 29. Julii. 1722. horâ locoque solitis.

Frustrà vitium vitaveris illud,
Si te aliò pravum detorseris.
Q. Horat. Flac. Satyr. lib. 2.

LUGDUNI BATAVORUM,
Apud JOHANNEM ARNOLDUM LANGERAK,

Figure 1 : Title page of a thesis by Antonius Le Duc (or Doucas) (Leiden, 1722)

years 1760 onwards began the heyday of variolation, under the influence of Gatti (1764) and others. It would last until Jenner's publication of his results with vaccinia.

The basic principle of variolation rested on the inoculation of infectious material by a route which was different from the natural portal of entry. In natural infection by the respiratory route vital organs such as the lungs were affected in the primary stage and the skin exanthem was secondary. Morbidity and mortality were determined above all by the involvement of the internal organs. In artificial infection through the skin the cutaneous process became the primary one and the pathogenesis was modified so that the illness took a more benign course. This was the generally accepted theory in the eighteenth century, which was confirmed by the results in practice.

Rinderpest

Rinderpest is caused by a morbillivirus closely related to that of measles and canine distemper. The disease has been eradicated in Europe, but in the eighteenth century it caused the death of 200 million cattle and had a catastrophic impact on the rural economy (Scott, 1990). Many contemporary medical opinion leaders had an active involvement in the disease, in part out of scientific interest, in part because their assistance was requested by the governments in several countries. The rinderpest epizootics contributed considerably to the creation of the first veterinary schools in the latter part of the eighteenth century.

Rinderpest was considered to be a kind of pox disease in those days and application of the inoculation principle appeared therefore to be a logical step to combat it. After initial trials in England in 1754, most later inoculations took place in the Netherlands, North-Germany and Denmark. The history of these inoculations is described in more detail elsewhere (Huygelen, 1997 a). The operation consisted of making an incision in the skin and infecting it with nasal or conjunctival discharge of affected animals. (Fig. 2) The most enthusiastic proponents of smallpox inoculation in man, like Pieter Camper in the Netherlands, were

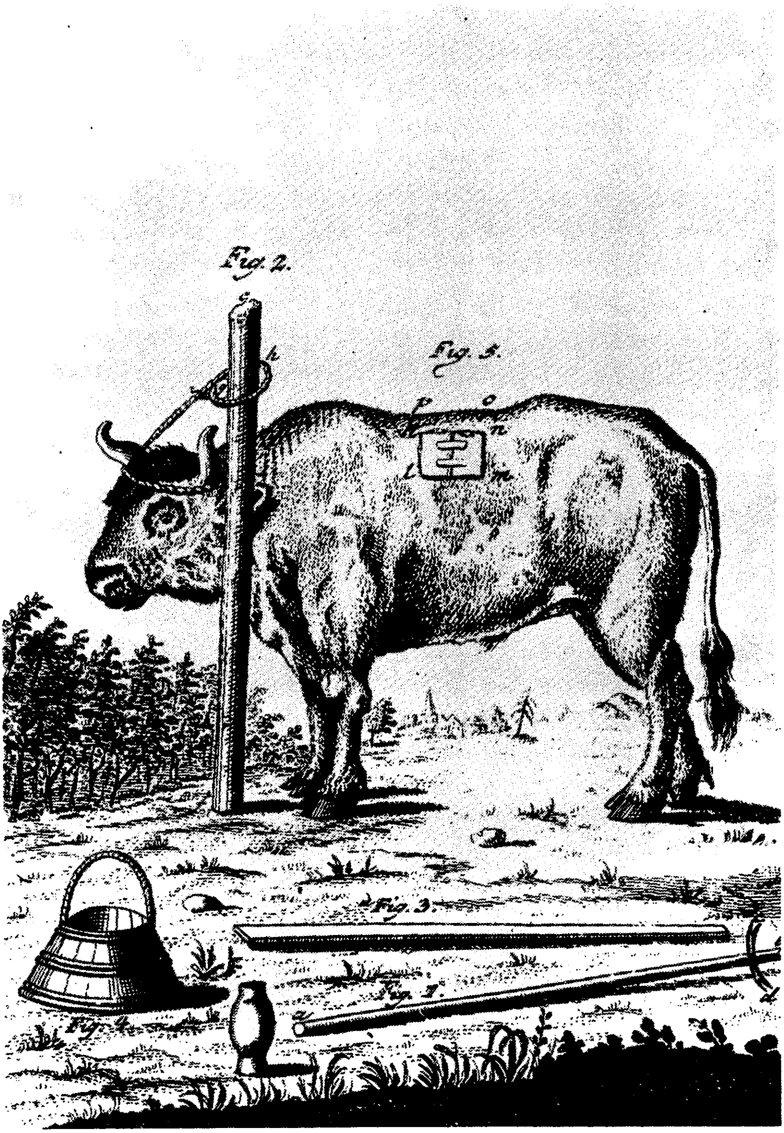


Figure 2 : Inoculation against rinderpest (W. Schumacher : "Die sichersten Mittel wider die Gefahr beym Eintritte der Rindviehseuche, Berlin, 1793)

also those who were most active in the promotion of rinderpest inoculation, at least in the initial stages. Mortality after inoculation turned out to be very high however; attempts to spare the internal organs by producing a primarily cutaneous infection like in smallpox failed. Therefore the interest in the procedure soon declined. Two approaches, however, led to better results and were also of interest from the viewpoint of the history of vaccinology.

In the Netherlands, Geert Reinders, a farmer in the province of Groningen and self-taught man, had observed that calves from cows, which had recovered from the disease, were immune against it. He saw that this phenomenon was not of hereditary origin, since the resistance of the calf was determined only by the status of the dam and not by that of the father. Reinders also noticed that a few months after birth these calves became as susceptible to rinderpest as calves from non-immune cows and that the age at which they became susceptible, varied widely from calf to calf. He then took advantage of this maternally derived resistance to develop an inoculation scheme. The calves were born in the first months of the year and received a first inoculation when they were a few weeks old and were still kept indoors; a second inoculation was given when they had been out in the pastures for some time and, finally, a third inoculation was performed towards the end of the summer, in August-September. By means of this threefold operation Reinders increased the chances of inoculating at a time when the calf had lost enough of its maternal antibody to allow virus replication, but when the antibody titre was still high enough to provide a certain degree of protection against severe illness. This method led to a marked reduction of the mortality post inoculation and was applied with relative success. In 1778 a society was founded which organized the inoculation of calves under strict conditions. The owner paid for the operation and received his animals back from the inoculation stables after recovery. It is noteworthy that the same procedure, i.e. administration of virulent rinderpest virus to calves with maternally derived immunity, was "rediscovered" one and a half centuries later by Doutresoulle (1924) in Africa. The principle was also applied to measles by Herrman (1915) in the United States in infants from immune mothers.

In Mecklenburg in the 1770's milder rinderpest strains were circulating alongside the more virulent ones. These "benign" strains were used to inoculate non-immune cattle and this resulted in a reduction of the mortality after inoculation to ten to fifteen percent, as compared to an average of around fifty percent after inoculation with more virulent strains. Isolated inoculation "institutes" (Impfanstalten) were created in which 15 to 40 animals could be inoculated at the same time through an incision in the skin using nasal discharge from animals with a benign form of rinderpest. The cattle were kept in the stables until they had completely recovered and were then returned to their owners. Towards the end of the 1770's insurance systems were in operation : the owner estimated the value of his calf; if it died after inoculation he received this amount as compensation; if it survived he had to pay half of the estimated value to get his calf back (von Oertzen, 1779).

Towards the end of the eighteenth century rinderpest inoculation was abandoned in Europe. It had become obvious that this approach perpetuated the infection and that epizootics could be better prevented by slaughtering the infected animals and by applying strict sanitary measures. The experience gathered from the rinderpest inoculation trials, however, was interesting in many respects :

- it proved that immunization against smallpox was not a unique phenomenon and that the inoculation procedure could also provide protection against other diseases;
- it was presumably the first time that maternally derived immunity was observed and used to reduce the losses post inoculation; and
- another novelty was the systematic use of naturally attenuated virus strains transferred between cattle in isolated inoculation stables.

Measles

The publication of the first results of rinderpest inoculation lead Weszprémi, a Hungarian physician then living in England, to promote the idea of extending the approach to other diseases like measles and plague (Weszprémi; 1755). Measles was causing the death of about ten percent of all children in those days. The first inoculation trials with measles were done in 1758 by Francis Home (1759) in Edinburgh with encouraging results. During the next two hundred years isolated trials were carried out in several countries, but measles immunization has never received wide acceptance before the 1960's because the results were too unpredictable (Huygelen, 1996 a).

Canine distemper

I have not found any references to immunization attempts against canine distemper in the eighteenth century literature. The interest in the disease increased in the beginning of the nineteenth century and Jenner, the discoverer of "cowpox" inoculation, published a good description of it (Jenner, 1809). Some attempts were made to apply the variolation principle by inoculating nasal discharge from affected dogs into healthy animals but data are scarce. In 1844 Karle, a veterinarian in Besigheim, rubbed the inoculum on the lips and gingival mucosa. He even proposed a trade name for his "vaccine" : Kyonin (Karle, 1844). However, even more so than for measles, inoculation against distemper remained limited to a few small trials. According to Johann Emanuel Keith the disease after inoculation was as severe as in natural infection (Veith, 1831).

The principle of cutaneous inoculation with natural homotypic virus failed to produce acceptable results in the case of rinderpest, measles and distemper. As mentioned above, in poxvirus diseases it was possible to induce a localized cutaneous reaction by inoculation whereby the internal organs were less involved; this was not the case in morbillivirus diseases. For these three diseases the attempts in the late 19th and the first half of the 20th centuries, ran a strikingly parallel course, but reliable live attenuated virus vaccines did not become available before the second half of this century (Huygelen, 1997 b).

Sheep pox

Sheep pox is caused by a capripoxvirus and is by far the post severe kind of pox disease in domestic animals. It shows many points of analogy with smallpox and is also transmitted aerogenically. Mortality varies considerably, but can reach fifty percent. The disease has now been eradicated in most European countries, but in the eighteenth century it was causing great losses in many places; the mortality averaged about 1 in 8. Sheep breeding had become economically more important and Merino sheep had been imported from Spain into the more northern countries in order to improve production. These Merino sheep, however, were more susceptible to pox than the indigenous breeds (Hutyra & Marek, 1909). Because of the analogy between sheeppox and smallpox, application of the inoculation procedure to sheep pox came as a logical step. This approach was recommended in France by Bourgelat in 1765 and in Germany by Erxleben in 1770 (Hurtrel d'Arboval, 1874; Kitt, 1886). Trials were initiated in several places; exudate from pocks, scabs or sometimes blood or nasal discharge were used as inoculum and applied through an incision in the skin of the legs or the ventral side of the tail (Sick, 1803). Later the procedure was made less traumatic by the use of special inoculation needles. (Fig. 3) As was the case in smallpox, the reactions after sheep pox inoculation were much milder than after infection by the natural portal of entry and mortality was about fourty times lower (Müller, 1837). The results remained to some extent unpredictable, however, and sometimes unusually high morbidity and mortality were observed, especially in animals in weak condition for a variety of reasons.

Sheep pox inoculation was used only sparingly in the eighteenth century, but became more widespread in the beginning of the nineteenth century as an indirect result of the growing popularity of Jenner's vaccination in man. In the early years after Jenner's discovery attempts were made to use vaccinia as a vaccine against sheep pox, but these trials inevitably failed because of the lack of cross immunity between the two affections. Thereupon attempts were started to attenuate the sheeppox virus itself by serial transfer from sheep to sheep by skin inoculation. This was done mainly in the countries under the rule of the Austrian monarchy. The early history of these attenuation trials was described in detail by Liebbald (1815) in Hungary. The pioneering work was done by Pessina and by Waldinger, both of them professors at the Veterinary

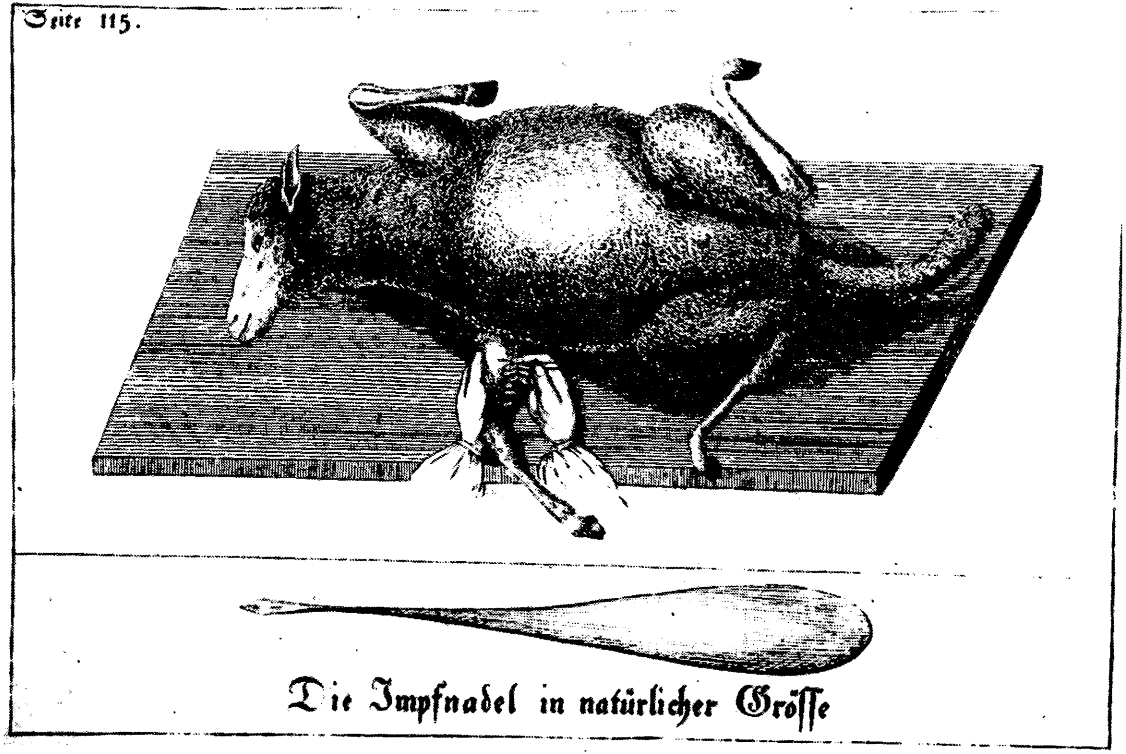


Figure 3 : Inoculation against sheep pox (G.F. Sick : "Ueber die Schafpokken und deren Einimpfung", Berlin, 1803)

Institute in Vienna. Pessina recommended inoculation of material from benign cases of sheep pox to a group of sheep, followed by selection of pocks from the mildest cases in the inoculated group and transfer of this material to the next group of sheep. He advised to continue this serial passage until only one pock would be induced at the inoculation site. In several parts of the Austrian empire pox production was organized in isolated stables which were usually established on large sheep farms. The sheep destined for inoculum production were kept under sanitary surveillance and isolated from other sheep. They also had a special attendant who was not allowed to come into contact with other sheep and they had their own pastures. Every fortnight two or more animals were inoculated with material from a previous passage and the pocks were harvested in the second week, i.e. about seven days after the beginning of the reaction at the inoculation site.

The inoculum obtained by serial transfer from skin to skin, was called "kultivirter Impfstoff". In the beginning of the nineteenth century most inoculators preferred it over the use of material from natural cases. The number of passages was increased systematically with the clear objective of attenuating the virus; in some cases a hundred or more transfers were carried out. This cultivated "vaccine" has been the subject of many years of controversy in the first half of the century (Huygelen, 1996 b). The proponents claimed to find marked differences in reactogenicity between cultivated and natural virus; they also claimed that the virus had lost its contagiousness, so that inoculated sheep could be put in contact with non-inoculated non-immune sheep without risk. The opponents saw no advantage in the use of cultivated material. It is very difficult to reach a conclusion in retrospect, because the literature data from that period were mostly incomplete and the interpretation of the results given by the authors often lacked critical judgement. In addition, the basic knowledge in the field of isolation, aseptic working conditions, sterilisation techniques etc. was not available. It was therefore impossible to isolate sheep destined for the production of the inoculum in such a way that they were adequately protected against infection with natural virus or with virus from a lower passage level. As time went by, more and more critical voices were being heard, also against sheep pox inoculation as such, because it perpetuated the infection in herds by transmission of the virus from inoculated to non-inoculated animals. Consequently the procedure was forbidden in most countries around 1880, except in herds in which the disease had already made its appearance.

From the scientific viewpoint the trials with cultivated inoculum are of great interest, because it was the first attempt to attenuate a virus by systematic serial transfer under artificial conditions. The concept of artificial attenuation thus existed long before Pasteur carried out his pioneering experimental work on the attenuation of bacteria and viruses. Serial passage of viruses under artificial conditions would be used extensively in the twentieth century and most live attenuated vaccines in use today have been developed by this technique.

Plague

As mentioned above Weszprémi had proposed in 1755 to extend the inoculation procedure to measles and plague, but he limited himself to theoretical considerations. Oehme in his thesis in 1771 also defended plague inoculation in areas where the disease was endemic (Oehme, 1771). In the second half of the eighteenth century plague was not a problem any more in Western Europe, but it continued to rage in Russia. Samoilowitz, a physician who had been actively involved in the 1771 epidemic in Moscow, proposed to start inoculating against the disease in 1782. He wanted to perform first a trial in prisoners sentenced to death and described the conditions, under which the experiment should be carried out (Samoilowitz, 1782). He was unable, however, to obtain the required permission from the authorities.

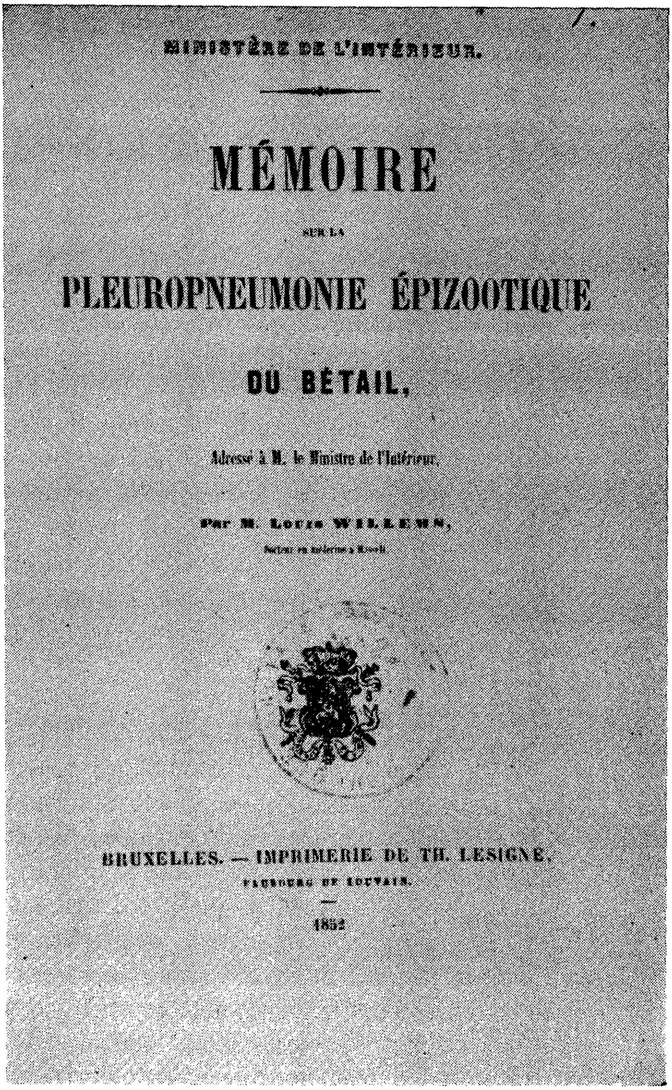
At the start of the nineteenth century several trials were performed in the Middle East where plague was still rampant. The English physician Whyte, inoculated himself and four assistants in 1802 with pus from a bubo; all five died a week later (McGregor, 1804; di Wolmar, 1827). A few other trials had less dramatic consequences, but most of them were inconclusive, because no plague symptoms appeared, probably because no plague bacilli were present in the inocula. Thereupon the interest in plague inoculation disappeared until the discovery of the causal agent at the end of the nineteeth century.

Contagious bovine pleuropneumonia

Contagious bovine pleuropneumonia is a mostly subacute or chronic affection, characterized by extensive oedema of the interlobular and alveolar lung tissues and by a sero-fibrinous pleurisy. It is caused by Mycoplasma mycoides subspecies mycoides, the prototype of the Mycoplasmata, which for many years were known as pleuropneumonia-like organisms or P.P.L.O. The incubation time is usually three to six weeks and epizootics follow a slow course. Cattle who recover, often remain contagious for a very long time.

In our countries the disease has been completely eradicated, but in the past century it caused enormous damage to the cattle population. It was presumably present in the beginning of the eighteenth century in some parts of Central Europe and from there it invaded the rest of Europe. Around the middle of the nineteenth century the whole continent had been contaminated. At the end of the eighteenth century it was still often confused with rinderpest (Semmer, 1889; Leclainche, 1955; von den Driesch, 1989). The struggle against the disease was hampered considerably by the debate between contagionists and non-contagionists. The latter were the advocates of the miasma-theory and did not believe in the contagiousness of pleuropneumonia.

In the middle of the nineteenth century the Limburg physician, Louis Willems, played a pioneer role in the inoculation against pleuropneumonia. Impressed by the severe losses in the cattle population in the region, he decided to attempt inoculation and started his trials in his father's herd. He used serous fluid from the lungs of affected freshly slaughtered animals and inoculated this material at the tip of the tail of healthy cattle. In 1852 he published his results in a report, which he sent to the then Minister of the Interior, Charles Rogier (Willems, 1852). (Fig. 4) His results were very encouraging and the minister appointed a commission consisting of professors, civil servants and practitioners to evaluate the procedure further. The publication also aroused much interest



MINISTÈRE DE L'INTÉRIEUR.

MÉMOIRE

SUR LA

PLEUROPNEUMONIE ÉPIZOOTIQUE

DU BÉTAIL,

Adressé à M. le Ministre de l'Intérieur,

Par M. Louis WILLEMS,

BRUXELLES. — IMPRIMERIE DE TH. LESIGNE,

FAUBOURG DE LOUVAIN.

1852

Figure 4 : Title page of Willems' first publication on inoculation against contagious bovine pleuropneumonia

abroad and in the Netherlands and in France and other countries similar commisions were created. These commissions had an extremely difficult task. The highly critical and negative reports of the Belgian commission led to a heated debate between Willems on the one hand and some commission members on the other hand. On both sides bitter reproaches were used and the medical and agricultural circles in the country were split in two camps, both of them defending their position with the utmost vigour (Rapports, 1858).

What was with hindsight the merit of the inoculation against bovine pleuropneumonia and the pros and cons in terms of reactogenicity, contagiousness and immunogenicity ?

At the inoculation site in the tail a painful swelling developed which was accompanied by fever; these symptoms usually subsided in one or two weeks, but in less favourable cases the swelling increased with suppuration and necrosis. About 7 to 9 % of inoculated animals lost part of their tail. The mortality after inoculation usually ranged between 1 and 3 %. The figures reported in the literature varied strongly from one country to another (Semmer, 1889). This variation was most probably related to the inoculation method used and to the titre and the degree of contamination of the inoculum with other bacteria.

The opponents of inoculation pretended that it did not provide immunity, but this claim was mostly based on the fact that the inoculation had been performed on already infected animals; inoculation had no effect in the incubation period and the animals often developed the disease in the weeks after the inoculation. Later trials in the nineteenth and twentieth centuries have provided overwhelming proof that inoculation induced protection in the large majority of animals, even when they were vaccinated with attenuated cultures of mycoplasma. Inoculation is stil being used in several countries in Africa and, until recently, in Australia (Henning, 1956; Radostits, 1994; Newton, 1992).

The risk of transmission from inoculated to other non-immune animals was relatively small according to most reports, but inoculation was nevertheless seen as a source of perpetuation of the presence of the causal agent in a herd. This aspect has contributed significantly to its the abandonment in Europe later in the nineteenth century.

Vaccinia and the use of a heterotypic virus

On 14 May 1796, now two hundred years ago, Edward Jenner inoculated James Phipps on his arm with pock material from Sarah Nelmes. Sarah had been infected by milking the cow Blossom who had pocks on her teats. (Fig. 5) Although some inoculations with such material had already been performed previously i.a. by Jesty, a local farmer, it was Jenner who approached the phenomenon from a more scientific standpoint. He thus initiated a new era by using a heterotypic virus that had enough in common with the infection against which it was used, to produce immunity and was yet sufficiently different so as not to cause severe illness. This approach has made it possible to eradicate one of the major scourges of mankind : in 1979 the world was officially declared smallpox free. The virus with which this victory was achieved, was vaccinia, but it was usually called cowpox. Vaccinia differs significantly, however, from cowpox. Its origin has never been completely elucidated and several theories have been developed about it; the most likely explanation is that it originated from horse pox, a disease which does not exist any more today (Baxby, 1981). Cowpox itself is probably an infection of rodents, from where the virus occasionally invades other species, like cattle, cats, man, etc. (Baxby, 1977).

The number of heterotypic viruses used as vaccines has remained very limited, because there are very few viruses which are close enough to the causal agent of a disease to be still immunogenic and yet different enough to be apathogenic. The big step forward taken by vaccinology as a result of Jenner's discovery, can therefore be largely attributed to luck. All together only half a dozen such vaccines have been used, almost exclusively in the veterinary field : in fowl pox, Marek's disease, canine distemper and parvovirus infection in dogs.

The Jennerian procedure was introduced extremely fast in many countries in spite of the Napoleonic wars. It lead to a significant expansion of the knowledge in vaccinology in the three quarters of a

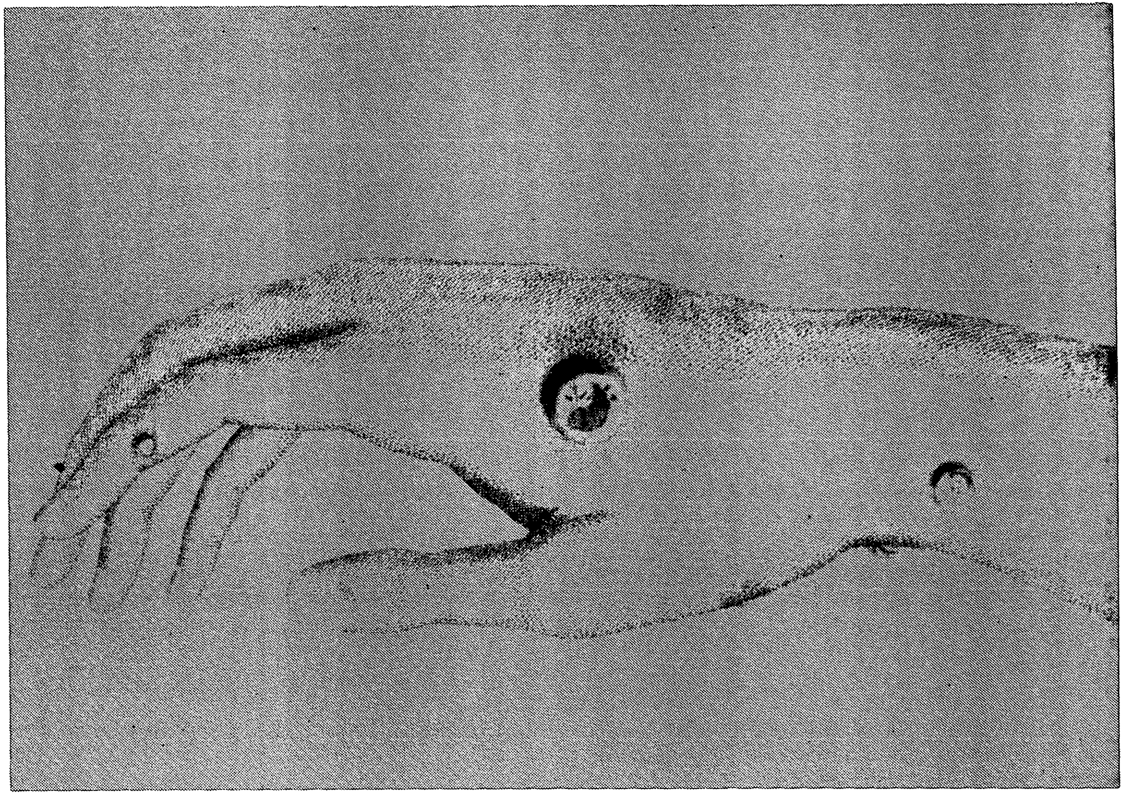


Figure 5 : Pocks on the hand of Sarah Nelmes

century that elapsed between the discoveries of Jenner and Pasteur. A more detailed description of this evolution can be found elsewhere (Huygelen, 1996 c).

For most of the nineteenth century vaccinia, wrongly called cowpox, was inoculated from arm to arm. The reasons for using this method can be summarized as follows :

- the procedure had been applied for several decades for variolation and, hence, was well introduced;
- many had an irrational fear of "bestialisation" as a result of inoculating substances of animal origin; this fear was kept alive and stimulated by the antivaccinists and by some caricaturists; (Fig. 6)
- genuine cowpox (or vaccinia) was rare in most countries and could therefore not be used as a direct source of vaccine; furthermore it was very difficult to differentiate between genuine cowpox (or vaccinia) and the many other lesions which were found on the bovine udder and which were called spurious cowpox in the nineteenth century. Today they are known to be caused by pseudocowpox, bovine papular stomatitis, herpes mammilitis, papillomatosis, bacterial infections or even insect bites;
- the reactions were less severe than after inoculation with material obtained directly from the cow; two factors may have been responsible for this phenomenon: genuine cowpox is more reactogenic in man than vaccinia (Baxby, 1994); the second reason was presumably that material from the cow was more heavily contaminated with bacteria;
- several investigators experienced difficulties when they tried to inoculate cows with material that had been passed for a long time from man to man;
- storage and transportation problems were avoided by using inoculated children for transportation of the virus; for intercontinental shipments a few dozen children were put on a ship and each week some of them were inoculated;
- the risk of transmitting human pathogens by the arm-to-arm procedure was strongly underestimated.

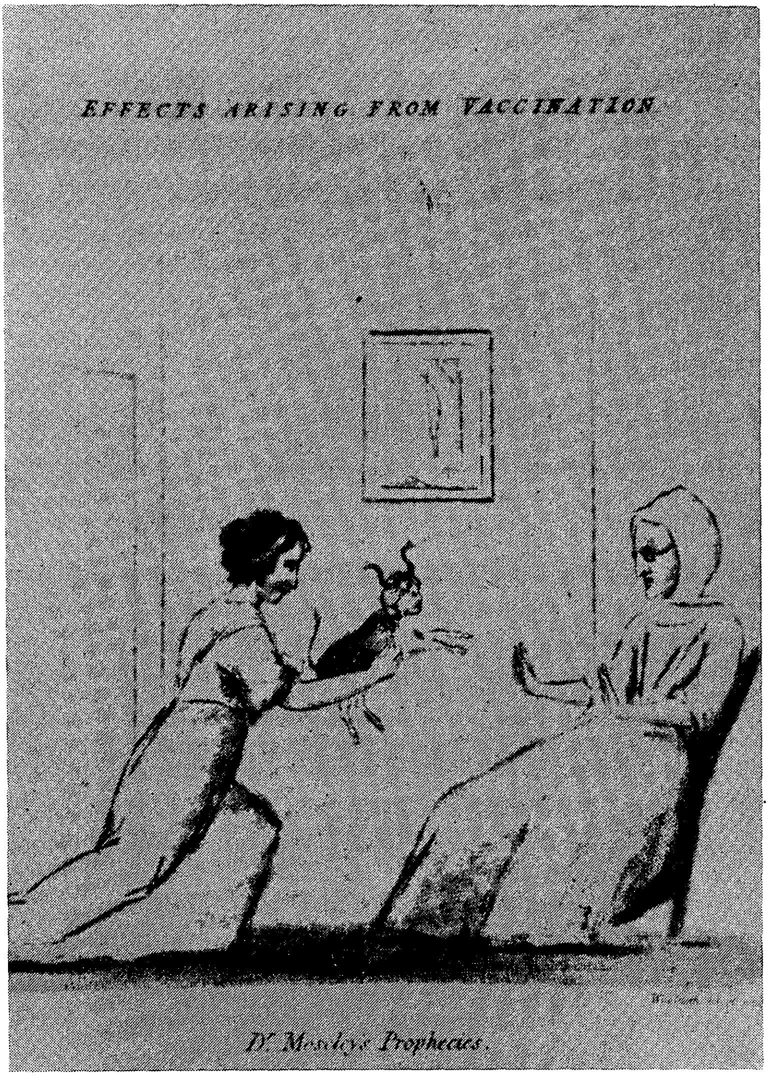


Figure 6 : "Effects arising from vaccination" From a caricature, 1806

What were the main lessons drawn from the widespread use of smallpox vaccination during the first three quarters of the nineteenth century ?

Contamination of the vaccine

In the beginning of the century most vaccinators believed that two different diseases could not be present at the same time in the same organism. This theory had been propagated by John Hunter (1788). This assumption was one of the main reasons why so little attention was being paid to the possible risk of the vaccine becoming contaminated with other agents. The most striking examples of such contaminations in the nineteenth century were those with smallpox, syphilis, hepatitis and with several bacterial agents.

Contamination with smallpox occurred in the very beginning of the vaccination era, because the vaccination was often carried out in smallpox hospitals. The problem was soon identified and resolved. Syphilis contaminations were reported in several countries from 1814 onwards and they led to animated debates which lasted for several decades. The available reports were critically reviewed by Viennois (1860), who reached the conclusion that syphilis could indeed be transmitted by vaccination when the person from whom the vaccine was taken was syphilitic. His conclusion was not accepted by many opinion leaders on the theoretical grounds mentioned above. In the end so many concrete proofs were gathered of syphilis transmission, that the arm-to-arm method was gradually replaced by vaccine production on the skin of calves. Our country played an important role in this switch under the influence of Warlomont (1875). Before the end of the century the arm-to-arm method was forbidden in most countries. Overall, the known cases of secundary infections remained relatively rare, but were used extensively by the antivaccinists as a propaganda weapon to create fear among the population. The risk of transmitting syphilis, hepatitis and other specific human infections disappeared after the switch to bovine vaccine, but this was not so for bacterial infections such as those caused by staphylococci and streptococci.

Immunity failures

Another problem identified in the early period of vaccination, was that of the duration of the immunity. It would also lead to long and heated discussions. Jenner himself and other pioneers of vaccination believed that the administration of vaccinia would provide the same lifelong immunity as that observed after variolation. This thinking was supported by the depletion theories which were widely accepted in those days. As we know today, immunity after vaccinia administration lasts only five years on average.

Immunity breakdowns were already observed from 1805 onwards, but they became more frequent as time advanced and the interval between vaccination and infection increased. They created enormous confusion among the general population and the medical community. This confusion was further aggravated by the atypical nature of the smallpox symptoms in those who had previously been vaccinated: the incubation time and the course of the disease were shorter, there was a lower tendency to confluence of the pocks and a much reduced mortality; this atypical smallpox was called varioloid. Many different explanations were put forward :

- in the beginning many blamed faulty vaccination due to the use of "spurious cowpox" or an inoculum harvested too late;
- many others attributed the symptoms to varicella;
- some saw varioloid as a new disease completely different from smallpox;
- another widespread opinion was that vaccinia had been overattenuated by the repeated arm-to-arm transfers and had lost its immunogenicity;
- finally, but much too late, the most obvious explanation was accepted, i.e. that the resistance to smallpox provided by vaccination was limited in time; it took several decades before this explanation was generally accepted.

Depending on the explanation given to the immunity breakdowns, several different solutions were proposed:

- some advocated resuming variolation or a combination of vaccination followed by variolation;
- many thought that the solution was to be found in going back to fresh "cowpox" and in several countries active searches were organized for pocks on the udder of cows; in some countries potential finders were promised a financial reward;
- many others were in favour of the so-called regeneration of vaccinia by making a few transfers in bovines
- only after tens of years of debate was revaccination adopted as the most appropriate means to avoid varioloid. Germany started much earlier with revaccination than e.g. France and the consequences were enormous : during the French-Prussian war of 1870-71 the Prussian army which was revaccinated every seven years counted only 316 deaths by smallpox as compared to 23,400 in the badly vaccinated French forces.

Conclusions

The inventory of the knowledge in the field of "vaccinology" at the time Pasteur initiated his vaccine trials, can be summarized as follows :

- a human subject or an animal that has gone through an attack of a disease, is, generally speaking, resistant against a reinfection by the same agent;
- this resistance is specific for a given disease;
- this resistance can be provided as well by a mild form of the disease as by a severe attack;
- administration of an agent through a non-natural portal of entry, results in some diseases in a relatively benign reaction and produces nevertheless a strong immunity; this approach was applied succesfully to pox diseases and to bovine pleuropneumonia, but it largely failed in morbillivirus diseases like measles and rinderpest;
- in some cases a heterotypic virus can also provide immunity;
- immunity can be lifelong or, as in vaccinia, restricted in time;
- immunity can be transferred from a mother to her offspring and this phenomenon is not attributable to hereditary factors; this maternally

derived immunity disappears after some time and its duration varies strongly from one individual to another;
- the concept of virus attenuation by serial transfers under artificial conditions was known but there is no experimental evidence that it was ever proven in practice;
- an adventitious agent can contaminate a vaccine and be transferred simultaneously with the immunizing agent;

In conclusion a significant amount of experience had been accumulated at the time when microbiology made its first steps and when the theoretical knowledge in the immunological field was still inexistent. The experience in active immunization was based above all on observation, experience and pragmatism. The traditional dogmas and theories of the eighteenth and nineteenth centuries e.g. those about miasmata, depletion, "unicity" of infectious agents, etc. have often been a hindrance rather than a help in the development of vaccinology.

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LAUDATIO RIA JANSEN-SIEBEN

Michel Thiery

Il m'échoit l'honneur et le très grand plaisir de prononcer l'éloge du Prof. Ria Jansen-Sieben, à qui la Faculté de Médecine de Gand présente aujourd'hui la médaille commémorative George Sarton. Que ce soit notre faculté qui ait introduit la candidature d'une germaniste peut vous étonner. A tort ! car cette spécialiste en linguistique historique a livré une contribution très importante à l'historiographie des "artes mechanicae", les "arts" qui, dans le passé, englobaient la médecine. En outre, le travail de recherche du prof. Jansen qui touche souvent de près à l'historiographie d'autres sciences, s'inscrit dans la philosophie et les aspirations de George Sarton, le "grand intégrateur" de l'histoire de la science qui, tout au long de sa vie, a plaidé pour "the interdisciplinary study of science and its social impact", discipline nouvelle qu'il a nommée "néo-humanisme".

Ria Sieben est née en 1930 à Mortsel (Anvers) mais sa famille est originaire de Maastricht, ville hollandaise proche de la frontière belge. Après des humanités gréco-latines au Lycée d'Anvers, Ria étudia à l'Université Libre de Bruxelles (U.L.B.), où elle obtint, en 1958, le titre de Licenciée en Philologie Germanique. La même année elle fut proclamée lauréate du Concours Universitaire. Sa carrière - ininterrompue - à l'U.L.B. débuta en 1960, lorsqu'elle devint assistante à la section de Philologie Néerlandaise. Huit ans plus tard, elle présenta à la Faculté de Philosophie et Lettres de l'U.L.B./V.U.B. (Vrije Universiteit Brussel) une thèse de doctorat traîtant de la cosmographie au Moyen-Age. L'Académie publia cette thèse qui consiste en l'édition raisonnée d'un poème éducatif datant du XIIIe siècle: "De Natuurkunde van het Geheelal". Le sujet est sans doute important en ce sens que le dr. Jansen réalisa la jonction entre la philologie historique et l'histoire de la médecine. En effet, les médecins qui, à cette époque, considéraient la position des astres comme déterminante pour la santé, pratiquaient autant l'astronomie que l'astrologie. Nommé professeur extra-ordinaire, bientôt ordinaire, à l'U.L.B. le prof. Jansen-Sieben enseigna dès 1968 la

Linguistique historique. Elle exerça la même fonction, depuis 1971, à la V.U.B. La liste des sociétés et groupes de travail dont elle fait partie, et la très longue liste de ses publications - 17 livres et quelque 80 articles - nous renseignent parfaitement sur l'évolution des sujets d'intérêt scientifique qu'elle a traités: partant de l'histoire de la langue, ils évoluent vers l'histoire des sciences, particulièrement vers celle de la médecine. En somme, une évolution rectiligne, dont elle a, elle-même, donné la motivation. Je cite le prof. Jansen-Sieben: "En tant que débutante en linguistique historique, je me suis mise à chercher comment on parlait néerlandais au Moyen-Age, car, curieusement, nous ne le savons pas ou à peine. Toute grammaire est fondée sur la Littérature (avec un grand L), or, le langage littéraire est très artificiel. Nous savons actuellement que ce langage n'est pas celui de l'homme de la rue. C'est pourquoi mon maître, le prof. Van Loey a essayé de s'approcher du langage courant parlé à cette époque en établissant une nouvelle grammaire à partir de documents officiels, de jugements, etc. Mais là aussi il s'agit d'une langue "officiellement" consignée. C'est pourquoi j'ai fait un pas de plus. J'ai recherché des textes "simples", des textes que l'auteur écrit sans aucune prétention littéraire, p.ex., les comptes-rendus du docteur Yperman, médecin du XIVe siècle, qui écrit à son fils comment on traite des fractures. Un tel homme ne s'embarrasse pas des règles de la rhétorique pour décrire comment il faut ouvrir la boîte crânienne. C'est grâce à des textes de ce genre que j'ai tenté de donner une image plus représentative du langage courant parlé aux Bas-Pays, au Moyen-Age" (fin de citation).
En quelque trente années de recherches, le prof. Jansen a examiné plus de mille (sic) textes moyen-néerlandais dont beaucoup n'étaient pas encore connus donc ni catalogués ni inventoriés. Elle a mis ces textes sur fiches et en 1989 elle a édité son "Repertorium van de Middelnederlandse Artes-Literatuur", volumineux ouvrage qui pour les chercheurs intéressés par l'histoire des sciences, y compris par celle de la médecine, est L'ouvrage de référence. Les textes médiévaux issus de nos contrées, et qui ont trait à la médecine dans le sens le plus large du terme tiennent dans cet ouvrage la place la plus importante.
Dans le "Repertorium" nous trouvons répertorié les trois types des "Artes": les artes liberales parmi lesquels la grammaire, la musique et l'astronomie; les artes mechanicae (le travail manuel) avec entr'autres, la

médecine et la chirurgie; et les artes magicae (les arts défendus) où nous retrouvons la magie et l'astrologie, qui, à l'époque, touchaient de près la pratique de la médecine. Si vous désirez apprendre quelque chose concernant le Moyen-Age - comment on y vivant, mangeait, guérissait ou opérait - vous trouverez ce genre de renseignements dans le "Repertorium" du prof. Jansen.

Le prof. Jansen ne s'est pas limitée à produire un instrument de travail. Depuis 1968 elle s'est penchée sur les textes eux-mêmes dont l'analyse linguistique - l'objet original de sa recherche - est graduellement passée au second plan. Actuellement elle publie surtout des récits qui illustrent la médecine médiévale. Pour pouvoir interpréter correctement les textes de cette époque il lui a fallu s'initier à l'histoire de la médecine. Il lui a fallu pénétrer dans le monde des idées des Anciens auteurs, des Arabes, des salernitains, de la médecine monastique, etc. qui ont laissé une profonde empreinte sur la pensée médicale du Moyen-Age. Nous savons que les historiens "de métier" osent "hineininterpretieren" et cela vaut également pour les philologues historiens. Le prof. Jansen-Sieben a scrupuleusement évité ce "biais déforme", cette interprétation qui trop souvent déforme la vérité scientifique.

L'image complexe, ambivalente qu'au Moyen-Age les Chrétiens et leurs médecins ont laissé de la "Femme" l'a toujours fascinée, inquiétée et ...inspirée. Le prof. Jansen a donné dans ses écrits du relief, de la réalité à la femme médiévale de nos contrées, à son statut, ses pensées, sa sexualité, son comportement, son corps et ses maladies.

Voilà en somme les facteurs qui ont opéré sa métamorphose, d'une linguiste historique en historienne de la médecine. L'époque: le Moyen-Age avec une préférence marquée pour le XIIIe siècle; le lieu: l'Occident, plus précisément les Bas-Pays; la langue: le néerlandais médiéval ou moyen-néerlandais; les sujets: tout ce qui a trait à l'art de guérir ou de maintenir la santé. Dans ce domaine également on distingue nettement les préférences du chercheur: l'astronomie et l'astrologie médicales; les iatro-mathématiques, avec les calendriers des mois et des années et les prescriptions d'hygiène; l'hygiène de la nutrition, depuis les livres de cuisine jusqu'à la gastronomie; la pharmacie et la "materia medica"; les moyens de diagnostic (coproscopie et uroscopie, p.ex.); certaines maladies endémiques telles que la lèpre; le monde des femmes, y compris la contraception et l'avortement ... et j'en passe. Tous ces sujets sont présentés sur un vaste fond d'histoire et d'histoire de la médecine. Ils sont basés sur des textes de chez nous, dont la plupart étaient inconnus, et qu'elle a traduits, commentés et édités. Un trésor de données originales !

Avant de conclure cet éloge, je tiens à vous présenter succinctement la sphère d'activité du prof. Jansen. En tant que femme et présidente elle a fortement marqué le "ZuidGeWina" (Zuid-Nederlands Genootschap voor Geschiedenis van de Geneeskunde, Wiskunde en Natuurkunde, dont les professeurs Vandewiele et Bockstaele ont été longtemps les inspirateurs) et insufflé un vent de nouveauté aux travaux de cette docte assemblée. Elle est co-fondateur du "Centre d'Histoire des Sciences" de l'U.L.B. et président du groupe de contact "Histoire comparée des Sciences de l'Antiquité à la Renaissance". Elle fait partie du "Nederlands Centrum voor de Geschiedenis van de Wetenschappen". Elle siège dans la commission permanente "Histoire des Sciences" de l'Académie Royale et fait partie du comité de rédaction de plusieurs revues parmi lesquelles "Scientiarum Historia" et la revue belgo-néerlandaise "Geschiedenis der Geneeskunde". A l'U.L.B. et à la V.U.B. elle a été le promoteur de plus de vingt thèses de Licence en Philosophie Germanique traitant de sujets d'histoire médicale.

Au-delà de nos frontières ses nombreuses contributions à l'histoire des sciences sont fort appréciées. A plusieurs reprises elle a été, aux Pays-Bas, co-promoteur de thèses de doctorat; elle est membre de la Würzburger Gesellschaft für Geschichte der Medizin" et de la "Schweizerische Paracelsus-Gesellschaft". Dans les années '80 elle a été invitée à deux reprises à donner un cours trimestriel à l'"Institut für Geschichte der Medizin" de l'Université de Würzburg.

Je ne vais pas mettre plus longtemps votre patience à contribution avant de laisser la parole à la lauréate de ce jour. Permettez-moi cependant de me répéter: bis repetita placet. Ce que je viens de vous dire explique et valorise les raisons pour lesquelles la faculté de Médecine de l'Université de Gand a posé la candidature du prof. Ria Jansen-Sieben et a demandé avec insistance le privilège de rendre hommage à cette historienne de la médecine.

LA MEDECINE SOUS PHILIPPE LE BON. LA MEDECINE ET PHILIPPE LE BON

Ria Jansen-Sieben

Il est impressionnant de constater combien de chirurgiens, de médecins, de barbiers et d'astronomes furent attachés à la cour de Bourgogne. C'est surtout Philippe le Bon qui réunissait autour de lui un grand nombre d'hommes de l'art. Cela ne l'empêcha pas d'être régulièrement malade et de mourir sans soins dans son lit.

Sous son règne, la médecine, et avec elle son cortège de métiers apparentés, subit d'importantes modifications. En effet, le XVe siècle fut aussi dans le domaine médical un lien entre le moyen âge et les temps modernes, peut-être plus évidemment que dans n'importe quelle autre discipline. Le pivot de son évolution se situe en 1453, soit au milieu du règne de Philippe le Bon.

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Dans la première moitié du XVe siècle, l'art médical restait traditionnel, donc essentiellement spéculatif, comme il l'était devenu au XIIIe s., sous l'influence de la scolastique, après avoir été pendant longtemps presque exclusivement clinique. Le centre de gravité s'était jadis déplacé de la pratique vers l'enseignement théorique. La célèbre école de Salerne s'était détachée la première de la pratique pour lier davantage la médecine à l'étude de la philosophie, une tendance déjà défendue par Hippocrate. L'Islam également, depuis le Xe s., évoluait de l'étude clinique vers une médecine fortement spéculative. Entretemps, la littérature médicale grecque avait été traduite pour la première fois en latin, selon des sources de seconde main, c.à.d. des traductions islamiques adaptées et largement développées. Cette arrivée en Occident des textes essentiels d'Hippocrate, d'Aristote, de Galien, de Théophile et de bien d'autres provoqua un rebondissement de la science médicale. Cela signifiait, pour l'Europe occidentale et méridionale, la fin d'une médecine monastique purement pratique. La 'medicina' fut bientôt reprise dans les universités comme une 'facultas' à part entière.

Le principe de base de cette médecine était la théorie de la pathologie humorale, qui ne sera abandonnée qu'au XIXe s. En principe, cette théorie procédait de celle des éléments d'Empédocle (Ve s. av. J.C.). Celui-ci enseignait que toute matière se compose d'un ou de plusieurs de ces quatre éléments: la terre, l'eau, l'air et le feu. Leurs différences qualitatives (froid, chaud, sec et humide) étaient transférées par l'école hippocratique aux humeurs corporelles: le phlegme, le sang, la bile noire et la bile jaune.

Galien, au IIe s., développa ce principe, le codifiant en un système très complexe, mais admirablement conséquent. Il reconnaissait à chaque humeur corporelle non pas une mais deux propriétés, de sorte qu'une grande variation de relations et de combinaisons devenait possible. Il établit ainsi la base de la théorie des tempéraments qui allait conditionner pendant dix-sept siècles la médecine occidentale: le phlegme est froid et humide; le sang est chaud et humide; la bile jaune chaude et sèche, et la bile noire froide et sèche. Le tempérament (ou la complexion) d'un individu était déterminé par la dose de chacune de ces humeurs et de leurs qualités: le phlegme domine chez le flegmatique; le sang chez le sanguin; la bile jaune (cholè) chez le colérique et la bile noire (melancholè) chez le mélancolique.

Le moyen âge procéda à un développement supplémentaire et très poussé du système galénique,. C'est ainsi que la prépondérance d'une humeur ne caractérisait plus seulement le tempérament, mais aussi la physionomie, la morphologie et le caractère: le physique, le morphologique et le psychique étaient ainsi liés et conditionnés par une même syncrasie.

Dans cette médecine, la pathologie humorale occupait toute la place, tandis que l'anatomie n'y jouait aucun rôle. On attribuait la maladie à une dyscrasie, c.à.d. une dose erronée ou une modification chimique des humeurs. Toute la thérapie consistera donc à rétablir l'équilibre originel par des médications adaptées. La 'materia medica' utilisée pour ce processus devait par conséquent posséder les qualités primaires requises par le cas. Les médicaments devaient corriger ou tempérer, mais la situation du macrocosme jouait également un rôle, ce qui explique le facteur grandissant de l'astrologie[1].

Il est donc important de rappeler que, surtout au XVe siècle, la croyance à une étroite relation entre le macrocosme et le microcosme était fermement établie, malgré quelques rares voix discordantes. On considérait que les planètes et les étoiles étaient par essence également constituées des quatre éléments et possédaient leur propre tempérament, qu'elles influençaient le sub-lunaire à tout moment et en tout domaine et que le médecin devait par conséquent tenir compte de leur situation et rechercher si elles correspondaient ou s'opposaient au tempérament, et donc au traitement, du patient.

Entretemps, depuis la fin du XIIIe s., une évidente scission s'était imposée entre le médecin académique d'une part et le chirurgien, l'apothicaire et l'herboriste, plus orientés vers la pratique. Les différents titres étaient cependant utilisés dans une telle confusion, pour ne pas dire abus, qu'il fut nécessaire de les officialiser à la fin du moyen âge.

Les étudiants en médecine devaient parcourir d'abord le curriculum des arts libéraux où le quadrivium (l'astronomie, la géométrie, la mathématique et la musique) était très important, puisqu'il se reliait à la théorie des correspondances macro- et microcosmiques. Après réussite, l'étudiant avait droit au titre de Bachelier ou de Maître (magister), et pouvait entamer ensuite les études médicales proprement dites, pour pouvoir prétendre au titre de Docteur. Il va de soi que ces titres étaient souvent portés abusivement.

Les chirurgiens étaient formés sur le tas chez un maître et reconnus par un jury municipal. Ils s'occupaient exclusivement des pratiques manuelles, auxquelles répugnaient les médecins: la saignée, le traitement des blessures, des fractures et des dermatoses, en un mot tous les problèmes externes. Ils confiaient cependant de plus en plus aux barbiers la pratique des saignées. La municipalité réglait leur statut et ils s'organisaient en gildes.

Le guérisseur itinérant tenait en général le milieu entre le chirurgien et le charlatan. Il était spécialisé dans les opérations de la cataracte et des hernies et dans la lithotomie. Il remplissait aussi les fonctions d'arracheur de dents et vendait toujours l'un ou l'autre produit miracle.

A côté d'eux, il y avait aussi un grand nombre de médecins profanes ('Laienärzte'), sans formation, pratiquant une médecine populaire, réunis en une gilde qui comprenait beaucoup de femmes. Cette médecine jouait un grand rôle par l'étendue de son action, avec des remèdes domestiques transmis surtout oralement, accompagnés parfois de magie ou de prières.

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A partir du milieu du XVe s., cette situation subit en partie d'importants changements. La seconde partie du siècle prépara la Renaissance dans nos contrées et fut essentiellement pratique, non seulement dans le domaine de la médecine, mais aussi dans celui de la philosophie et de la physique. La conséquence en fut la multiplication des expériences, des inventions et des voyages de découverte. Dans le domaine socio-économique, le changement fut également sensible.

L'une des causes d'une vision rénovée de la science en général et de la médecine en particulier fut la chute de Constantinople en 1453. Beaucoup de savants grecs fuirent vers l'Occident. Cela permit enfin l'accès à de nombreux textes grecs originaux et leur comparaison avec les traductions souvent fautives de l'arabe, considérées comme immuablement sacro-saintes depuis des siècles. Les savants occidentaux , impressionnés, se rendirent compte des importants écarts et des nombreux changements apportés aux textes d'origine. Cette constatation bouleversante les amena à développer et aiguiser un esprit critique qui jusque là leur avait fait défaut en cette matière. Le résultat fut la rupture avec les spéculations scolastiques. C'en fut aussi fini de reprendre et de répéter sans examen sérieux les anciennes théories. Le contact direct avec les textes grecs d'Hippocrate, de Galien, de Paul d'Egine et de nombreux autres stimula le développement d'une pensée plus indépendante. L'expérience personnelle et une conception critique jouèrent, pour la première fois depuis longtemps, un rôle important, mais une indéfectible fidélité à la théorie des humeurs et une évidente ignorance de toute notion anatomique freinèrent considérablement le progrès scientifique.

Durant la même période parurent les premiers rapports des explorateurs, offrant des descriptions de peuples, d'animaux et de plantes plus qu'étranges. De nouvelles herbes et épices apparurent sur les marchés. Un monde inconnu ouvrit ses portes. Mais en même temps, une nouvelle maladie envahissait l'Europe: la syphilis, dont l'origine resta longtemps mystérieuse.

D'autre part, par la découverte de l'imprimerie en 1450 d'insoupçonnables possibilités de communication surgirent: il va de soi que cette révolution technique devait mener à des innovations fondamentales. Vers 1450 parut la première histoire de la médecine sous la signature de Giovanni Tortelli[2]. Les textes grecs faisant autorité furent édités en traduction latine, parfois en langue vulgaire. Leur influence fut énorme, mais ils ne furent plus considérés comme intouchables ou inattaquables. N'y avait-il pas eu de grandes lacunes dans leurs connaissances, puisqu'on n'y trouvait aucune mention des nouvelles régions, médecines et maladies ?

C'est ainsi qu'en médecine le réalisme, l'individualisme et l'empirisme commencèrent à remplacer une attitude par trop spéculative et dogmatique. Ce fut le prélude au renouveau du XVIe siècle, avec un Paracelse, un Ambroise Paré, un André Vésale.

La chirurgie fit des progrès notoires, et la frontière entre médecins et chirurgiens commença tout doucement à s'estomper. D'autres nouveautés furent l'importance attribuée à l'hygiène, le rôle grandissant des sages-femmes et de l'astrologie. Cette dernière fut considérée comme une assistance indispensable à l'art de guérir.

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Le règne de Philippe le Bon enjambe la date cruciale de 1450. Ainsi, la plupart des découvertes et des progrès réalisés sont nettement perceptibles sous son régime.

Par exemple, le nombre d'astrologues qu'il consulta ou engagea à sa cour augmenta au fur et à mesure[3], ce qui contredit l'assertion de Huizinga que le Duc ne s'intéressa pas ou guère à l'astrologie[4]. Huizinga se basa sur la phrase de Chastellain : "De ceste manière de faire et de croire follement en tels pronostiqueurs n'estoit point usager le duc, car en toutes choses se monstra homme de léalle entière foy envers Dieu, sans enquérir riens de ses secrets"[5]. Il nous semble qu'il n'est pas possible d'accorder foi à cette affirmation, du moins pas dans le sens que Huizinga lui prêta. Car, d'une part, Chastellain fit ici directement le procès de Louis XI, entouré d'astrologues, en lui opposant l'attitude 'édifiante' de son maître, qui avait mis son sort uniquement entre les mains de Dieu. D'autre part, il se sentit obligé d'ajouter une remarque qui tempère fortement les précédentes: "non obstant que sa maison pour tant n'en estoit point desgarnie, ne que les autres amis, en y avoit de bien souffisans", c'est-à-dire qu'à la cour les astrologues ne firent pas plus défaut que les amis ou courtisans. Et finalement, Chastellain lui-même semble accorder un certain crédit aux pratiques et interprétations astrologiques, si l'on en juge par les nombreux passages où il en donne des relations détaillées et apparemment objectives[6].

Certains de ses astrologues furent de très grande réputation, comme Henri-Arnaud de Zwolle (Hendrik-Arnold van Zwolle), un des médecins les plus célèbres de son temps, qui resta au service de la Bourgogne de 1431 à 1465[7]. Il fut également un éminent mathématicien et un très habile mécanicien, puisque le Duc lui commanda en 1454 la fabrication d'un "certain notable et subtil ouvrage que icelui S. lui a fait faire du mouvement des sept planettes et de la VIIIe et IXe spère"[8]. Déjà en 1431 figure dans les comptes l'octroi d'une somme de six francs à "maistre Henry Zwolls, astronomien, pour avoir fait les deux cadrans en iceulx deux signets"[9].

Un manuscrit composite de la Bibliothèque Nationale (lat. 7300 A) comporte un almanach anonyme pour 1426, dont le destinataire devait être un grand prince, peut-être, comme certains le supposent, Philippe le Bon. Sur la totalité des jours de l'année, 121 jours sont 'élus' pour entreprendre avec succès l'une ou l'autre activité. La plupart des aspects de la vie du prince sont ainsi passés en revue. En ce qui concerne l'hygiène, 41 jours sont favorables pour se baigner, 19 pour se laver ou nettoyer la tête, 34 pour se tondre ou raser ses cheveux, 29 pour se couper les ongles, 1 pour "raire son poil", etc.[10]

Un autre très grand médecin, Roland l'Ecrivain (ou Rolandus Scriptoris), physicien de Philippe et de Charles le Téméraire, de 1437 jusqu'à sa mort vers 1469, était connu comme un fervent praticien de l'astrologie[11]. Il est l'auteur d'almanachs médicaux, d'un traité de physiognomonie et de géomancie[12]. Il est assez improbable que le Duc eût toléré à un poste aussi important et le touchant d'aussi près quelqu'un dont il n'approuvât pas l'orientation astro-médicale ou iatro-mathématique.

Jean de Wesalia, l'arrière-grand-père d'André Vésale, lui-même déjà auréolé d'une réputation très grande, professeur, puis Recteur à l'université de Louvain, composa pour Philippe le Bon plusieurs 'almanachs' (c'est-à-dire des pronostics astrologiques annuels)[13].

Ces astrologues, à quelques exceptions près, étaient tous médecins. Car, si un astrologue n'était pas toujours formé médicalement, on entendait qu'un bon médecin eût obligatoirement une connaissance astrologique approfondie. L'un des ouvrages de la bibliothèque du Duc commence ainsi: "Quiconques est medechins et se ne set nient d'astronomie [comprenez: astrologie], nus hom malades ne se doit mettre en sa main"[14]. Ces médecins-astrologues rédigeaient donc régulièrement pour le Prince prédictions, horoscopes et règles d'hygiène.

Un de ces textes, extrêmement concis, pour l'année 1427, a été conservé: "La tierce demande est se aucun inconvenient survendra point a monseigneur de Bourgoigne, par mort, maladie ou autrement durant la dicte annee. Response: selon la signifiance qui est veue en la derreniere partie de ceste revolucion presente, laquelle finera le derrenier jour de juillet 1427 après medi, 7 heures et 12 minutes, laquelle revolucion monstre bonne sancté et bonne prosperité de sa personne et en tous afaires et par especial a l'encontre de ses anemis, et de sage et bon advis en ses fais. Ce est signifié par les bons regars des planetes qui sont en ceste revolucion, puissans et en leur dignités et donnans leur forces les uns aus autres en l'acroissement du bien d'icelui prince, etc."[15] Tout comme le firent Jean Fusoris[16] et Henri-Arnault de Zwolle, d'autres médecins construisaient, à la demande du Duc, des instruments astronomiques complexes capables de situer étoiles et planètes afin de fournir ainsi les données indispensables au diagnostic, au pronostic et au choix de la thérapie.

Dès lors, il n'est pas surprenant de trouver dans sa bibliothèque, "moult grande et bien estoffiée"[17] - c'est-à-dire l'une des plus remarquables et des plus riches d'Europe - de nombreuses oeuvres astrologiques et médicales. Outre plusieurs encyclopédies, comme celles de Barthélémy l'Anglais (*De proprietatibus rerum*) et de Brunetto Latini (*Li Livres dou Trésor*), qui réservent une grande place à la médecine et l'astrologie, on y a retracé la présence de plusieurs ouvrages de divination, d'astronomie, de cosmographie et un nombre important de traités médicaux[18].

Le zodiaque et les planètes exerçaient un ascendant puissant sur tout ce qui se passait sur terre. Chaque astre régnait sur une partie du corps et, d'après sa situation, l'influence pouvait être favorable ou non. Il était donc important de connaître avec précision le moment propice pour entreprendre avec succès une intervention chirurgicale ou administrer une médecine. Pour la fréquence des saignées, il y avait un calendrier précisant les jours fastes et néfastes, de même que pour la taille des ongles et des cheveux, ou pour toute autre activité physique.

Les villes disposaient maintenant de médecins à leur service, qui devaient conseiller les autorités sur l'assistance aux pauvres, les problèmes d'épidémie, les expertises juridiques, la nomination des sages-femmes, etc., mais surtout sur l'hygiène publique à laquelle, à partir du XVe s., les municipalités attachèrent une grande importance. Ceci entraina un nombre considérable de réglements relatifs aux dépôts d'immondices, à l'ensevelissement des animaux morts, au nettoyage des rues, à l'isolement des lépreux, à l'organisation des bains publics, au commerce des denrées périssables, etc.

La santé publique fut davantage organisée par l'Etat. Des lazarets de quarantaine furent édifiés pendant les épidémies. Les maisons des malades décédés devaient être enfumées. Lits et literies devaient être aérés et lavés. Les attroupements furent interdits. La possession d'animaux domestiques fut limitée ou proscrite en ville et leur déclaration rendue obligatoire.

L'hygiène personnelle devint aussi un thème favori: les régimes de santé, jusque là d'un énoncé assez sommaire, furent formulés de manière beaucoup plus détaillée. Un petit traité d'hygiène infantine, provenant de la famille de Croy, serviteurs dévoués des ducs de Bourgogne, a vraisemblablement servi au petit comte de Charolais. Le traité est destiné à un enfant d'environ un an, et donne aussi bien des conseils précis pour l'alimentation que pour l'habillement, les jeux, les maladies, la chambre, l'entourage. C'est un adorable recueil de recommandations pleines de sollicitude et de précautions[19].

Un certain Jean Wauquelin traduisit en 1450 [!] à la demande de Philippe le Bon - qui parlait trois langues mais ignorait le latin[20] - le *De regimine principum*, qu'à l'origine Aegidius Romanus (Gilles de Rome) avait rédigé vers 1280 pour Philippe le Bel[21]. Un magnifique exemplaire de cette traduction[22], actuellement conservé à la Bibliothèque Royale à Bruxelles (ms. 9043), porte pour titre *Le livre du gouvernement des princes*. Il comporte entre autres un régime de santé très détaillé. D'après un modèle classique, dû au médecin persan Avicenne (Xe s.), Gilles y traite des six causes externes des maladies (les "res non naturales"): l'air, la nourriture, la sommeil et la veille, l'exercice, l'évacuation et les émotions.

Guido Parato, médecin du duc de Milan, fit parvenir à Philippe le Bon, en guise de présent, son *Libellus de sanitate conservanda*[23], que le Duc fit traduire[24]. Ce n'est pas une oeuvre originale: la base en est principalement le *Regimen sanitatis* de Magnino de Milan, ainsi que le *Regimen sanitatis ad regem Aragonum* d'Arnaud de Villeneuve[25].

* * *

Les princes bourguignons ont toujours montré un grand intérêt pour la médecine. Ils ont soumis la pratique médicale à des règles. En 1408, ils ont décrété l'interdiction de son exercice par des médecins non-universitaires[26]. Suite à cette décision, on érigea à Dijon une section médicale où les étudiants pouvaient obtenir le titre de bachelier. Ensuite, ils devaient se rendre à Montpellier pour conquérir les grades supérieurs. L'université de Louvain, fondée en 1426, posséda également, dès sa création, une Faculté de médecine complète. Philippe lui-même, dans les premières années de son règne (en 1424) avait créé une université à Dôle, à laquelle était attachée une Faculté médicale[27]. En 1443 fut fondé l'Hôtel-Dieu de Beaune, modèle du genre, avec un médecin et un chirurgien permanents, vingt-huit lits pour les malades et une galerie supérieure pour assurer leur surveillance.

* * *

Plusieurs médecins de Philippe le Bon nous ont laissé des traités scientifiques, et aussi, parfois, des observations générales sur la vie à cette époque[28], mais aucun ne nous a livré la moindre information sur les états de santé de son illustre patient. Et aucune étude moderne n'a jusqu'ici tenté de combler cette lacune, en exploitant les éléments pourtant nombreux, bien que parfois vagues, disséminés dans les différentes chroniques historiques. Sans essayer de tirer des conclusions hasardeuses, et laissant aux praticiens le soin de poser d'éventuels diagnostics, nous avons donc rassemblé et ordonné ces données dans l'intention d'éclairer quelque peu cet aspect négligé par les historiens, à savoir la description et l'évolution de l'état physique et moral, ainsi que les pathologies du Duc, tout au long de sa vie.

Philippe le Bon, né sous le signe du Lion, le 31 juillet 1396[29], présenta un grand nombre de caractéristiques attribuées à cet astre de magnificence. On appela d'ailleurs ce prince, "à l'orgueil immense et chatouilleux", "le gran lyon"[30]. Cependant, l'image d'une personnalité puissante, autoritaire, ayant le goût du faste, friand de tournois et de fêtes, est partiellement tempérée à l'âge adulte par les marques d'une mélancolie parfois profonde (qui fut d'ailleurs dans l'air du temps[31]). Celle-ci, au sens médiéval du terme, était considérée comme une maladie mortelle, avec ses symptômes maintes fois décrits[32], provoquée principalement par l'influence de Saturne. Huizinga, qui n'a jamais été tendre pour Philippe le Bon, frôla le diagnostic, mais conclut finalement à un état de acedia: "Ce sera, tour à tour, la torpeur brute, le manque d'entrain, la mélancolie, le "Weltschmerz", la peur de vivre et d'agir"[33].

Il y eut plus grave. A l'annonce du meurtre de son père, le 10 août 1419, le jeune Duc fut pris par une crise de nerfs qui effraya au plus haut point les assistants, dont son chroniqueur flamand, Georges Chastellain[34]: "gectant un haut effrayeux cry, avec toutes manières lamentables, se rua sur un lit: et là gisant, subitement défiguré de visage, privé de parole et tout amorty d'esprit. Les yeux luy commencèrent à tourner, les lèvres à noircir, les dents à estreindre, les bras et les jambes à tirer à mort; seulement en l'estomac vers le coeur se retrahy la vye, lequel tellement s'engrossy et enfla que très-hastivement luy falloit couper la lachure de ses habillemens et deffermer les dents à force continuelle, ou il eust esté estaint infailliblement en son deuil". Il parut étouffer. Les assistants lui arrachèrent les vêtements du corps et s'efforcèrent de lui ouvrir la bouche.

Lorsqu'on lui annonça la mort de son fils d'un an, en 1430, sa réaction, plus qu'éplorée, fut fondamentalement désespérée: "Plust à Dieu que je fusse mort aussi josne, je me tenroie bien heurès"[35]. Il répéta d'ailleurs de temps à autre qu'il ne souhaitait pas vivre longtemps. En 1449, il invita dans son hôtel de Bruges une troupe pour représenter 'La danse macabre'[36]. Il était toujours vêtu de noir, et exigeait de même de sa suite et pour ses chevaux[37]: le noir est la couleur des enfants de Saturne et de la mélancolie.

Malgré un grand courage physique et une activité incessante, il était notoirement paresseux, c'est-à-dire qu'il n'avait pas un véritable goût du travail[38]. Chastellain, sur ce point, le critique sévèrement: "négligent estoit et nonchallant de toutes ses affaires, ce qui tournoit à grand playe à ses pays et subjects, en fait de justice, en fait de finances, en fait de marchandises et en fait de diverses iniquités, qui à telle cause peuvent sourdre et avoir cours, mesmes porter rompture et ruyne en sa maison [...] Avoit trésor, mais ne congnoissoit; de son amas ne voulut oncques riens voir ne argent manier, n'en sçavoir nombre [...] son corps et ses biens, tout commettoit en autruy mains"[39]. Malgré ses moments de bonne humeur, il était d'un tempérament typiquement mélancolique. Ce ne sont pas les seules contradictions de cette personnalité ambigue[40].

Son aspect physique a été décrit de manière détaillée et probablement un rien flatteuse par Chastellain: "De stature, il estoit moyennement haut homme; corporellement, à la mesure de sa hauteur, et en tous ses membres bras et jambes, trait a linge sans excès; estoit gent en corsage plus qu'autre, droit comme un jonc, fort d'eschine et de bras, et de bonne croisure; avoit le col à la proportion du corps, maigre et sec pied; et avoit plus en os qu'en charnure, veines grosses et pleines de sang"[41].

Il était donc de taille moyenne, bien proportionné et plutôt maigre. Sa complexion - d'après son thème astrologique - devait être celle d'un 'cholérique', c'est-à-dire un tempérament bilieux, viril et solaire[42]. Habituellement, il était très sobre, dormait peu, mangeait frugalement et jeûnait sévèrement (quatre jours par semaine, il ne se nourrissait que d'eau et de pain). Ses veines, "grosses et pleines de sang", ont souvent dû inciter ses chirurgiens-barbiers à des saignées. Son buste d'albâtre, au musée des Beaux-Arts de Dijon, le représente avec un visage plein de cicatrices. Serait-ce une conséquence de la petite vérole ?

Son activité sexuelle était remarquable, si l'on en juge rien que par la trentaine de maîtresses quasi-officielles, reconnues et dotées, les dix-sept bâtards affichés, ainsi que les parties fines organisées de temps à autre dans le jardin de plaisance de Hesdin, dont les comptes mentionnent l'installation de toutes sortes de 'joyeulsetez', fort à la mode, mais d'un goût parfois assez gaulois, comme cet "engien pour moullier les dames en marchant par dessus [...] avec huit conduiz pour moullier les dames par dessoubz"[43]. Ce qu'il faut se représenter à cette description n'est pas évident. Quoi qu'il en soit, ses chroniqueurs condamnaient unanimement, comme étant son plus grand défaut, la luxure de ce prince "durement lubrique"[44].

Un exemple particulier de son caractère autoritaire fut directement lié à une prescription de ses médecins. Ceux-ci, lorsqu'il fut gravement malade, en 1462, pour une raison inconnue (poux, eczéma ?), exigèrent de lui tondre le crâne. Aussitôt, le Duc fit publier un édit enjoignant tous les membres de sa Cour de se coiffer comme lui[45]. Le célèbre portrait de Roger van der Weyden le représente ainsi: les tempes rasées, portant une perruque en forme de calotte (le tableau original est perdu; une excellente copie se trouve au Palais Royal de Madrid, une autre à Anvers, Koninklijk Museum voor Schone Kunsten). Olivier de la Marche en fit le récit suivant: "Et en ce temps le duc Philippe eust une maladie, et par le conseil de ses medecins se fit resre la teste et oster ses cheveulx; et pour n'estre seul rez et desnué de ses cheveulx, il fit un edit que tous les nobles hommes se feroient resre leurs testes comme luy; et se trouverent plus de cinq cens nobles hommes qui pour l'amour du Duc se firent resre comme luy; et aussi fut ordonné messire Pierre Vacquembac et aultres, qui, prestement qu'ilz veoient ung noble homme, luy ostoient ses cheveulx; et vint ceste chose mal à point, pour la pareure de la maison de Bourgoigne; car en ce temps vindrent nouvelle à monseigneur le daulphin que le Roy Charles, son pere, estoit malade à Meun sur Yevre; [...]"[46].

Un jour, échauffé plus que de coutume après une longue partie de jeu de paume, "par non prendre garde de luy et par froid pris, il cheut en une fièvre et en porta trois ou quatre excès bien aspres. Secouru toutevoies par ses phisiciens", il fut mis hors de danger, et on le crut guéri. "Mais non bien affrancy ou par mauvaise gouverne rechupt arrière en plus dure que devant". Cette fois-ci, la crise dura trente-six heures sans répit, et tous le crurent mourant, "car n'avoit en lui sens nul, ne cognoissance, par la longue continuation et durté de l'excès". Finalement, Dieu le fit revenir à lui et lui restitua la parole, "et de là en avant, par le curieux soin des phisiciens, fut tellement secouru que peu à peu recouvra la santé"[47].

Selon des témoins oculaires, dont Jean Germain[48], le premier chancelier de la Toison d'Or, ses accès de colère rares, mais terrifiants lui bleuissaient le visage. Lors d'une violente dispute avec son fils au sujet d'un des Croy, en janvier 1457, "le sang, avecques les paroles, lui tira à coeur, et devint pâle et puis à coup enflambé et si espoentable en son vis, comme je l'oys recorder au clerc de la chapelle qui seul estoit emprès luy, que hideur estoit à le regarder"[49]. Après cela, il tomba dans une sorte d'hébètement et, le soir venu, il quitta seul, à cheval, Bruxelles. Toute la nuit il erra par champs et forêts, inconscient de l'heure, de l'endroit, des intempéries. Finalement, il fit une chute et se blessa. Au lever du jour, il trouva refuge et nourriture dans la hutte d'un charbonnier. Cet épisode dramatique a été longuement relaté, avec une profusion de détails, par Chastellain (III, 249-289).

Enfant déjà, jeune homme encore[50], Philippe eut de fréquents accès de fièvre. Adulte, il a dû être souvent malade, ou tout au moins très préoccupé par sa santé, si l'on tient compte de la soixantaine de médecins attachés à sa personne ou consultés ponctuellement à la Cour. Il les récompensa pour la plupart par le titre de Conseiller, parfois d'Ambassadeur, et leur accorda souvent un titre de noblesse, pour autant qu'ils n'en soient pas déjà pourvus. Grâce à de nombreuses sources, il nous a été possible de constituer une liste assez impressionnante, mais inévitablement incomplète , d'une grande partie du personnel médical attaché, mandé ou ayant un rapport à la cour de Bourgogne du temps de Philippe le Bon (voir annexe), alors que précédemment on était d'avis que: "Parmi les membres de la cour de Bourgogne au milieu du XVe siècle, figurent un certain nombre de médecins, sur lesquels nous n'avons malheureusement aucun renseignement"[51].

La nouvelle distinction entre médecin et chirurgien s'est ici visiblement accomplie, car plus de vingt chirurgiens sont mentionnés avec nom et prénom dans les livres de comptes et les chroniques. Il est souvent question de personnes qui exercent le double emploi de chirurgien et de barbier. Ceci concorde avec la nouvelle tendance de la seconde moitié du XVe s.: les titres de barbier et de chirurgien tendent à se confondre en une seule personne.

Pendant sa visite de la ville d'Amiens, où régnait une épidémie de peste, Philippe ne craignit point la contagion[52]. On connaissait pourtant la théorie aériste des anciens, suspectant le danger de l'inhalation de l'air ambiant. Sous son règne éclatèrent plusieurs épidémies, surtout de peste, qui provoquèrent une grande mortalité: à Maastricht en 1428, à Ypres en 1436, à Bruges en 1437-39, à Louvain en 1438, à Tournai et à Lille en

1450, à Gand en 1452, à Bruxelles en 1454 et à Douai en 1455, puis à nouveau à Lille en 1464.
En février de l'année 1462, Philippe le Bon tomba gravement malade: il est fait mention de huit médecins appelés à Bruxelles en son château du Coudenberg[53]. Pendant cette maladie, dont le stade aigu dura quatre mois, on n'osa relater au Duc le décès accidentel d'un de ses proches: "pour cause que l'œuvre en estoit triste et l'accident mélancolieux pour un malade"[54]. Le Duc, en danger de mort, fut sauvé, mais déclinait inexorablement par la suite: "il devint malade à mort, languissant deux ans, où toutes ses vertus et vigueurs corporelles se consumèrent, avecques ce que vieil estoit et de haux jours"[55] [à ce moment, il était âgé de 66 ans]. Les premières traces de sénilité apparurent. L'ambassadeur milanais Thomas de Rieti remarqua de manière euphémique "qu'il se fait vieux et ne brille pas par la sagesse"[56].

Dans ses dernières années, le Duc, constamment malade, dut observer le régime du pain de seigle, qui contrairement au pain blanc des riches, était le lot quotidien des moins nantis[57].

En 1464, il fut à nouveau tellement souffrant qu'on ne se permit pas de lui annoncer la mort de personnes de son entourage (par exemple, celle de son chancelier Nicolas Rolin[58]), et qu'il était défendu de se montrer auprès de lui en habits de deuil.

Début 1467, dans un accès de colère (encore un !) contre ses trésoriers, il fut frappé d'apoplexie. Quelques mois plus tard, le vendredi 12 juin 1467, vers le soir, il fut pris de vomissements pénibles[59], et son fils fut mandé d'urgence. Il mourut trois jours plus tard, le 15 juin, vers les dix heures du soir, dans sa chère ville de Bruges, d'une pneumonie ou d'une hémorragie cérébrale, édenté[60], sénile[61], privé de la parole, abandonné par ses serviteurs, "par nuit, couché en ses fleumes, mal secouru et mal gardé"[62], tandis que plusieurs médecins dormaient paisiblement dans la chambre voisine ...

Son coeur fut porté à Jérusalem, satisfaction ultime, mais hélas posthume pour un prince qui n'avait jamais pu réaliser son rêve de croisade ...

Notes

1. Au XVe s., il y a des chaires d'astrologie aux universités de Padoue, Pavie, Ferrare, Augsbourg, Leipzig et Cracovie. Le statut social des professeurs d'astrologie est considérable et leur influence très grande. Voir: Jean-Patrice BOUDET et Thérèse CHARMASSON, Une consultation princière en 1427. In: *Comprendre et maîtriser la nature au moyen âge*. Mélanges d'histoire des sciences offerts à Guy Beaujouan. (Ecole pratique des Hautes Etudes - IVe section. V. Hautes études médiévales et modernes 73) Genève, 1994, 255-278.

2. *Orthographia*. Venezia, Nicolò Jenson, 1471, suivi de nombreuses rééditions. "Alla voce *Hippocrates* parla della medicina, e dei più celebri medici antichi e medievali, ultimi i senesi Ugo e Socino Bensi, padre e figlio": Giovanni Tortelli cooperatore di Niccolò V nel fondare la Biblioteca Vaticana, in: *Archivio storico italiano* 78 (1920) 161-282; 233, note 6.

3. Tel fut également le cas à la cour de France, où, pour la première fois, en 1451 apparut un personnage officiel portant le titre d' "astrologien du roy". A partir de cette date, Louis XI se fit entourer de plusieurs astrologues attitrés ou non: Jean-Patrice BOUDET, Les astrologues et le pouvoir sous le règne de Louis XI. In: Bernard RIBEMONT (éd.), *Observer, lire, écrire le ciel au moyen âge*. Actes du Colloque d'Orléans, 22-23 avril 1989. Paris, 1989, 7-42.

4. J. HUIZINGA, *Herfsttij der Middeleeuwen*. Haarlem, 1950, 299.

5. Quelques mois après la mort du Duc, Chastelain - déjà fort âgé - écrit un superbe panégyrique intitulé *Declaration de tous les haul glorieuses adventures du duc Philippe de Bourgoingne qey se nomme le duc et le gran lyon* (ms. Bruxelles, BR, 21.687-691). Edition: *Oeuvres de Georges Chastellain*, éd. KERVYN de LETTENHOVE. Bruxelles, 1863-66, 8 vol., III, 448.

6. e.a. Chastellain II, 376; III 446, 447, 448; IV 213; V 32.

7. J. RICHARD, Aux origines de l'Ecole de médecine de Dijon (XIVe-XVe s.). In: *Annales de Bourgogne* 19 (1947) 261.

8. L. de LABORDE, *Les ducs de Bourgogne. Etudes sur les lettres, les arts et l'industrie pendant le XVe siècle*. Paris, 1849-53, 3 vol., I, 1578.

9. Alexandre-Joseph FAIDHERBE, *Les médecins et les chirurgiens de Flandre avant 1789*. (Fac. de médecine de Paris. Thèse pour le doctorat en médecine) Lille, 1892, 150.

10. BOUDET, Les astrologues, 23.

11. THORNDIKE IV, 139-143; Thérèse CHARMASSON, Roland l'Ecrivain, médecin des ducs de Bourgogne. In: *Comptes rendus 101e Congrès National des Sociétés Savantes*. Lille, 1976. Section des Sciences. Fasc. III. Histoire des Sciences et des Techniques. Paris, 1976, 21-32; *Nationaal biografisch woordenboek* VI (1974) 854-857.

12. Emile POULLE, Horoscopes princiers des XIVe-XVe siècles. In: *Bulletin Société nationale des Antiquaires de France* 1969, 63-77; Thérèse CHARMASSON, L'établissement d'un almanach médical pour l'année 1437. In: *Comptes rendus du 99e Congrès national des Sociétés savantes*. Besançon, 1974, 217-234; Thérèse CHARMASSON, Sciences et techniques divinatoires au XVe siècle: Roland l'Ecrivain, médecin, astrologue et géomancien. In: *Ecole nationale des Chartes. Positions des Thèses*. Paris, 1973, 27-31.

13. C. BROECKX, *Prodrome de l'histoire de la Faculté de médecine de l'ancienne Université de Louvain depuis son origine jusqu'à sa suppression*. Anvers, 1865, 9; A. ABEL et Mina MARTENS, Le rôle de Jean de Vésale, médecin de la ville de Bruxelles, dans la propagande de Charles le Téméraire. In: *Cahiers bruxellois* 1 (1956) 41-86; 45.

"En 1432, Jean de Wesel offrait au duc de Bourgogne de grands et petits almanachs. Vingt-sept ans après, en 1459, on rencontre la mention du grand almanach qu'il rédigeait chaque année, en y indiquant 'les jours esleus' (Registres de la chambre des comptes, cités par M. Pinchart)": KERVYN III, 448.

14. Préface du *Quadrupti Tholome*, traduction du *Tetrabiblos* de Ptolémée: Georges DOUTREPONT, *Inventaire de la "librairie" de Philippe le Bon (1420)*. Bruxelles, 1906; reprint Genève, 1977, 90, n° 136.

15. BOUDET et CHARMASSON, 274.

16. E. POULLE, *Un constructeur d'instruments astronomiques au XVe siècle, Jean Fusoris*. Paris, 1963.

17. A la mort de Philippe le Bon, elle contenait plus de 900 volumes: P. GRAS, A propos du Trésor de Bourgogne. In: *Annales de Bourgogne* 21 (1949) 81-87.

18. La plupart de ces manuscrits sont conservés à la Bibliothèque Royale de Bruxelles, d'autres à la Bibliothèque Nationale à Paris. Voir: *La librairie de Philippe le Bon*. Exposition organisée à l'occasion du 500e anniversaire de la mort du Duc. Catalogue rédigé par Georges DOGAER et Marguerite DEBAE. Bruxelles, 1967; ainsi que DOUTREPONT, *Inventaire*.

19. Emile ROY, Un régime de santé du XVe siècle pour les petits enfants, et l'hygiène de Gargantua. In: *Mélanges Emile Picot*. Paris, 1913, I, 151-158.

20. Jean sans Peur "lui fit apprendre non seulement le français, mais aussi le flamand, tandis que le jeune prince trouvait, dans l'entourage de sa mère, l'occasion de se familiariser également avec l'allemand" : Paul COLIN, *Les ducs de Bourgogne*. (Bibliothèque historique) Bruxelles, 194312, 147.

21. F. MAILLARD, *Les traductions du De Regimine principum de Gilles de Rome*. Ecole des Chartes, Position des thèses, 1948, pp. 93-96; Georges DOUTREPONT, *La Littérature Française à la cour des Ducs de Bourgogne*. Paris, 1909, 23, 25, 309-310, 457.

22. Ce n'est pas la première traduction: celle de Wauquelin a été précédée de peu par celle de Henri de Gauchy, qui n'avait pas été commandée par Philippe, et dont le manuscrit, d'une facture moins luxueuse, est également conservé à la Bibliothèque Royale de Bruxelles, sous la cote 10.368.

23. Conservé à la Bibliothèque Royale de Bruxelles: ms. 10.861.

24. Ce magnifique manuscrit se trouve actuellement à Saint-Petersbourg, ms.Fr.Q.v.VI.I.

25. E. WICKERSHEIMER, Le régime de santé de Guido Parato, physicien du Duc de Milan. In: *Bull. Soc. franç. hist. méd.* 12 (1913) 82-95.

26. Jean RICHARD, Aux origines de l'Ecole de Médecine de Dijon. In: *Annales de Bourgogne* 19 (1947) 260-262.

27. RICHARD, 261.

28. Voir par exemple Danielle JACQUART, Le regard d'un médecin sur son temps: Jacques Despars (1380? - 1458). In: *Bibliothèque de l'Ecole des Chartes* 138 (1980) 35-86.

29. Etienne PICARD, Le lieu et la date de naissance de Philippe-le--Bon. In: *La Revue de Bourgogne* 1926, 341-354.

30. Paul BONENFANT, *Philippe le Bon*. (Collection Notre Passé) Bruxelles, 1943 , 18.

31. La deuxième moitié du XVe siècle est traversée par un courant de pessimisme qui se retrouve dans tous les domaines. Les auteurs

déplorent généralement la dégradation des conditions de vie et la déchéance des mentalités.

32. D'après Avicenne, ceux-ci sont "une corruption du jugement et de la réflexion [...]. Les patients atteints par cette maladie sont sujets à des peurs qu'ils ne peuvent maîtriser": Danielle JACQUART, Le regard d'un médecin sur son temps: Jacques Despars (1380? - 1458). In: *Bibliothèque de l'Ecole des Chartes* 138 (1980) 35-86.

33. J. HUIZINGA, La physionomie morale de Philippe le Bon. In: *Annales de Bourgogne* 1932, 101-129; 126.

34. Chastellain I, 49 et V, 240.

35. *Enguerrand de Monstrelet, Chroniques,* éd. L. DOUËT D'ARCQ (Société de l'histoire de France). Paris, 1857-63, 6 vol., IV, 430.

36. LABORDE II, 393.

37. Chastellain VIII, 223.

38. HUIZINGA, La physionomie, 112.

39. Chastellain VII, 223.

40. Une analyse de quelques unes de ces contradictions dans HUIZINGA, La physionomie.

41. Chastellain VII, 219.

42. cf. un schéma très élaboré in: Ria JANSEN-SIEBEN, De vrouw in de medische literatuur. In: R.E.V. STUIP en C. VELLEKOOP, *Middeleeuwers over vrouwen*. Utrecht, 1985, 160-178, 205-6.

43. *Mémoires d'Olivier de La Marche, Maître d'hôtel et Capitaine des gardes de Charles le Téméraire,* publiés par Henri BEAUNE et J. d'ARBAUMONT. (Société de l'Histoire de France) Paris,

1883-88, 4 vol., t. II, 350.

44. "Avoit aussi en luy le vice de la chair; estoit durement lubrique" etc. : Chastellain VII, 224. Lire à ce propos la diatribe impitoyable de Jean Germain, Liber de virtutibus Philippi ducis Burgundiae, in: KERVYN de LETTENHOVE (éd.), *Chroniques relatives à l'histoire de la Belgique sous la domination des ducs de Bourgogne*. Bruxelles, 1876, tome I, 113-115.

45. Osw. RUBBRECHT, *L'origine du type familial de la Maison de Habsbourg*. Bruxelles, 1910, p. 17. Certains historiens contestent l'existence d'un tel édit, dont on n'a pas trouvé de trace. Le tableau de Van Eyck, La Madonne avec le Chancelier Rolin (Paris, Louvre), par exemple, représente ce dernier avec la même coiffure que le Duc.

46. Olivier de la Marche II, 421-2.

47. Chastellain III, 442-3.

48. *Jean Germain, Liber de virtutibus Philippi, ducis Burgundiae,* éd. KERVYN de LETTENHOVE, *Chroniques relatives à l'histoire de la Belgique sous la domination des ducs de Bourgogne.* (Collection des chron. belges) Bruxelles, 1876, t. II.

49. Chastellain III, 231-6.

50. Chastellain I, 41: "environ de vingt ou de vingt et deux ans [...] souvent assez fiévreux".

51. Thérèse CHARMASSON, Roland l'Ecrivain, médecin des ducs de Bourgogne. In: *Comptes rendus du 101e Congrès national des Sociétés Savantes,* Lille 1976, Section des Sciences, 21-31; p. 21.

52. Chastellain III, 365.

53. "Le duc de Bourgongne en ce temps-cy encore estoit griefvement

malade. Ceste maladie luy prit d'une fièvre très-aspre, au commencement de laquelle toutesvoies, par ayde de médecins, fut mitigée et réduite à ploy de bon espoir; mais la rechute y survint qui donna la menace de la mort". Aux dires de Chastellain (IV, 200-203), Philippe sera sauvé par les prières ardentes de son peuple, bien plus que par les médecins.

54. Chastellain IV, 204.

55. Chastellain V, 62-63.

56. BONENFANT 83.

57. Henri DAVID, L'hôtel ducal sous Philippe le Bon. Moeurs et coutumes. Les offices. In: *Annales de Bourgogne* 37 (1965) 241-255; 245.

58. Chastellain III, 296; IV, 213, 216.

59. "zo buytermaten onlustich, zieck ende cranck omtrent den looftijde binnen zijnen hove te Brugghe, dat hy smaendachs snavens daer naer, up St. Modestusdach, tusschen den neghen ende thien euren, deser weerelt overleet, van der oude van bet dan LXXI jaer": J. de JONGHE (éd.), *Cronijcke van den lande ende graefscepe van Vlaenderen, gemaect door JOr Nicolaes Despars* [...]. Brugge, 1839, 579.

60. TRICOT-ROYER, *Les ducs de Bourgogne inhumés à Dijon.* Anvers, 1937, et Carlos GYSEL, Marie de Bourgogne (1457-1482), son oligodontie et la prognathie des Habsbourg. In: *L'Orthodontie française* 63 (1992) 585-594.

61. Pourtant, Chastellain (V, 227) dit que le Duc meurt "plein encore de bon sens", ce qui, de l'avis de plusieurs témoins, est manifestement faux: "l'intelligence du duc déclinait depuis deux ans en même temps que sa santé. Le duc Philippe passait toutes ses journées dans une petite chambre où il aiguisait des aiguilles,

retrempait de vieilles lames ou réunissait des débris de vitrages. Cet atelier le suivait partout, et là se bornaient les occupations d'un prince naguère si habile et si redouté". Ce commentaire est fourni en note par l'éditeur de Chastellain. Il ne cite pas ses sources, pas plus que Huizinga (La physionomie, 112): "Dans sa décrépitude, il s'amuse à repasser des aiguilles et à réparer de vieux couteaux".

62. Chastellain V, 229.

Annexe: Les médecins de la Cour de Philippe le Bon

Comme il est souvent difficile de déterminer si un membre du corps médical fut attaché exclusivement à une seule personne de la famille ducale, j'ai pris la liberté d'inclure dans cette liste tous les noms de ceux qui dans ce contexte furent attachés ou appelés à la cour ou qui dans le domaine astro-médico-hygiénique eurent un rapport quelconque avec Philippe le Bon et son entourage familial, depuis sa naissance jusqu'à sa mort. Pour des raisons d'uniformité, je l'appelle partout "le Duc", même avant 1419, lorsqu'il n'était encore que Comte de Charolais.

Alard de Lattre	BARBIER et VALET DE CHAMBRE du Duc, 1459-60 / Brand 1458 / Jacq.
Alard Van den Hende	CHIRURGIEN, Bruges, 1436 / Wick. accompagna en 1436 le contingent brugeois sous le commandement du Duc
Albert Ditmari	MEDECIN, 1434, professeur Louvain / Wick. Le Duc l'appelle son "bien amé phisicien"

Albert de Molemont	MEDECIN, 1442, Tournai / Laborde 1367 / Wick. mandé de Tournai en Bourgogne "pour aucunes choses secretes"
André ab Armis	MEDECIN du Pape, 1437 / Wick. / Laborde 1181 envoyé à la cour ducale, reçut six tasses d'argent
André de Palazzago	= André ab Armis
André de Puessieux	MEDECIN du Duc, 1413 / Wick.
André de Venise	= André ab Armis
Anselme Grebert	MEDECIN, Dijon, 1437-41 / Wick. naissance légitimée par le Duc, vers 1442
Antoine Patenostre	MEDECIN, 1461 / Laborde 1854 / Wick. secours du Duc pour études à Louvain 1461-2
Barthelemy Cazal	MEDECIN, de Venise / Kervyn IV 211 mandé à Bruxelles en 1461-62
Barthelemy Partant	BARBIER du Duc, 1427, 1429, 1438 / Brand 1445, 1458 / Wick./ Parav. II 267; IV 305-6 / Vandenpeereboom 15
Barthelemy Partault	= Barthelemy Partant
Claude de Messey	ASTROLOGUE, prévôt de Watten, Saint-Omer / "moult expert en la science": Chastellain III, 448

Dominique	MEDECIN, ASTROLOGUE, de Genève, établi à Bruges / Wick. / Laborde 66 / Kervyn IV 211 mandé à Bruxelles en 1461-62
Dominique de Baxadonne	MEDECIN, chanoine de Sainte-Waudru, Mons / Wick. médecin de la duchesse de Bourgogne
Elie	MEDECIN ? Pise, env. 1409 / Wick. le Duc écrit au Pape pour lui faire envoyer Elie
Elie Sabbati	MEDECIN du Duc, Bologne, Paris, Bruges, 1410-11 / Wick. / Laborde 119
Enguerrand	CHIRURGIEN de Charles VI / Wick. envoyé en 1395 auprès de Jean sans Peur "qui avoit l'espaule rompue"
Etienne Chevalier	MEDECIN du Duc, 1461 / Brand 1458 / Wick. / Laborde II, p. XIII
Eustace Cailleux	MEDECIN et CONSEILLER du Duc, 1430, 1450 Laborde 1256 / Wick./ Faidh. 150 / Parav. III 157
Eustache de la Pierre	= Eustace Cailleux, Calculus, Caillou
Fasse de Saint-Séverin	CHIRURGIEN et ASTROLOGUE de la duchesse d'Orléans / Wick. envoyé en 1395 auprès de Jean sans Peur "qui avoit l'espaule rompue"
Fernand de Cordoue	MEDECIN, théologien, juriste, Cordoue / Wick. en 1446 se rendit à

	Gand, à la cour de Bourgogne
Florent Flory	MEDECIN, 1439, Saint-Omer / Laborde 1298 / Wick. mandé à Hesdin, vers 1440, pour le Comte de Charolais, malade
Fonse de Lucerne	= Fonse de Lureux
Fonse de Lureux	MEDECIN et CONSEILLER du Duc, 1456-1459/ Laborde 1824, 1835 / Wick.
François Allegre	MEDECIN du Duc, 1427-8, Bruges / Laborde 845, 878 / Wick.
Gauthier de Vacque	BARBIER et VALET DE CHAMBRE du Duc / Brand 1458
Geoffroy ...	= Joffroy ...
Georges Causez	ASTRONOME, 1439 / Laborde 1286 "en considération de plusieurs services"
Gilles de Effelterre	MEDECIN, Gand / Wick./ Van der Straeten 351
Gilles Pinchon	CHIRURGIEN, 1438, Bruxelles / Laborde 1235 guérit femme renversée par cheval du Duc
Gillet Baudoul	BARBIER du Duc, 1409, 1415 / Parav. I 21; I 64 / Wick. accompagna le Duc à Lille, en 1413
Gillet du Cellier	EPICIER.et APOTHICAIRE du Duc, 1409, 1415, 1427, 1429, 1433/ Brand

	/ Parav. I 22; I 68; II 280; IV 324
Gisbert van den Berghe	MEDECIN ? et CONSEILLER du Duc, 1400-1401, 1407-1408 / Uyttebr. 184 loge au Coudenberg
Godefroid vander Wilghen	professeur Louvain / Broeckx 9
Gonde Salve	= Gonsalve de Vargas
Gonsalve de Berges	= Gonsalve de Vargas
Gonsalves de Vargas	MEDECIN et CONSEILLER du Duc, 1456-1470 / Brand 1458 / Wick./ Laborde 1830, 1872 et II, p. XIII, 227, 274
Guillaume Bourgeois	MEDECIN du Duc, 1409, 1412, 1415 / Laborde 134 / Parav. I 10; I 45 / Wick. / Jacq.
Guillaume Brun	MEDECIN et CONSEILLER du Duc, 1466 / Brand 1458 / Laborde 1851; II, p. XIII / Wick.
Guillaume Cardonnel	MEDECIN du Roi / Wick. en 1403, se rendit à Melun, pour donner ses soins à Philippe
Guillaume de Cologne	ASTRONOME, 1457 / Laborde 1826 le Duc intervient "pour lui aidier à vivre"
Guillaume du Bois	CHIRURGIEN et VALET DE CHAMBRE du Duc,1463-7 / Brand 1458 / Wick. / Laborde 1900 / Faidh. 155

Guillaume Feliant	BARBIER, 1450 / Laborde 6695
Guillaume Hatteclyffe	MEDECIN d'Edouard IV d'Angleterre / Wick. envoyé à la cour de Bourgogne
Guillaume Hobit	ASTRONOME, 1442-3 / Laborde 1366 mappemonde
Guillaume le Mire	CHIRURGIEN, 1436, Montreuil s/Mer / Laborde 1188/ Wick mandé à Hesdin, 1435 ou 1436:genou malade
Guillaume de Lens	BARBIER du Duc, 1464-65 / Jacq.
Guillaume de Naste	MEDECIN et CONSEILLER du Duc, Lille, 1464-7 / Laborde 1905 / Wick. / Jacq. / Dulieu 222
Guillaume Paradis	MEDECIN, 1438-9, Saint-Omer / Wick. / Jacq. / Laborde 1255, 1366
Guillaume de Rocque	MEDECIN, 1448, Lille / Wick./ Faidh.151 autopsie du valet de chambre Willekin Jehanzone
Guillaume Roussel	MEDECIN, 1411-12 / Laborde 92, 116 / Wick.
Guillaume de Sens	CHIRURGIEN, BARBIER et VALET DE CHAMBRE du Duc, 1465-72 / Brand 1449, 1458/ Faidh. 155
Guillaume van den Bossche	= Guillaume du Bois

Guillemin	BARBIER à la cour de Bourgogne, 1405 / Wick.
Haquin de Vesoul	MEDECIN du Duc, 1416 / Wick. / Jacq. soins à la duchesse et sa fille Marguerite, 1416 employé e.a. "en certainnes choses secrettes"
Helie (maistre)	MEDECIN du Duc, 1411-12 / Laborde 116 = Elie ?
Henri Arnault de Zwolle	MEDECIN du Duc, MAITRE EN MEDECINE, PROFESSEUR EN MEDECINE, ASTROLOGUE, ASTRONOME, 1431, Dijon / Brand / Laborde 901 [Henry Arnault de Zubolis], 1578 / Jacq. / Wick. / Faidh. 150, 217 appareil astronomique; cartes géographiques; disciple de Jean Fusoris
Henri Carpentin	MEDECIN de la Duchesse, 1397-1403, Laon, Bruges, Tournai / Wick.
Henri de Coster, Custodis	MEDECIN, prof. Louvain, Oosterwijk, 1428 / Broeckx 9
Henri de Courtrai	CHIRURGIEN du Duc, Bruges, 1422-23 / Wick.
Henri Frater	MEDECIN et CONSEILLER du Duc, 1411-2 / Laborde 105 / Wick.
Henri Fusolis	MEDECIN, 1466 / Brand 1458 / Wick. / Laborde II, p. XIII

Henri Petri	MEDECIN et CONSEILLER du Duc, Utrecht, prof. Louvain, 1424-7 / Wick. / Broeckx 23
Henri Scatter	= Henri Petri
Henri Scoenwol de Wila	= Henri Steinhoewel de Weil
Henri Steinhoewel de Weil	MEDECIN, 1466 / Brand 1458 / Wick. / Laborde II p. XIII
Henri de Troyes	CHIRURGIEN du Duc, 1425-8, 1429, 1433 / Brand / Laborde 730, 866, 4938 / Wick. / Jacq. / Parav. II 283; IV 329
Henri van Oosterwyc	= Henri de Coster
Henri de Vocht	MEDECIN, Hollande, 1456-7 / Laborde 1815 / Wick.
Henri de Wocht	= Henri de Vocht
Henri Zwollis	= Henri Arnaud de Zwolle
Hugues Picotin	MEDECIN ? Wick. vers 1400-02, Jean sans Peur lui donna de l'argent "pour avoir un livre de médecine"; Philippe le Bon le fit nommer chanoine de Poligny
Hugues van Oesterwyck	MEDECIN, Louvain, 1441 / Van der Straeten 352
Humbert Quanteau	MEDECIN du Duc, Salins, 1411 - / Wick. / Jacq. annobli en 1459

Jacques Candel / Caudel	CHIRURGIEN et VALET DE CHAMBRE du Duc, 1437 / Brand 1445 / Laborde 1241, 4028 / Faidh.149, 152 / Vandenpeereboom 16 / Wick.
Jacques Caudet / Cadet	= Jacques Candel
Jacques Despars (de Partibus)	MEDECIN et CONSEILLER du Duc, 1427, 1436 / Laborde 1194, 4916 / Wick. / Jacq. / Van der Straeten 352 / Keil 179 / Dulieu 99, 222, 280 / Faidh. 151
Jacques Parent	BARBIER et CHIRURGIEN du Duc, frère de Jean Parent , 1438, 1449 / Brand 1458 / Wick. / Faidh. 153 accompagne les troupes en Flandre, 1434
Jacques Sacquespée	MEDECIN du Duc, Arras, 1419-1436 / Wick.
Jacques Tournemyne	MEDECIN, 1448, Lille, prof. Louvain / Wick/ Faidh. 151: autopsie de valet de chambre Willekin Jehanzone
Jacquot Michel	EPICIER, APOTHICAIRE, VALET DE CHAMBRE du Duc, 1427, 1429, 1433, 1438, 1449 / Brand / Parav. II 281; IV 325 père de Pierre Michiel
Jacquotin le Barbier	BARBIER du Duc / Parav. IV 308 = Jacquotin Parent ? = Jacques Parent?

Jacquotin Parent	= Jacques Parent ? / Brand 1445
Jean	MEDECIN à la cour, 1378-1400 / Wick.
Jean	MEDECIN du Duc, 1411 / Wick.
Jean	MEDECIN du Duc, 1419-20 / Wick. = Jean van Eele de Breda ?
Jean (Maître)	BARBIER du Duc, 1412, 1426 / Parav. II 267 = Jean Lanternier l'Ancien ?
Jean Avantage	MEDECIN et CONSEILLER du Duc, 1421-56 / Laborde 830, 1157, 4938 /Wick. / Faidh. 149 / Parav. II 290; IV 328 / Dulieu 222, 283 maintes missions diplomatiques
Jean Bertault	(dit: de Hollande) CHIRURGIEN, Lille / Wick. obtint lettres de légitimation de Philippe le Bon
Jean Bommick	CHIRURGIEN du Duc, 1466-7 / Laborde 1919 / Wick.
Jean de Breda	= Jean van Eele de Breda
Jean de Bregy	MEDECIN et ASTROLOGUE, 1435 / Wick. / Simon de Phares 254-5 "principié et érudit en la maison de Bourgongne"
Jean de Bruges	MEDECIN et ASTROLOGUE, 1442, Louvain / Simon de Phares 255

Jean Cadart	MEDECIN (licencié), 1412 / Laborde 139 / Wick.
Jean Candel / Caudel / Cadet	CHIRURGIEN du Duc, 1433- / Brand 1445, 1458 / Laborde 1213, 1241, II p.XIII / Wick. / Vandenpeereboom / Faidh. 149, 152 / Parav. IV 330
Jean Carot	BARBIER, Paris / Wick. prêta serment au Duc, en 1418
Jean de Chalon	MEDECIN du Duc, 1396, 1419 / Picard 350, 351 / Wick. / Jacq. MEDECIN de la Duchesse ?
Jean Chevalier	MEDECIN de la Duchesse Isabelle / Wick.
Jean Claudel	CHIRURGIEN, 1427-28 / Wick. / Laborde 853 le Duc lui fit remettre 8 livres
Jean Coiffy	MEDECIN, Langres, 1413 / Wick. soins à Duchesse Marguerite, Dijon, 1413
Jean Coiffy	MEDECIN, Langres, 1413 / Wick. soigne la Duchesse
Jean de Colonia	MEDECIN / Wick. = Jean de Coulogne ?
Jean Cottereau	MEDECIN et CONSEILLER du Duc, 1421- / Brand 1445/ Laborde 728, 1254, 1861, 4938/ Wick. / Parav. II 289; IV 327 / Bartier annobli en 1435

	1441: Bruxelles, auprès du Duc 1461-2 "en certain accident de maladie qui lui est nouvellement survenu"
Jean de Coulogne	ASTRONOME , Lille, 1436-7, 1457-8 / Wick./ Laborde 1179, 1828 défrayé pour voyage Gand-Bruxelles, 1457-8 = Jean de Colonia ?
Jean de Coveleyns (Coblence ? Comblain ?)	MEDECIN ? du Duc, 1427-8 / Uyttebr. 184
Jean Despeaulx	EPICIER et VALET DE CHAMBRE du Duc / Brand 1438 / Parav. IV 302
Jean du Bois	CHIRURGIEN et VALET DE CHAMBRE du Duc, 1419-20 / Wick./ Laborde 562
Jean Durand	MEDECIN, 1402, Paris / Wick. soigna surtout Philippe le Hardi
Jean de Froitmont (Fromont)	CHIRURGIEN, 1448, Lille / Wick. / Faidh. 151 autopsie de valet de chambre Willekin Jehanzone
Jean Fusoris	MEDECIN, ASTRONOME, ASTROLOGUE, 1397 / Wick. / Simon de Phares 245, 255 / Jacq./ Laborde 5798 maître de Henri-Arnaud de Zwolle; livre deux horloges
Jean Grancy	BARBIER, 1450-57 / Wick. prisonnier du Duc à Châtillon-sur-Seine

Jean Harbelot	APOTHICAIRE, EPICIER et VALET DE CHAMBRE du Duc, 1449 / Brand 1455
Jean de Heda	= Jean van Eele de Breda
Jean Hoestraten	Broeckx / Keil und Reinecke 380
Jean Joliette	MEDECIN, Dijon, 1413 / Wick. soigna la Duchesse
Jean Lanternier l'Ancien	CHIRURGIEN, BARBIER et VALET DE CHAMBRE du Duc, 1433, 1448-49/ Brand 1445 / Wick. / Laborde 1849 / Faidh. 153 / Parav. IV 309 = Maître Jean ?
Jean Lanternier le Jeune	BARBIER, 1449 / Brand 1449
Jean Lavantage	= Jean Avantage
Jean Lemonnier	CHIRURGIEN du Duc, 1462 / Wick.
Jean de Lens / Lan	CHIRURGIEN, 1466 / Laborde
Jean Marcelin	BARBIER, 1407 - 1412 / Uyttebr. 163 barbier d'Antoine
Jean Merven	MEDECIN du duc de Bretagne, 1411-12 / Laborde 117 / Wick.
Jean de Neda	= Jean van Eele de Breda
Jean de Palmes	MEDECIN du Duc, Dijon, 1413-20 / Wick. / Jacq.

Jean Parent	BARBIER du Duc, 1449/ Brand 1444 frère de Jacquotin Parent
Jean de Polligny	CHIRURGIEN et VALET DE CHAMBRE du Duc, 1411-18 / Laborde 114, 118 / Wick. / Jacq.
Jean de Ponchartrel	CHIRURGIEN et VALET DE CHAMBRE du Duc, 1418 / Wick. nommé concierge de l'hôtel de Lille
Jean de Ponchatel	EPICIER et APOTHICAIRE, 1468 / Wick. nommé concierge de l'hôtel de Lille
Jean Prat	CHIRURGIEN, 1430 / Wick. "venu vers le Duc pour le guarir de la goutte"
Jean Raymon	EPICIER du Duc, 1430 Parav. III 141
Jean de Roux (de Rubeis)	FAUX MEDECIN et CHIRURGIEN, ASTROLOGUE (pronostics), 1419-20 / Wick. / Jacq. / Thorndike IV, 94-6 au service des Ducs à partir de 1419
Jean de Sandalcourt	MEDECIN du Duc, 1438 / Wick. envoyé en ambassade au concile de Ferrare
Jean Sans Pitié	CHIRURGIEN, "du royaume d'Arménie", 1461, Bruges / Laborde 1864 / Wick. / Kervyn IV 211 mandé de Bruges à Bruxelles: 1461-2

Jean Spierinck	MEDECIN et CONSEILLER du Duc, ASTROLOGUE, prof. Louvain, 1461/ Laborde 1862, 1873 / Wick. / Jacq./ Keil 180 / Keil und Reinecke 380 / Faidh. 150 / Simon de Phares 263 / Broeckx 24
Jean Spirinc	= Jean Spierinck
Jean Sucquet	MEDECIN, prof. Louvain et Recteur, 1461, Malines / Laborde 1860 / Wick. / Broeckx 23 / Mechelen 139-140 et 169-170 1458-62: visite à Bruxelles, soins au Duc
Jean Surquet	= Jean Sucquet
Jean van den Eele	= Jean van Eele
Jean van den Nele	= Jean van Eele
Jean van Eede	MEDECIN, Bruxelles, 1414 / Dickstein 228 appelé en consultation à la cour, 1432
Jean van Eele de Breda	MEDECIN du Duc, professeur et recteur à Louvain, 1419, 1423-4, 1429-31, Bruxelles / Uyttebr. 184 / Laborde 559, 4915 / Wick. bis / Broeckx 8 / Jacq. de Bruxelles à Arras pour soigner le Duc, 1419 mandé à Zevenberghe, Duc malade: 1427 a sa chambre au Coudenberg

Jean de Vaulx	CHIRURGIEN, 1456-7, Mons / Laborde 1582 / Wick. au service du comte de Charolais
Jean Voignon	MEDECIN du Duc, 1404-1418 / Wick. / Jacq. médecin de Philippe le Hardi et de Jean sans Peur
Jean de Wesalia	MEDECIN, ASTROLOGUE, prof. Louvain / Wick./ Jacq. / Mechelen 138 / Broeckx 9 1432: almanachs pour Philippe le Bon
Jean Zeberti de Ele	= Jean van Eele de Breda
Joffroy Maupoinre	MEDECIN du Duc, 1412 - / Laborde 136, 262, 4330 / Wick.
Johannes Cesar	ASTRONOME, Convalence, 1443 / Laborde 78 auteur d'un astrolabe
Josse (Maître)	MEDECIN, anno 1431 / Laborde 904 = Josse Bruninc ?
Josse Bruninc	CHIRURGIEN et VALET DE CHAMBRE du Duc, Brabant, 1449 / Laborde 1423, 1512, 1797 / Wick. / Faidh. 152 s'occupait surtout des personnages de la Cour, chirurgien de Charles le Téméraire
Josse Brunyt	= Josse Bruninc
Josse Nicolay	CHIRURGIEN, 1440, Amiens / Laborde 1342 / Wick.

	mandé à Bruxelles pour jambe malade: 1440 ou 1441
Laurent Bruninc	CHIRURGIEN du Duc, Bruxelles/ Brand / Wick. / Laborde II, p.XIII chirurgien de Charles le Téméraire ?
Lionnet van den Steene	MEDECIN ? du Duc, 1408-09, 1411-12 / Uyttebr. 184
Louis de Lapide	MEDECIN, 1407, Louvain / Wick. médecin du duc de Brabant ou de Bourgogne
Louis van der Steene	= Louis de Lapide
Luc Alixandre	MEDECIN, 1461 ou 1462, MEDECIN du Duc de Milan / Laborde 1859 / Wick. lors de sa visite à Bruxelles mandé auprès du Duc "en sa maladie qui lui est advenue audit lieu de Bruxelles"
Michel Zuerinc	BARBIER du Duc / Brand 1449, 1458 = Michel Zuertrich (Brand 1438, 1445, 1449) ?
Nicolas de le Horbe	MEDECIN du Duc, 1429-1435 / Wick. / Faidh. 149
Nicolas le Jolyetet	MEDECIN, Dijon, 1418 / Wick. 1418: 50 francs pour soins donnés au Duc, aux Duchesses et aux enfants
Nicolas Lamberti de Valkenisse	MEDECIN, 1461, prof. Louvain / Laborde 1865/ Wick./ Jacq. mandé 1461-2

Nicolas de Morrey	APOTHICAIRE, EPICIER, BARBIER et VALET DE CHAMBRE du Duc, 1449/ Brand 1449
Nicolas de Tuchovia	ASTRONOME du Duc, 1466-68 / Wick. / Laborde 1910 / Jacq.
Nicole de Vallerenesse	= Nicolas Lamberti de Valkenisse
Olivier Chantemerle	ASTROLOGUE, 1438 / Simon de Phares 254
Philippe Bauduyn	MEDECIN, Valenciennes, 1467 / Wick. au service de Charles le Téméraire
Philippe Bouton	CHAMBELLAN du Duc / Wick. / Jacq. auteur d'un *Régime pour longuement vivre*
Philippe de Champsi	MEDECIN ? du Duc, 1427-8 / Uyttebr. 184
Philippe Guyart	MEDECIN, Beauvais, 1411-12 / Laborde 121
Pierre de Harlenc	CHIRURGIEN du Duc / Wick.
Pierre de Herlain	= Pierre de Herlem
Pierre de Herlem (Herlensis)	MEDECIN, 1461, Bourg-en-Bresse / Laborde 1867/ Wick. / Kervyn IV 211 fit transcrire un traité d'astrologie mandé à Bruxelles 1461-62

Pierre le Loup	CHIRURGIEN, 1466-70 / Laborde 1918/ Wick./ Faidh. 155
Pierre le Mire	MEDECIN ? du Duc, 1407-08 / Uyttebr. 184
Pierre Michiel	APOTHICAIRE et VALET DE CHAMBRE du Duc / Brand 1449 fils de Jacquot Michiel
Pierre Miotte	MEDECIN du Duc, 1411, 1418 / Wick. / Jacq. mandé à Arras auprès de Philippe le Bon, en 1411 mandé de Dijon à Châtillon, pour soins à Duchesse et ses filles, 1418
Pierre Vacquembac	BARBIER du Duc ? 1462 / Olivier de la Marche II 421-2
Pierre de Wede	MEDECIN et CONSEILLER du Duc, 1463 / Brand 1458 / Laborde II, p. XIII/ Wick.
Pons de Lureux	= Fonse de Lureux
Raymond de Monnesson	MEDECIN du Duc, 1412-27 / Laborde 138, 756, 818, 4917 / Wick.
Raymond de Montfor	= Raymond de Monnesson
Regnault Chaillet	CHIRURGIEN, BARBIER et VALET DE CHAMBRE du Duc / Wick. en 1443, lettre de Philippe le Bon aux magistrats de Dijon où R.C. veut s'établir

Richard (Maître)	BARBIER du Duc, 1427 / Parav. II 226 = Richard le Comte ?
Richard le Comte	Premier BARBIER, VALET DE CHAMBRE et GARDE DES LIVRES du Duc, 1401-1426 / Brand 1426-7, 1438, 1445 / Parav. IV 307 / Wick. / Laborde 771
Robert de Rosa	= Robert du Homme
Robert du Homme	MEDECIN et CONSEILLER du Duc, Bruges / Wick. / Faidh. 154-5 / De Meyer 113
Roland l'Ecrivain	MEDECIN et CONSEILLER du Duc, ASTROLOGUE , 1438-1469, Bruges / Brand 1445, 1458 / Laborde 1207, 1254, 1901 et II, p. XIII / Wick./ Jacq. / Faidh. 150 / Simon de Phares 252, 253-4 / Parav. / Thorndike IV, 139-140
Roland Scriptoris	= Roland l'Ecrivain
Salomon de Baume	MEDECIN, env. 1417, Dijon / Wick. "employé" par le duc et la duchesse de Bourgogne
Sansonnet de Bercy	PHARMACIEN, EPICIER, Dijon, 1396 / Picard 351 fournitures pour "régime selon médecine" pour le Duc nourrisson
Simon de Doms	= Simon de l'Ecluse

Simon de l'Ecluse	MEDECIN et CONSEILLER du Duc, Rotterdam, 1461-62 / Laborde 1853 / Wick. / Faidh. 154
Simon de Roches	MEDECIN et CONSEILLER du Duc, 1449-68 /Brand 1445, 1458 / Laborde II, p. XIII, 1422 / Wick.
Simon de Sluse	= Simon de l'Ecluse
Simon van der Sluys	= Simon de l'Ecluse
Thierry de Aire	MEDECIN de Jean sans Peur, 1404-1419 / Wick.
Thierry de Hollande	CHIRURGIEN de la cour de Bourgogne, 1477 ? / Wick. = Thierry Sapiens de Olandia, 1415-16 ? / Wick.
Viennot Gettet	MEDECIN du Duc, 1419-1467 / Wick.
Yves Philippe	CHIRURGIEN, 1436, Noyon / Laborde 1187 /Wick. mandé à Hesdin pour le genou malade du Duc

Abbreviations

Bartier = John BARTIER, *Légistes et gens de finance au XVe siècle*. Bruxelles, 1955.

Brand = recherches aimablement faites à ma demande par Hanno

BRAND, dans la documentation du Deutsches Historisches Institut, à Paris.

Broeckx = C. BROECKX, *Prodrome de l'histoire de la Faculté de médecine de l'ancienne Université de Louvain depuis son origine jusqu'à sa suppression*. Anvers, 1865.

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Dickstein = Cl. DICKSTEIN-BERNARD, Le médecin et le chirurgien aux gages de la ville de Bruxelles au XVe siècle. In: *Les Pays-Bas bourguignons. Histoire et Institutions.* Mélanges André Uyttebrouck, publiés par J.-M. Duvosquel, J. Nazet et A. Vanrie. (Archives et bibliothèques de Belgique. N° spécial 53) Bruxelles,. 1996, 227-236.

Dulieu = Louis DULIEU, *La médecine à Montpellier*. I. Le moyen-âge. Avignon, 1975.

Faidh. = Alexandre-Joseph FAIDHERBE, *Les médecins et les chirurgiens de Flandre avant 1789*. (Fac. de médecine Paris. Thèse pour le doctorat en médecine) Lille, 1892.

Jacq. = Danielle JACQUART, *Supplément à Ernest Wickersheimer, Dictionnaire biographique des médecins de France au moyen âge*. Genève, 1979.

Keil = Gundolf KEIL, Randnotizen zu Danielle Jacquarts Wickersheimer-Supplement. In: *Sudhoffs Archiv* 66 (1982) 172-186.

Keil + Reinecke = Gundolf KEIL und Hans REINECKE, Der kranewitber-Traktat des Doktor Hubertus. In: *Sudhoffs Archiv* 57 (1973) 361-415.

Kervyn = *Oeuvres de Georges Chastellain*, éd. KERVYN DE LETTENHOVE. Bruxelles, 1863-66. 8 vol.

Laborde = L. de LABORDE, *Les ducs de Bourgogne. Etudes sur les lettres, les arts et l'industrie pendant le XVe siècle.* Paris, 1849-53. 3 vol.

Mechelen = G. van DOORSLAER, Aperçu historique sur La Médecine & les Médecins à Malines avant le XIXe siècle. In: *Bulletin du Cercle Archéologique, Littéraire et Artistique de Malines* 10 (1900) 121-311.

Parav. = Werner PARAVICINI, Die Hofordnungen Herzog Philipps des Guten von Burgund. In: *Francia* 10 (1982) 131-166 (= I); 11 (1983) 257-301 (= II); 13 (1985) 191-211 (= III); 15 (1987) 183-231 (= IV).

Picard = Etienne PICARD, Le lieu et la date de naissance de Philippe-le-Bon. In: *La Revue de Bourgogne* 1926, 341-354.

Simon de Phares = Ernest WICKERSHEIMER (éd.), *Recueil des plus célèbres astrologues et quelques hommes doctes faict par Simon de Phares du temps de Charles VIIIe.* Paris, 1929.

Thorndike = Lynn THORNDIKE, *A History of Magic and Experimental Science.* New York, 1924-1934.

Uyttebr. = André UYTTEBROUCK, *Le gouvernement du duché de Brabant au bas moyen âge* (1355-1430). Vol.I. Bruxelles, 1975.

Vandenpeereboom = Alph. VANDENPEEREBOOM, Droits et gages des dignitaires et employés à la Cour de Philippe-le-Bon. In: *Annales Soc. d'Emulation* 37 (1876-77) 1-24.

Van der Straeten = Edmond van der STRAETEN, Médecins et chirurgiens attachés à l'hôpital Notre-Dame, à Audenarde. In: *Ann. Ac. Archéol. de Belg.* 13 (1856) 351-356.

Wick. = Ernest WICKERSHEIMER, *Dictionnaire biographique des médecins en France au Moyen Age*. Paris, 1936.

LAUDATIO CHRIS BISSELL

A. Van Cauwenberghe

Christopher Charles BISSELL, born 12 May 1952, obtained his first university degree, a BA (Bachelor of Arts) in Natural Sciences and Medieval Languages and Literature, at Cambridge University in 1974. The combination of these two major subjects looks already very peculiar and will set the tune for his further career.

In 1993 he obtained a PhD degree at the Open University for his work on "Inventing the language: stability theory and the emergence of the discipline of control engineering".

Meanwhile he got qualifications from the Institute of Linguists in French, Italian and German. He has also a good knowledge of Dutch and published already in our mother tongue.

Since 1984 he was a lecturer and later (in 1994) a senior lecturer in Electronics at the Open University, where he developed courses in signal processing, control engineering, telecommunications and mathematics. Since 1996 he is Head of the Department of Telematics at the same university.

From his multitude of external activities, suffice it to mention:

- Chartered Engineer (Ceng) and Member of the Institute of Measurement and Control
- Member of SEFI (Société Européenne pour la Formation des Ingénieurs) curriculum development working group
- Higher Education Funding Council Quality Assessor for German and for Electrical Engineering (1995-96)
- Visiting Lecturer, Cranfield University (MSc Signal Processing) (1996)

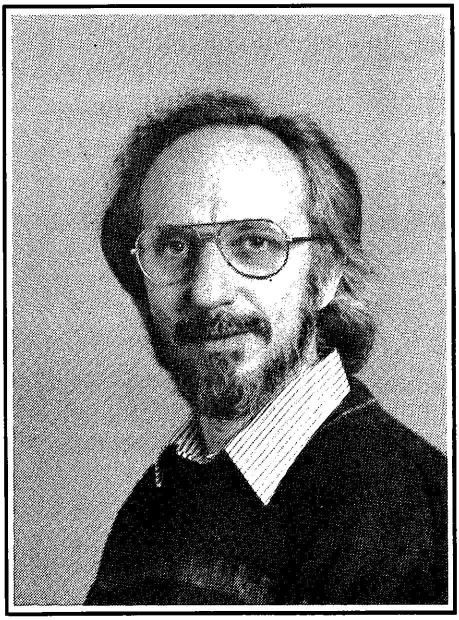
Prof. Bissell is not only a well-known specialist in automatic control and signal processing (authoring 3 textbooks), a linguist, an educator but also very active in the history of technology, mainly in the areas of control engineering and control education. He is the author of many publications (24 alltogether) in this field.

Prof. Bissell has keen interests in both worlds of culture:
- the natural sciences and engineering, as well as
- arts and humanities

and found an elegant way to bridge the gap between both by studying his history of technology. His thesis is that such history cannot be told as a simple, linear, narrative based on any one particular viewpoint. On the contrary, there are many interwoven stories, which are contingent in time and/or space.

From all this we may rightly conclude that Prof. Bissell is a brilliant engineer, a man of science and technology with wide cultural interests. As a young professor, working in a country which was the birthplace of the industrial revolution, he got interested and became proficient in the history of automatic control, a discipline that largely contributed to the shaping of our modern industrialized society.

The Sarton Committee is happy that he accepted to deliver a Sarton Memorial Lecture in Ghent, one of the very first towns on the continent, where the industrial revolution took roots.



BEYOND THE MASTER NARRATIVE: TALES OF THE CREATION OF AUTOMATIC CONTROL

Christopher C. Bissell

1. Introduction

Automatic control is one of the key technologies of modern industrialised society. Like most contemporary technologies, it has a complex history, and this history can be recounted in many different ways. In this lecture I aim to examine the development of control engineering over the crucial period 1930 to 1950, taking into account some recent trends in the history of technology.

The fully-fledged, independent discipline of control engineering emerged only in the period since the Second World War, yet its roots go back to antiquity: rudimentary water level control systems, for example, are well attested in the classical world. More sophisticated feedback devices appeared with the maturing of industrial technology in post-medieval Europe. The celebrated furnace temperature control system of Cornelis Drebble dates back to the early 17th century, for example; while windmill control devices, the centrifugal governor, and the early hydraulic servomechanisms associated with steam power on ships and elsewhere appeared in the eighteenth and nineteenth centuries. By the first few decades of the twentieth century increasingly sophisticated instrumentation and control systems were deployed for process control and mechanised assembly, prime mover and electrical regulation, and flight and ship control. On the eve of the Second World War, it seems (with hindsight at least), the new discipline of automatic control was waiting in the wings, lacking only the impetus of the 'fire control' problem (gun servomechanisms) to bring it on to centre stage. Wartime military research brought together engineers from various disciplines to work on this 'fire control' problem, applying fundamental ideas from telecommunications and electrical engineering to the servomechanisms used for gun aiming. The result was the techniques of classical frequency response feedback loop design that are still widely used today, associated with the theoretical results of Bode, Nyquist, Nichols, Evans, and so on.

Such, in essence, is the 'technical' story often told of the history of automatic control. A version of it commonly appears in introductory textbooks. Table 1 derives from Dorf (1989), while Table 2 is taken from the endpapers of Franklin et al (1991). While they differ in their emphasis (Dorf stresses inventions and processes, while Franklin et al give pride of place to control theory), the picture is of discovery and invention, of great theoretical strides, and of continuous progress towards our current state of knowledge. In this lecture I shall explore in some detail the assumptions and shortcomings of this picture of the history of control engineering, with particular reference to the midtwentieth century. But before I do so, a few words on recent trends in the history of technology in general are in order.

1769	•	Watt steam engine and governor
1800	•	Whitney's interchangeable parts for musket manufacture
1868	•	Maxwell's stability analysis of a centrifugal governor
1913	•	Henry Ford's mechanised assembly for automobiles
1927	•	Black's feedback amplifier
1932	•	Nyquist stability analysis of feedback amplifier
1952	•	Numerical control of machine tools at MIT
1954	•	"Programmed article transfer" developed by Devol
1960	•	Unimate industrial robot

Table 1

1868	•	Maxwell, Flyball stability analysis
1877	•	Routh, Stability criterion
1890	•	Lyapunov, Nonlinear stability
1910	•	Sperry, Gyroscope and autopilot

1927	•	Black, Feedback electronic amplifier
	•	Bush, Differential analyzer
1932	•	Nyquist, Nyquist stability criterion
1938	•	Bode, Frequency response methods
1942	•	Wiener, Optimal filter design
1947	•	Hurewicz, Sampled data systems
	•	Nichols, Nichols chart
1948	•	Evans, Root locus
1950	•	Kochenburger, Nonlinear analysis
1956	•	Pontryagin, Maximum principle
1957	•	Bellman, Dynamic programming
1960	•	Draper, Inertial navigation
	•	Kalman, Optimal estimation
1969	•	Hoff, Microprocessor

Table 2

2. Approaches to the history of technology

Stuart Bennett began his 1995 Sarton Memorial Lecture by commenting on some recent developments in the historiography of technology, and it is worth considering current approaches in a little more detail. (The following discussion is taken from Bissell & Bennett, 1997.)

Traditionally, the great ideological divide in the history of science and, to a lesser extent, the history of technology has been that between the internalist and externalist approaches. As the names imply, the internalist historian concentrates on the internal history of the development of artefacts or ideas within a discipline (or sub-discipline), while the externalist is more concerned with the relationship of the discipline to the external world of politics, religious belief, social structure, and so on. In recent years the internalist/externalist controversy has become rather muted. Many, if not most, historians of technology now acknowledge the need for a 'contextualist' approach - that is, a historiography which is concerned with all the 'various political and cultural constituencies in the historical process and with the tensions and conflicts between them'

(Smith & Marx, 1994, p.259). Still vigorous, however, is the (sometimes acrimonious) debate between those of a more or less 'hard' determinist persuasion, who believe that it is predominantly science and technology which drive social change and thus historical development, and those who consider it more productive to view science and technology themselves as social constructs, and to study them as such in both their contemporary and historical manifestations. The former view is often characterised by the terms "technological determinism" or "autonomous technology", while the latter has become known as "social constructivism". For an introduction to social constructivist ideas see, for example, Bijker (1987, 1995) and Collins (1985), while a thorough examination of the various shades of technological determinism in the historiography of technology can be found in Smith & Marx (1994).

A further important trend of the last fifteen years or so has been the 'system builders' approach to the history of technology, a seminal work being *Networks of Power,* by Thomas Hughes (1983). Such historians view attempts to create large-scale, sociotechnical systems as major determinants of technological change. For example, in *Networks of Power*, Hughes argues that much of the technical change in the early years of this century was a consequence of the building of the electricity supply network, and that the form the new technology took was determined as much by decisions of the financiers and entrepreneurs who wanted to control the networks as by technical issues. He argues that the drive to create such large-scale, socio-technical systems leads to what he terms 'reverse salients' or 'impasses' - that is, areas in which crucial system development is hindered by a lack of technical knowledge or understanding. The term 'reverse salient' comes from military usage, denoting the situation which develops when the advance of an army is held up at one part of the front as the rest of the army moves forward. For Hughes and historians of a similar persuasion, the drive to develop and extend a given large-scale technical system results in massive investment of resources in order to eliminate or by-pass such a reverse salient.

So where does all this leave the poor student of the history of technology? History, like many other academic disciplines, has been greatly influenced by developments in postmodernist thinking. Just as students of literature have had to engage with the problem of the 'loss of the canon' - that is, attacks on the notion of a single, 'great tradition' (to use F.R. Leavis's phrase) - so historians have had to come to terms with the shortcomings of writing history as a single story, as a 'master narrative'. Most historians of technology are now agreed that history can rarely, if ever, be told as a simple, linear, narrative, based on any single point of view. Rather, there are many, complex, interwoven stories. Indeed, some historians would even reject the use of the word 'history' in the singular. Histories of technology, then, like our current world are messy; they are local, sited and contingent in either or both time and space. The historian's task, as Philip Scranton (1994) has argued, is to unravel the conjunctural complexities. In this spirit, then, let us try to do this for a few (hi)stories of how automatic control emerged as a separate engineering discipline. In particular, we shall consider

- technical stories
- institutional stories
- a cultural-linguistic story
- cultural-political stories

3. Technical stories

As already implied in Tables 1 and 2, the leitmotiv of technical stories is that of continuous progress - and, indeed, there has been an astounding technical achievement over the past decades. Within fifty years, the fairly rudimentary control systems of the early part of the century evolved into large-scale process plant management systems; high performance computer disc drive or robot arm controllers; automobile automatic braking systems; and so on. Accepting, for the moment, the ethos of Tables 1 and 2, we might be tempted to expand it (for the period 1925-1950) as Table 3.

So what are the major characteristics of the technical story of Table 3? To begin with, closer inspection reveals that it is not one, but a number of interlinked, technical stories: the single chronology is quite tendentious. Consider, for example, the italicised entries. These feature rarely, if at all, in either the secondary English-language literature of the history of the discipline or in the potted histories contained in English-language undergraduate textbooks. Russian and German stories, on the other hand, take a significantly different view - often emphasising, as might be expected, the native contributions of those cultures to the technical development of control engineering. Second, Tables 1 - 3 stress theory, a linear chronological development, technical successes (failures do not feature at all); they concentrate on the achievements of great men (no women); and they give an impression of uninterrupted technological progress. These are common characteristics of technical stories of the development of a particular discipline; and if one particular story ultimately wins out (as might be claimed, perhaps, for the American version in the case of classical control engineering), the competing stories are soon neglected, marginalised, or completely forgotten. Bearing this in mind, the historian of automatic control interested in exploring the process of technological change might usefully look at some alternative stories, and we shall proceed to do this now.

1927	• Black's feedback amplifier
1928	• *Küpfmüller's work on control system stability*
1932	• Nyquist's analysis of feedback amplifier stability
1934	• Hazen's work on servos for differential analysers
1936	• *Mikhailov's application of Nyquist's results to control systems*
1937	• Taplin's use of the 'closed-loop' transfer function
	• *Oppelt's generic description of control systems*
1940	• *Leonhard's application of Nyquist's results to electrical regulation*
The war years	• Frequency response approach to control system design (USA/UK)
	• A generic systems approach (USA/UK/Germany)
	• Development of approaches to stochastic modelling (USA/USSR)
	• Tools for the analysis of sampled-data systems (USA/UK/USSR)
	• *Andronov's approach to non-linear control system analysis*

1948	•	Evans's root locus approach
late 1940s/ early 1950s	•	Work on sampled-data systems by Hurewicz, Jury, Ragazzini (USA), *Tsypkin (USSR), Tustin (UK)*
	•	Describing function approach of *Dutilh (France), Goldfarb (USSR),* Kochenburger (USA), *Tustin (UK)*

Table 3

4. Institutional stories

The professional institutions have played a major role in the development of engineering in the twentieth century. From the mid-1930s onwards, engineering institutions in various countries started to take a professional interest in automatic control. Table 4 lists some of the important events. It is interesting to compare this with Table 3. At first sight, there is considerable agreement in the chronology: the first specialist groupings in the mid- to late-1930s in the USA, Germany and the USSR, for example, coincide in time with the published work of Black, Bode, Mikhailov, Nyquist, and Oppelt. Yet the theoretical work was largely unknown, or not considered particularly relevant, to most practising engineers and the participants in these early institutional groups. The exigencies of industrial control problems, rather than the theoretical work taking place in the highly specialised fields of telecommunications, servomechanisms for differential analyzers, or autopilot design, provided the initial driving force for the institutions, particularly in the ASME and VDI groups - and even during the war years. And whereas Tables 1 - 3 might suggest a direct line from research to practice, with a radical change in thinking as the new discoveries, techniques and theories emerged, then the institutional stories demonstrate a greater continuity with the past. These (rather conservative) bodies tended to preserve their traditions, defending their positions, adapting slowly, absorbing and codifying developments. It is worth singling out four themes from the institutional history.

1. Work on terminology and standardization. This started before the war in both the USA and Germany and continued, rather surprisingly,

throughout the hostilities. The British Servo-Panel, a loose wartime organisation founded in 1942 to promulgate developments in servomechanisms, also took terminology very seriously.

2. Institutional structures. The uncertain status of the new discipline in immediate postwar years is well illustrated by the rapidly changing committee structure of the American Institute of Electrical Engineers, of which 29 committees or subcommittees concerned themselves at some point or other with automatic control during the period 1945-1957 (the field became the province of a single committee only in 1960; for details see Bennett, 1976). The contrast to the linear technical stories is striking; the impression gained is of considerable confusion; of attempts to absorb the new area into existing structures (often involving suspicion between groups, and associated political infighting); and of a lack of understanding of the generic nature of automatic control. Other institutions dealt with the problem in different ways, but supporting the new discipline proved problematic in a number of countries (less so in continental Europe, with their unitary bodies, than in, say, North America and the UK).

3. Technical conferences. These had a great influence in bringing together international players in control engineering, and drawing together the disparate developments of the wartime years. Landmark events include the Cranfield Conference of 1951 (the first international conference on automatic control); the New York Conference of 1953; the Heidelberg conference of 1957; and the Moscow Conference (the first IFAC meeting) of 1960.

4. Links between the professional bodies and governments. Such links had been established in the Allied countries during the war, and continued after hostilities ceased. The Cranfield Conference, for example, was organised by the British government, in collaboration with the IEE and IMechE.

1934 • Special Soviet Commission on Remote Control & Automation

1936 • ASME Industrial Instruments & Regulators Committee

1939	•	VDI Control Committee formed
	•	Soviet Institute of Automation & Remote Control Formed
1940	•	First Soviet All-Union Conference on Automatic Control
	•	US National Defense Research Committee formed
1942	•	British Servo-Panel established
1944	•	British and German glossaries published
1946-7	•	First IEE conferences on control topics
1949	•	First part of British Standard 1523 issued
	•	AIEE Servomechanisms Committee
1950	•	Control Section of Society of Instrument Technologists established
1951	•	IRE Technical Committee on servo-systems formed
	•	Cranfield International Conference
1952	•	ASME Dynamic Systems Committee formed
	•	AIEE/ASME/ASA terminology published
	•	DIN standard
1953	•	New York Conference
1954	•	Soviet Glossary published
	•	Joint VDE/VDI conference on applications in economics
1956	•	Heidelberg Conference
	•	IFAC established

Table 4

The institutional stories add a new dimension to the technical stories told earlier. Note that they imply a greater range of coexisting narratives than the former. This is hardly surprising. Professional institutions are embedded in different national cultures; their histories reflect this cultural diversity as well as the social dimension of technology, while purely technical stories tend to hide both.

5. A cultural-linguistic story

The terminological activities of the various professional institutions have already been mentioned, and it is productive to view these activities as part of a more general phenomenon - what might be called a cultural-linguistic story. This is the tale of the emergence and acceptance of a radical new language for system modelling and design; it is the story of using a new language, learning to asking new questions, and doing new things. As Thomas Kuhn has put it (Kuhn, 1970):

> Examining the record of past research from the vantage of contemporary historiography, the historian of science may be tempted to exclaim that when paradigms change, the world itself changes with them. Led by a new paradigm, scientists adopt new instruments and look in new places. Even more important, during revolutions scientists see new and different things when looking with familiar instruments in places they have looked before.

So, for example, as a result of the wartime 'control engineering revolution', engineers began to see generically related systems where formerly they had seen quite separate mechanical, electrical or chemical processes. They began to see signal and information flows where formerly there had been only mechanical linkages or the flow of energy and materials. Such radical changes in thinking were neither sudden nor easy. The author recently had the opportunity to discuss this with a number of engineers who were closely involved with control engineering in the 1940s and 1950s. Their recollections are illuminating:

> Systems theory emerged very slowly and really in a quite anonymous way - no single person was responsible. We also devoted a lot of time and effort to this aspect in the specialist VDI committee. But the development of systems thinking came about very slowly, as a part of group discussion... It was a long time before the general applicability of control concepts was understood... The shift from a "communications way of thinking" to a much more general "control way of thinking" was the fundamental step...

(Winfried Oppelt, interview, 1991)

> I think my personal realisation [of systems ideas] came as I worked with control systems which consisted of a number of operations in sequence - the fire control problem was classic, of course, with target detection, tracking, prediction, and gun laying. As we worked on such systems, combining the responses of the various elements to get the total response, it became natural to think in general system terms, applying identical methods even though one element might be electrical, another mechanical, hydraulic or even human.
>
> (Arnold Tustin, interview, 1991)

> When I got into control engineering, there were many different approaches to solving a control problem: rules for turbine control, other rules for temperature control, and so on, which had little to do with each other. You can't really talk of any 'systems thinking' at that time. Our achievement was to recognise the commonality, to bring everything together, to use the same language and the same symbols. In this way 'systems thinking' came about automatically. That would have been just before the war.
>
> (Hans Sartorius, interview, 1994)

In many ways, the creation of the new discipline of automatic control was the creation and acceptance of this new language. It is striking that discussions of papers presented at technical meetings immediately after the war included reference after reference to 'the need for translation' in order for engineers from different disciplines to be able to understand one another. Many quite eminent engineers were unhappy with the emerging new language, which they saw as unfamiliar and unnecessary (for full bibliographic details of the following citations see Bissell, 1994 & 1996):

> The experts in the servomechanism and control fields are unfortunately not exceptions to the rule that the experts in an art always ball up the terminology and notation until they can be followed only by a like expert ... At least the [process engineer] can directly express a ratio of effect to

cause ... without becoming involved in the width of a hypothetical frequency transmission band and in such acoustical abstraction as dB per octave.

(Ed Smith, 1946)

[The various fields of automatic control] have developed separately, and those concerned have developed their own terminology and philosophy. The approach is different in each case, and it is going to be extremely difficult, I think, to effect a reconciliation [...] the approach which seems to be quite suitable for servo mechanisms and industrial regulators causes us considerable difficulty, so far as out process control work is concerned; and in order to understand the paper fully we have to translate it into entirely different language.

(G.H. Farrington, 1947)

The fact that at least four largely independent developments of the theory of automatic control have been made [prime mover governors; pneumatic process controllers; electronic feedback amplifiers; and wartime fire-control servomechanisms] has naturally resulted in a great confusion of nomenclature. It requires a feat of translation for the chemical engineer to profit from the stockpiles of clarification and invention which the mechanical engineer, the communication engineer, and the electrical power engineer has built up, and the same applies in the reverse direction.

(A. Tustin, 1950)

These remarks are contemporaneous with the publication of the first textbooks on control engineering, textbooks which form a vital part of the cultural-linguistic story. Again, Kuhn (1970) has made a perceptive observation:

Textbooks have to be rewritten in whole or in part in the aftermath of each scientific revolution, and, once rewritten, they inevitably disguise not only the role but the very existence of the revolutions that produced them.

The early textbooks on servomechanisms and automatic control did not simply describe the work that had been carried out during the war, they created it anew. The American books of the late 1940s in particular were responsible for creating or disseminating many aspects of an approach we still use today: the Nichols chart; frequency-response design methods; conversion between step-response and frequency response as a measure of control loop quality; and so on. The new approach was quickly promulgated in the engineering profession, with the rapid translation of many seminal works into major world languages (Table 5 indicates some of the earliest of these). Given the remarks just quoted, we might even speak of 'translation' both within a single language, and from one language to another.

The way that control engineering theory and techniques became public rather suddenly after the secrecy of the war years had made contemporary engineers - for a brief period at least - highly aware of the linguistic dimension to their work. It is interesting to note, however, that once agreement had been reached on language and conventions, the conceptual difficulties and arguments demonstrated in the preceeding quotations appeared to fade away. The specific, cultural-linguistic story just identified thus brings to light an all too often neglected dimension of the historical development of automatic control.

1944	• Oldenbourg & Sartorius *Dynamik selbsttätiger Regelungen*
	• Lossievskii *Avtomaticheskie Regulyatory*
	• Smith *Automatic Control Engineering*
1945	• MacColl *Fundamental theory of servo-mechanisms*
	• Bode *Network Analysis and Feedback Amplifier Design*
1946	• Eckman *Principles of Industrial Control*
1947	• James et al *Theory of servomechanisms*
	• Lauer, Lesnick & Matson *Servomechanism Fundamentals*
	• Oppelt *Grundgesetzte der Regelung*
	• Russian translation of *MacColl*
1948	• Brown & Campbell *Principles of Servomechanisms*

- English translation of *Oldenbourg & Sartorius*;
- Russian translations of *Bode; Lauer et al; Oldenbourg & Sartorius*

1951 • Russian translation of *James et al*

Table 5 (For references and more details see Bissell, 1996)

6. Cultural-political stories

All the stories I have considered so far have been located primarily within the control engineering community. But there are other stories of the emergence of the discipline which can be told only in a much broader cultural and political context. As illustrations, let me briefly examine two such stories, set in the immediate post war period in the USA and USSR respectively (see Bissell, 1996, for further details).

6.1 An American tale

By the closing days of the Second World War, US government scientific advisors were in no doubt about the importance of science and technology in the post-war world. In his report to President Roosevelt, *Science: The Endless Frontier*, Vannevar Bush recommended that the US Government should accept new responsibilities for promoting the flow of scientific knowledge: "These responsibilities are the proper concern of the Government, for they vitally affect our health, our jobs, and our national security. It is in keeping also with basic United States policy that the Government should foster the opening of new frontiers and this is the modern way to do it." A vigorous debate ensued over precisely how science and technology should be officially promoted, but that there should be such government intervention was disputed less and less. And this trend is clear in the way that automatic control was codified and presented to the wider engineering community through the writings of American control engineers.

For example, in the preface to his *Fundamental Theory of Servomechanisms*, LeRoy MacColl explained how Warren Weaver, Chief of the Applied Mathematics Panel of the National Defense Research Committee, had asked him to write a general expository paper on the theory of servomechanisms and that it was ultimately decided that "the purpose of the work, *as a contribution to the war effort* [my italics], would be better served if it were to appear in book form". So even before the war ended, there was a concerted, directed effort in the United States to set down the technological achievements of the war years - for military and political reasons, as well as scientific ones. Deriving initially from the war effort itself, such publications soon became part of an open *post-war* push towards technological supremacy, in which the United States was to pick up the European mantle as the intellectual driving force of science and technology. One aspect of this political dimension was the continuing high level of official support for the promulgation of the wartime technical achievements of the United States. Perhaps the most impressive outcome in this area was the MIT Radiation Laboratory Series of texts. These formed a 27-volume monument to (predominantly American) wartime technological achievement in electronics, radar, control engineering, and so on. They were also a clear political statement about the technological role the United States was to play in the post-war world. But before making further comment on this, let us move on to the Soviet tale.

6.2 A Soviet tale

A key figure in immediate post-war Soviet control engineering was A.A. Andronov, whose interest in control had developed from his earlier work on non-linear dynamics. In 1944 he established a 'seminar' at the Institute of Automation and Remote Control in Moscow, which was of crucial importance for the development of modern control theory in the USSR. Unusually, the particular story I wish to relate also involves the study of the history of science and technology as an academic discipline.

During the late 1940s, Andronov and some of his colleagues developed a keen interest in non-linear control problems in both their contemporary manifestations and in the context of early work by the nineteenth century St Petersburg engineer, I. A. Vyshnegradskii. In collaboration with I. N. Voznesenskii, Andronov produced a critical edition of early control engineering writings by J. C. Maxwell, Vyshnegradskii himself, and Aurel Stodola (the engineer responsible for drawing the attention of Adolf Hurwitz to the stability problem). Andronov & Voznesenskii's book became well known in the USSR, and most of the post-war generation of Russian control engineering textbooks included Vyshnegradskii's technique for assessing stability, sometimes extended to higher-order systems, alongside the classical control methods of the 1930s and 1940s. Indeed, Vyshnegradskii's work was often presented as the first step in a continuous progression leading ultimately to the Mikhailov and Nyquist criteria, and to the technique developed by Neimark and others in the late 1940s in the Soviet Union known as D-partition or D-decomposition.

In the immediate post war period in the Soviet Union, the history of science and technology had taken on a new ideological significance. During the war, the alliance against Germany had encouraged an outward-looking approach to the history of science. For example the 300th anniversaries of the death of Galileo and the birth of Newton in 1942 and 1943 respectively, and the 400th anniversary of Copernicus' *De Revolutionibus* in 1943, resulted in many publications which set Russian science firmly within the European scientific tradition. With the onset of the cold war, however, attitudes changed. Until 1947, Russian historians were particularly concerned with identifying and analysing Russian contributions to international science. After 1947, and in particular after a conference on 'national Russian science' in January 1949, historians were discouraged from indicating inconsistencies and digressions in pre-Soviet Russian science and were encouraged to emphasise the pristine purity of national sources, often with quite spurious claims for priority of invention and theory (Vucinich, 1984).

The genesis and publication of Andronov's historical writings on the history of control coincided almost precisely with this hardening political atmosphere. His own historical research, while it stressed the importance of early Russian work on the control of prime movers, did not suffer from the downright xenophobia of much contemporary Soviet writing on the history of science and technology - even if some of his conclusions are a little tendentious.

It seems highly likely that the historical interests of Andronov's circle were acceptable only because they were consistent with the political post-war imperative of re-defining Russian science and technology. The right sort of historical investigation could be pursued with confidence - and, in the case of automatic control, could be used explicitly to legitimate teaching and research in a technological discipline which turned out to have an excellent native pedigree.

Both the American and Russian tales illustrate well how the immediate post-war development of automatic control - even in such apparently apolitical areas as the writing of textbooks - was closely linked to ideology and national cultures. Even the *theory* of automatic control is not value free!

7. Conclusion

We have come a long way from the picture of control history presented at the beginning of this lecture, with its focus on dates, inventions and theory. Taking time to look at some other narratives has brought into clearer focus the social, political and even linguistic dimensions of the history of the discipline. Historians of technology can take comfort in this. Abandoning the master narrative is no barrier to researching or relating the histories of technology. Indeed, examining the multiplicity of interwoven stories sheds light on technological development in a way that no single, master narrative can.

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