

Ageing and the Galenic tradition: a brief overview

CHRIS GILLEARD*

ABSTRACT

Ageing and longevity have been central to the concerns of Western natural philosophy since their origins in Classical Greece. Greek medicine formulated the idea that the humours constituted the physiological basis of all living beings. Hippocrates identified these as blood, phlegm, black and yellow bile. Several hundred years later, Galen elaborated this Hippocratic doctrine, formulating the outlines of a theory of ageing and a regime to maintain health in old age. Formalised in Alexandria, the Galenic canon was later revised and expanded by physicians and philosophers from the Islamic world. The result was a theoretical superstructure linking together the humours, the elements (air, earth, fire and water) and the four qualities (heat, coldness, moisture and dryness) that constituted the basis of life, its development, decline and end. This ‘superstructure’ was further refined and revised during the Middle Ages, providing the theoretical basis for regimes for living well in later life that were written and published during the Renaissance. Although the ‘scientific revolution’ of the 17th century challenged Galenic medicine, many aspects of it survived into the modern period. This paper reviews the rise and demise of this tradition while also recognising that through much of this period other, more controversial approaches to the problems of ageing were espoused. In concluding, continuing points of contact with contemporary gerontological theory are emphasised.

KEY WORDS – ageing, Galenism, humours, radical moisture.

Introduction

In the present paper, I aim to outline the main components of the Galenic approach to ageing as these have developed from the classical period through to the late Renaissance. At the same time, I want briefly to note some of the ‘subaltern’ practices that offered alternatives to Galen’s ‘rational-hygienic’ approach to ageing. In doing so, I hope to show the continuing relevance of this tradition, not only in terms of contemporary discourses about ‘healthy ageing’ but also in terms of the relevance of its underlying

* Mental Health Sciences Unit, UCL, London, UK.

theoretical framework, when interpreted in the light of contemporary biogerontological discourse on ageing and longevity.

The classical model of human physiology that was articulated by Galen in the latter part of the second century of the Common Era has exercised a long-lasting influence over ways of thinking about ageing in the West. Linked historically to the earlier writings of Aristotle and Hippocrates and later elaborated by Avicenna and his Western scholastic followers, this tradition can arguably be placed as the rationalist core of thinking about ageing as a ‘natural’ phenomenon that has been at the heart of most subsequent models of ageing and longevity, including those of contemporary bio-gerontology. It represents, it can be argued, a model of ageing that accepts rational limits upon the human lifespan, distinguishes between ‘unnecessary’ and ‘necessary’ death, and seeks to develop rational ways of maintaining health and vitality in later life based principally on lifestyle and environmental factors rather than the arcana of anti-ageing ‘magical bullets’ or prolongevity ‘elixirs’.

Galen’s natural philosophy¹ was based heavily upon his own reading of Hippocrates together with the works of Aristotle and Plato. Galen was a prolific if at times long-winded writer whose ideas continued to evolve throughout his professional life. At his best when he was criticising others, much of his own thinking remained incomplete or only loosely sketched out. As a doctrine, Galenism was made coherent through a series of commentaries, synopses and textbooks first collated by Alexandrine writers and later by Arab philosopher-physicians (Temkin 1977). Most notable amongst these was Ibn Sīnā (Latinised as Avicenna), whose *Al-Qanun fil Tib* (*Canon of Medicine*) provided one of the most comprehensive accounts of Galenist natural philosophy (Avicenna 1930). Avicenna’s writings were translated from Arabic into Latin during the course of the 12th and 13th centuries and these newly Latinised translations came to dominate earlier Arabic synopses to become the main theoretical texts underpinning the scholastic medicine that appeared in the new French and Italian universities (Jordan 1991). What would later be called the ‘Galenic’ model of ageing provided the theoretical foundation for the numerous texts on ‘ageing well’ that were published in the Renaissance (Gilleard 2013) and continued to exercise an influence on ideas about age and ageing well into the 18th century and beyond (*e.g.* Cheyne 1742; Floyer 1724).

Throughout this period—from the Hellenistic era through to the late Renaissance—Galenism co-existed alongside other less orthodox models and ways of conceiving ageing. These alternatives form their own distinct but interlinked traditions, with roots that lay less in the rational Hippocratic model than in the ‘folk’ and ‘empiric’ traditions associated with medical practitioners working inside and outside the academy. In the secret arts of

alchemy and astrology there emerged more challenging approaches to ageing and particularly practices designed to achieve ‘super-natural’ pro-longevity through the use of various ‘arcana’ and ‘elixirs’. These alternative approaches to uncovering ‘nature’s secrets’ continued into and beyond the ‘scientific revolution’ even, it may be claimed, shaping aspects of that very revolution. Arguably, this other ‘occult’ tradition still permeates thinking about ageing, particularly in those contemporary medical approaches that emphasise the application of ‘anti-ageing’ pharmaceutical and nutraceutical materials.

Ageing and the early Galenic tradition

Galen’s physiology drew heavily upon Hippocrates, particularly the Hippocratic treatise, *De Natura Hominis* (*Nature of Man*, trans. Jones 1931). In this treatise, Hippocrates² argued that the four elements – air, earth, fire and water – traditionally viewed by the pre-Socratic philosophers as the core materials from which all matter is constituted – were relatively unimportant for medicine; instead he wrote the main components of concern in human physiology were the four humours, contained within the maternal blood, from which all the tissues, organs and fluids of the body were formed. These four humours were blood, phlegm, yellow and black bile. They ‘make up the nature of his body and through these he feels pain or enjoys health’ (*Nature of Man*, IV, trans. Jones 1931). In his commentary on the Nature of Man and in his other works, Galen developed his own brand of physiology based upon the four humours, the four principles or qualities that shaped and were expressed by them, the innate heat that confers life on the body and the ‘pneuma’ or spirit’ that activates the nervous system (*On the Natural Faculties*, Book I, Chap. III, Book II, Chap. VIII, Galen 1916; *On the Elements According to Hippocrates*, I, Galen 1996; *On the Doctrines of Hippocrates and Plato*, Galen 1978). The formation of the humours was derived from – or rather operated through – the influence of the hot and the cold, the moist and the dry. But while the humours provide the material substrate for both the solid and the liquid parts of the body, it is the four qualities of ‘warming, chilling, drying or moistening’ that determine the crucial processes of generation or coming to be, of development and growth, and of the maintenance and sustenance of the mature body (*On the Natural Faculties*, Book I, Section VI, 13, Galen 1916).

These three processes operate through a range of activities or faculties – generation from sexual intercourse, growth from nutrition and bodily maintenance from a combination of nutrition and evacuation, activity and rest, and the environment in which the organism lived (*On the Natural*

Faculties, Book I, Section V, Galen 1916). Generation sets the parameters for growth and body maintenance; the sperm and the menstrual blood provide the basic material from which the body is built; these confer the ‘innate heat’ that powers the body in all its operations as well as an ‘innate’ moisture that permeates the body from conception and fuels its natural heat. Care – both maternal and medical – ensures a healthy development and an adequate length of life. Life ends when the natural heat lessens and the body gradually withers or dries out, rendering the physiological functions of bodily maintenance weaker and less efficient, compromising the necessary balance – of the humours, of warmth and of moisture, and of mind and body – that constitutes health and physical wellbeing [*De Sanitate Tuenda (On Healthcare)*, Galen 1951; *De Marasmo (On Marasmus)*, Galen 1971)].

In order to ensure a ‘healthy’ old age, Galen emphasised the role of ‘regimen’. Central to the idea of the regimen were the ‘non-naturals’. These so-called non-natural phenomena seem to have emerged piecemeal in a number of Galen’s later works, including the *De Sanitate Tuenda (On Healthcare)*, Galen 1951), his works on the pulse [*De Causis Pulsuum (The Causes Altering the Pulse)* and *De Pulsibus Libellus ad Tyrones (The Book on the Pulse for Beginners)*, Galen 1984] and his commentaries on Hippocrates (in *Hippocrates Epidemica* VI, cited by Garcia-Ballester, 1993: 108). They were first formalised as the ‘six non naturals’ in a work called *Ars Medica*, that though accepted as the work of Galen, seems more likely to have been an early elaboration of Alexandrian Galenism dating to the third century CE (García-Ballester 1993: 114–5). These six things upon which the health of every man depends – climate, food and drink, evacuation and repletion, sleep and wakefulness, movement and rest, the passions of the mind – might seem to form a less coherent component in Galen’s natural philosophy, but they would prove perhaps his most long-lasting legacy (García-Ballester 1993: 105).

Avicenna and the evolving canon

Although it is possible to summarise the main components of Galen’s natural philosophy this way – in terms of humours, qualities and the non-naturals – it was only ever expressed partially, with the various elements outlined, revised and re-interpreted at various points in his career, appearing at different times, in different books and treatises. The resulting ‘theory’ was not always coherent or consistent. Theoretical consistency came later, as Galen’s work began to be systematised and shaped into a rational medical system in Alexandria, during the early years of the Byzantine era (Temkin 1977: 202). The Alexandrian curriculum was already formalised at the time of the Arabic conquest in 645 CE and it was this synthesising tradition that provided the

foundation for the subsequent ‘institutionalisation’ of Galen’s work within the medicine of the Arabic empire. One of the first such systematising works to reach the West was that undertaken by Hunain ibn Ishaq, 810–873 CE (Latinised as Joannitius). He wrote a brief synopsis of Galenic theory called in Latin the *Isagoge ad Techne Galieni* (*Introduction to Galen’s Art*). This would form the theoretical core of the ‘basic’ medical textbook used in the school of Salerno, the *Articella* (French 2003: 73). Other synoptic works followed, including the *Pantegni* or *Liber Regalis* written by ‘Ali ibn al-‘Abbas al-Majusi, 949–983 CE (Latinised as Haly Abbas). This was translated into Latin in the early 12th century by Gerard of Cremona (Strohmaier 1998: 163). It provided a more extensive outline of the Galenic model and served for some time as ‘the bible of the doctors’ (French 2003: 75).

These earlier works were overshadowed by Ibn Sīnā (Latinised as Avicenna), 980–1037 CE, whose great work systematising medical teaching, the *Canon of Medicine* (*Al-Qanun fil Tib*) was written sometime around 1020–1025 CE. Shortly thereafter, like the *Pantegni*, it was translated into Latin by Gerard of Cremona. Known as the prince of Arab doctors, Avicenna provided in his five-volume *Canon* the major synthesis of what would come to be known as Galenism. The *Canon* was described by one Renaissance writer as an ‘exhaustive and extremely systematic work’ that ‘stayed very close to Galen’ (Miguel Ledesma 1547, cited in García-Ballester 2002: 188), outshining all the earlier Galenism of the Alexandrians and the early Arab synthesists.

By the end of the first millennium CE, there was a general consensus amongst both Byzantine and Arab authors that medicine consisted of two major branches – theory and practice. The first branch, theory, was divided into three areas, physiology, pathology and symptomatology (Temkin 1977: 210). In the ninth-century manuscript written by Hunayin ibn Ishaq and translated into Latin as the *Isagoge* in the 11th century – physiology (*De Rebus Naturalibus*) was said to be concerned with seven key topics, what became known as the ‘seven naturals’. These included the elements (*elementa*), the temperaments (*commixtiones*), the humours (*compositiones*), the solid parts (*membra*), the faculties or powers (*virtutes*) the actions or operations (*operationes*) and the spirits (*spiritus*) (Maurach 1978: 151). In addition to these core topics, consideration was also given to a number of inter-linked themes, namely ‘ages’ (*aetas*), ‘complexions’ (*colores*), ‘shapes’ (*figuras*), ‘moistures’ (*humiditatis*) and sex differences (*distantiam inter masculum et feminam*).

The terse division of the principle elements of physiology that is evident in the *Isagoge* was elaborated and more thoroughly explicated in the first book of Avicenna’s *Canon* (Lib. I, Avicenna 1930). Here, he addresses first how the elements form the basis of all matter, next how the mixture between hot

and cold, dry and moist determines the overall temperament of each human being, how this mixture varies – between the different parts of the body and according to the sex, age and location of human beings – and how the body fluids or humours are formed and their functions categorised (*Canon*, Lib 1, Fen 1, Theses II, III, IV, sections 20–113). Avicenna distinguishes between the healthy or good humours and the unhealthy or bad ones and between the primary and the secondary humours – a distinction explored further in the next section on the ‘radical moisture’. For the rest of this section, however, I shall concentrate upon Avicenna’s formulation of ageing.

For Galenists, understanding and explaining age was not framed by the operation of a continuous chronology but through a distinct series of transitions from one age (*aetas*) to another. According to both Galen and Avicenna, there are four principal ages or stages of life. The first is defined by growth and development, the second forms the prime of life, defined from the time that the body reaches its maximal growth, the third is that of older age once the prime of life has passed, *i.e.* when the full development maintained (and even augmented) in the prime of life begins to recede, and a fourth and final period of senility or deep old age when vigour and powers fail (*Canon*, Book 1, Fen 1, Theses III, section 51). Like Galen, Avicenna uses the Aristotelian concepts of ‘innate heat’ and ‘innate moisture’ to explain how the latter fuels the former and how, as a result, the ages successively transform the temperament of the body. In childhood, the excess of fuel/moisture over the heat enables the body to heat itself up further and hence to grow rapidly. As the amount of heat increases, it begins to use up the moisture. To prevent too rapid or severe a depletion of the moisture, development is brought to a stop. After reaching the prime of life the innate heat of the body begins to fail. This arises for several reasons: first ‘because the ambient air dries up the moisture of the body’, second because the innate heat itself ‘also helps dry up this moisture’, third because of the effort involved in the performance of the physical and emotional activities that make up living and finally because of ‘the failure of nature to withstand the steadily and silently increasing dissipation of the faculties’ (*Canon*, Lib. I, Fen. 1, Thesis III, sections 58, 59).

To illustrate this process, Avicenna employs a metaphor introduced by Aristotle and used on a number of occasions by Galen, namely that of the oil lamp (Niebyl 1971). The light and heat of the lamp are fuelled by the wick whose moisture is maintained from the oil in the lamp’s bowl. The flame represents the natural or innate heat; the wick represents the radical moisture and the oil in the bowl the alimantal or supplemental moisture, *i.e.* that derived from nutrition. In the *Canon*, Avicenna distinguishes four types of moisture, the superficial moisture that lies on the skin, second the moisture that is found in the veins and the skin, third the moisture that forms

the humours, ready to serve as nutriment to replace what has been lost from the body, and finally the fourth or ‘inborn’ moisture that permeates the body, and which maintains its continuity and cohesiveness. In his discussion of ‘hectic’ fever, in the fourth book of the *Canon*, Avicenna likens the moisture kept in the skin (*i.e.* the still uncoagulated moisture) to the oil that is poured into the bowl of a lamp, while the humorous moisture is likened to the oil that is soaked up into the wick while the inherent moisture contained in the body is likened to the moisture of the cotton wick itself. Only if the fever reaches a degree or severity that it burns this core moisture will the flame (the innate heat) be extinguished, and the individual die (see Reynolds 1999: 112–3).

The lamp metaphor, first employed by Galen in his treatise on respiration (*De Usu Respirationis*, Galen 1984), was elaborated more critically in his later treatise on withering or wasting (*De Marasmo*, Galen 1971). In this work, Galen brought together the theme of fever and ageing that Avicenna and others would subsequently draw upon. Just as the treatment of fevers requires maintaining the internal moisture and reducing the body’s overall ‘excessive’ heat, so the maintenance of a long life requires the careful husbanding of heat and moisture through appropriate ‘healthy ageing regimes’. Such regimes need to ensure a suitable supplemental form of moisture that, though never quite equal in quality to the innate moisture, could nevertheless act as a kind of substitute without corrupting the innate moisture sufficiently to extinguish the flame. The lamp metaphor and its representation of natural heat and radical moisture would prove a major source of controversy. Thus Galen, in his treatise on wasting (*De Marasmo*), deliberated over the extent to which it was or was not possible to maintain indefinitely life’s heat and moisture – and thus prolong life infinitely. Central to answering this question was the ‘convertibility’ or ‘compatibility’ of external sources of moisture to the moisture built into the body at birth. This issue continued to be a controversial topic in scholastic Galenism and arguably continues in a different form into the present. The particular question of the ‘finite’ nature of the radical moisture served as a major concern for one of medieval medicine’s most scholarly figures, Arnaldo de Villanova.

Arnaldo de Villanova and the radical moisture

Roger Bacon (1214–1294 CE) and Arnaldo de Villanova (1240–1312 CE) are both attributed as being the authors of some of the earliest known treatises on the art of preserving youth and preventing old age (Bacon, *De Retardandis Senectutis Accidentibus*; De Villanova, *De Conservazione Juventis et*

Retardatione Senectutis). Both treatises were translated from their Latin into English in the early modern period (Browne 1683; Drummond 1544); both bear considerable similarities to each other and both have been dubiously (or mistakenly) attributed to their respective authors. de Villanova certainly addressed ageing and old age in other more authenticated works and rather than dwell upon the ‘pseudo’ Arnaldian regime for rejuvenation and prolongevity, I concentrate here upon his treatise on the radical moisture – *Tractatus de Humido Radicali* (*Treatise on the Radical Moisture*) recently edited by Michael McVaugh (2010). Written around 1300, this treatise examines the concept of the ‘radical moisture’, a term which following Galen and Aristotle, he used to describe the inherent moisture within the embryo that ensures its future growth and development.

The radical moisture had been seen by the Arabic Galenists as one of a series of ‘secondary humours’ that serve as fuel to sustain the innate heat which determines and maintains life (Hall 1971; McVaugh 1974). As already noted, Avicenna described the radical humidity as both the product of the fourth stage in the development of the ‘secondary moistures’ and also as part of the ‘first creation’, a fixed quantity of moisture derived from the sperm and embodied from conception in the solid parts of the body which he likened to the moisture inhering in the lamp’s wick (cf. Niebyl 1971: 358–9). Avicenna’s outline of the secondary humours (‘humiditates’) was developed further by physicians and philosophers during the 12th and 13th centuries. The nature and ‘restorability’ of the radical moisture was a central concern. This not only bore on medical questions of human being’s mortality and the reasonableness of prolonging life. It also touched on matters of Christian theology, the very identity or ‘essence’ of individual bodies and their continuity in life and after the resurrection (Reynolds 1999: 116). If the radical moisture represents the unchanging ‘primordial’ essence, the constant by which the body can be identified and ‘restored’ at the resurrection, then it cannot properly ‘mix’ with other humours or ‘humidities’ such as the ‘nutrimental’ moisture which can only ever be an ‘accrescence’ to the body, necessary for life and growth but inherently alien to the ‘*veritas humanae naturae*’ (‘true human nature’; Crisciani 2005: 337).

The concerns of the theologians as well as the medics shaped de Villanova’s thinking. In his treatise on the radical moisture, he attempted to provide a coherent account of the concept based upon the classical works of Aristotle and Galen, its later elaboration in Avicenna’s *Canon*, while making due reference to other contemporary, but uncited, medical and philosophical writers supporting or opposing his thesis (Ferrari 2005: 300–1). The treatise is divided into two main sections. The first addresses three issues, whether the nature of the radical moisture overlaps with that of the spermatic, *i.e.* the source and agent of reproduction, second, whether or not

it corresponds, in its material moisture, to that of the sperm, and finally if it is not identical with sperm, how best its substance can be defined. In the second section, he first lists the reasons against the restorability (*restauratio*) of the radical moisture; next, he addresses reasons in favour of its restorability, while in the third part he outlines reasons to refute the arguments of those who say it cannot be restored. Finally, in the fourth part, he considers how effectively and with what limitations any restoration of the moisture can take place.

Despite the complexity of the treatise it is possible to summarise its main points – namely that life depends upon the radical moisture that is present throughout the body from birth but it cannot be equated with sperm. While it can be conserved and to some degree replenished through nutrition, there are limits to its restorability because the nutrimental moistness (*nutrimentalis humiditatis*) is inevitably of an inferior quality to the original radical moistness and so slowly corrupts the latter's purity. Thus slowly corrupted, the resultant moisture becomes increasingly unable to 'fuel' the natural or innate heat (*calor innatus*). The length of life, de Villanova claims, is consequently limited. In principle, he argues, longevity is pre-determined at conception by the ratio of the innate heat to the innate moisture operating across all parts of the body. In practice, however, that ratio can never be calculated and hence none can know in advance how long a person may naturally be destined to live. Because of the inherent limits to our knowledge and thus to the possibility of intervening to re-calibrate that ratio correctly, no doctor can keep life going indefinitely.

In so defining the nature of the radical moisture, Arnaldo revisits the theme of the secondary humours outlined by Avicenna in the *Canon*. He argues that while there are two 'essential' moistures, the radical moisture is primary because it alone originates from the sperm while the nutrimental moisture (*humidum nutrimentali*) comes from food. The radical moisture is an intrinsic element in the creation and development of the body; the '*humidum nutrimentali*' is secondary, its origins come externally from nutrition. Even so, it too is essential to life – for no animal or plant can grow without taking in necessary nutriment. Using this framework to define these two essential moistures, the *radicali* and the *nutrimentali*, Arnold then distinguishes between two forms of ageing, 'natural' and 'accidental'. The latter, he argues, also comes from external sources – from badly digested food, poor climate, inadequate diet, lack of exercise or the 'ill humour' brought about by external stresses. The former is pre-determined by the inherent ratio of the natural heat to the radical moisture. For de Villanova, natural ageing is neither the drying up of the essential moisture nor the loss of the intrinsic heat but the progressive and irrecoverable loss of balance between these two arising from the slow corruption of the essential moisture.

While doctors are certainly able to apply an appropriate regime to neutralise extrinsic damages that may impede the achievement of the maximum lifespan allowed by this pre-determined ratio, and hence prevent the accidental shortening of life, there is little they can do to re-calibrate the ratio between heat and moisture accurately and comprehensively – not because of a lack of appropriate medicines or methods but because of the inherent incalculability of that ratio.

From moitures to marasmus: Bernard de Gordon and the idea of withering

While de Villanova framed ageing through the lens of the radical moisture, he did so as a reflection of both medical and theological thinking of the time (Crisciani 2005). The topic of the radical moisture was addressed in the writings of many medieval scholastics including Thomas Aquinas, Albertus Magnus, Giles of Rome, Nicholas of Ockham and Peter of Spain. Each of these writers reflected a particular mixture of medical, philosophical and theological concerns about the ‘truth’ of human nature and the constancy of the individual body before and after resurrection (Crisciani and Ferrari 2010; McVaugh 1974; Reynolds 1999; Ziegler 1998). But Galen, the ‘master’, had focused less upon the organisation and function of the secondary humours or ‘humidities’ (*humidum, humiditatis*) in determining ageing than upon the nature and ‘longevity’ of the natural heat itself. For Galen, the innate heat or ‘*calidum naturale*’ was ‘paramount’. It alone determined generation, growth, ageing and death (Durling 1988: 210).

In *De Marasmo*, Galen (1971) explicitly linked ageing to illness and particularly to fever which resulted in a disturbance to the body’s natural heat. While de Villanova more or less ignored the topic of fevers in his treatise, concentrating instead upon growth and digestion, other late medieval writers had turned back, beyond Galen, to Aristotle and particularly his treatise on the length and shortness of life – *De longitudine et brevitate vitae*. While Aristotle had enunciated the idea of a necessary balance between heat and moisture in order to prevent one or other being overwhelmed, his view of ageing was based primarily on the loss of moisture arising directly from the gradual failure of the natural heat to draw in sufficient moisture to keep it going (Dunne 2003: 321). In *De Marasmo*, Galen had described wasting as the corruption of the body due to dryness. Two types of wasting existed, simple marasmus – drying up due to starvation, with no alteration of heat or cold – and complex marasmus when the drying out took place in association with or as a result of changes in heat or coldness. Dryness from too much heat was characteristic of consumptive fevers; dryness from coldness (or too

little heat) was characteristic of ageing and ‘acquired’ senility (*De Marasmo*, Galen 1971: 371–2).

Unlike feeding and growing, Galen argues that ageing cannot be considered a ‘natural’ process – in the sense that it is not a power or faculty of the seven natural things. Still, he considers it a necessary ‘affliction’ that affects all living things. It is not a lack of fuel that causes the natural heat to fail in later life (here Galen criticises the lamp metaphor) but rather it is the failure of ageing to maintain the necessary heat to continue to draw in the moisture to the heart and the other vital organs. The loss of heat is an inherent risk, Galen argues, and it requires constant replenishment via food, respiration, drink and general circulation. This replenishment becomes less easy to maintain after the prime of life has been reached. The subsequent loss of heat only adds to this difficulty and eventually there is insufficient heat to draw in any moisture. The body fades – atrophies, withers – into the ‘marasmus’ of old age. Although it may be possible to delay this drying out process, Galen argues, there is no possibility of doing so forever, since once full development has been reached the natural heat gradually loses its power to draw down moisture.

This idea was developed further by another Montpellier-based physician, Bernard de Gordon. In a treatise called, *De Marasmode secundum sententiam Galieni*, de Gordon, a younger contemporary of Arnolde de Villanova, goes over much of the same ground as Galen, but returns more forcefully than Galen to the idea of a radical moisture burning up the natural heat and thus rendering the body dry from over consumption of the moisture (De Gordon 1992; Demaitre 1992). de Gordon’s treatise vacillates between giving priority to the failure of natural heat due to the corruption of its moisture by what he terms ‘the superfluities’ or ‘bad humours’ retained within the body and emphasising the relentless consumption of the radical moisture by the natural heat and hence the body’s ‘auto-destruction’. What distinguishes de Gordon’s treatise, however, is less his inability to resolve the problem of the body’s changing degrees of heat and moisture than his apparent willingness to offer interventions – both in relation to treating fevers causing ‘premature’ withering and, in the last chapter of his treatise, in preventing or retarding such loss of innate heat and consequent age-associated ‘withering’ through medicine. In the last chapter with which he concludes his treatise, he describes an elixir to sustain the natural heat and maintain the intrinsic moisture of the body and thereby prevent or at least considerably reduce the rate and degree of ageing.

Unlike de Villanova, de Gordon was more a thorough-going physician and practitioner who did not venture to write about philosophical or theological topics. In his other medical writings he had already expounded the use of an elixir said to be ‘marvellously beneficial to old people’ (cited in

Demaitre 1980: 77). He describes something similar, in *De Marasmode* (On Marasmus), which he calls a ‘*confeccione ducente ad insenscibilitatem inquantam est possibile per naturam et eciam aliquo modo supra naturam*’ (‘a sweet confection from which it is possible to prevent ageing as far as that is natural and which in some way can even exceed nature’) (de Gordon 1992: 305). The elixir is produced through the distillation of five liquids, spring dew, ‘pure human blood’, juices from the roots, leaves and flowers of the bugloss plant, material from the bark of the lemon tree and moisture from the ‘purest red roses’ (de Gordon 1992: text, l.512). All these materials are to be fermented in the sun through to mid-September, by which time they will have also received ‘energy’ from the sun and the stars (‘*acceperunt vigorem ex sole et stellis*’ (de Gordon 1992: text, l.516). The resulting liquid is then mixed with various aromatic spices, white amber, coral, the fragmented ‘bone’ of a stag’s heart (‘*ossis de corde cervi*’), powdered precious stones and, of course, powdered, drinkable gold – this to be taken early in the morning, at noon and again at evening (de Gordon 1992: text, l.533). Many of the contents of this ‘compound’ echo those outlined by ‘pseudo-Roger Bacon’ in his *De Retardandis Senectutis* and bear close resemblance to those which would later appear in knowingly comic form in Thomas Middleton’s *A Mad World My Masters* (Middleton 2007: Act 3, Scene 2). This electuary, he says proudly, is his own conception which ‘causes man as far as is naturally possible not to grow old, which sustains the heart and viscera, expels the superfluous humors and builds up the natural heat within all the parts of the body’.³ de Gordon had already written a Galenic treatise on ‘hygiene’ and the preservation of health and his interest in prolonging life and delaying ageing reflected a theme running through medieval medicine (Crisiani 2005: 355–70) characterised by various ‘alchemical’, ‘empiric’ and ‘occult’ methods mingled with Galenic hygienic interventions typified in the ‘pseudo’ Baconian and Arnaldian ‘*De Retardatione*’ treatises (Browne 1683; Drummond 1544).⁴

The path less travelled: al-chimya and the occult approach to ageing

The last chapter of de Gordon’s treatise reveals an alternative approach to ageing, one that might be considered a medieval version of ‘anti-ageing’ or ‘*insenscibilitatis*’. Impatience with the tedium of rationality and regimen can be sensed already in the medieval physician and friar Roger Bacon’s earlier book, *De Retardandis Senectutis Accidentibus* (*On Delaying Old Age*). Although the authorship of this treatise, rendered into English in the 17th century by a Richard Browne, is dubious, the sentiments it contains seem genuine. The author writes that there are two ways of preventing or delaying ageing – one

‘the doctrine of soberly ordering one’s life’ by ‘proportioning the six causes . . . necessary to fence preserve and keep the body’, the other the use of ‘medicines obscurely laid down by the ancients and as it were concealed’ (Browne 1683: 13). The former, which represents the orthodox ‘Galenic’ way, pseudo-Bacon argues, is however impractical. Its requirement to carefully balance each day the use of the six non-naturals – air and climate, sleep and waking, food and drink, rest and exercise, ingestion and evacuation, and ‘the accidents of the mind’ – demands more to be done ‘than be well put in practice’ (Browne 1683: 14). On the other hand, Bacon notes, there is another route, one that ‘may avert those inconveniences’ that promises ‘to hinder that the internal moisture be not too easily diminished to renew the moisture itself and when renewed defend it from too quick and hasty destruction’ (Browne 1683: 74). This alternative (or complementary) method uses material that may only be described ‘in obscure and difficult terms’ . . . ‘imitating the precepts of the prince of philosophers to Alexander’ (Browne 1683: 15). This latter is a reference to the pseudo-Aristotelian *Liber Secretum Secretorum*, the Book of the Secret of Secrets, and one of the foundational alchemical texts of the early Middle Ages (Eamon 1994). It contained a mixture of rules, regimens and recipes said to have ‘originated as a “mirror for princes” and was based upon the supposed letters of Aristotle to Alexander the Great’ (Eamon 1994: 45). Translated from the Arabic into Latin some time in the mid-12th century, it swept into Europe along with a ‘tidal flow’ of Aristotelian translations (Eamon 1994: 46), providing a source of inspiration and intrigue that fascinated both scholars and rulers alike.

Bacon was part of the scholastic medical tradition. The ‘theory’ of ageing expounded in *De Retardandis* was ‘classically’ Galenic. It was based upon the traditional concepts of primary and secondary humours/moistures, the innate heat and the six essential ‘non-naturals’ required to maintain health. But Bacon was also fascinated by the esoteric and the occult – the secrets of the sciences that ‘were not written on the skins of goats and sheep so that they can be discovered by the multitude’ (Bacon, *Opus Majus*, cited in Eamon 1994: 48). Nor was Bacon alone in his fascination. From the high Middle Ages onwards, a new kind of ‘experimental science’ or ‘empirical knowledge’ competed with rational understandings in interpreting nature and the limits of ‘the natural’. This ‘experimental science’ was not experimental in the modern sense, however, but was based upon experience and practice handed down outside the academy – of which de Gordon’s ‘anti-ageing’ electuary is but one example.

The rise of alchemy was one other consequence of the West’s ‘re-encountering’ the classic traditions via the East (Principe 2013). In the 12th century an English monk, Robert of Chester, ‘at work in Spain

completed his translation from Arabic of a book often given the title *De Compositione Alchemiae* . . . which marked the entry of alchemy into the European middle ages' (Principe 2013: 51). From that point on, alchemy would flourish across the Latin West as new alchemical manuscripts appeared 'under the names of revered [and safely dead] figures like Albertus Magnus, Roger Bacon, Ramon Lull and a host of others including . . . Avicenna' (Principe 2013: 63). John of Rupescissa (Jean de Roquetaillade), a 14th-century Franciscan friar, provides a particularly clear illustration of this 'alternative' or 'complementary' approach to prolonging life and warding off old age. Accepting the basic Galenic model of ageing as a decline of innate heat and the drawing down of radical moisture, Rupescissa argued that such 'dyscrasia' could be rectified by the use of a mysterious fifth element, something that was neither earth, air, water or fire. This 'quintessence' could balance out the decline in heat and moisture associated with natural ageing, replenishing them by bringing to bear the 'celestial' element into the human body, and thus conferring upon it 'something of the divine' (DeVun 2009: 69). The quintessence described was basically alcohol, but of an exceptional purity, only obtained after the multiple distilling of wine had removed all traces of the four 'base' elements from it. What was left was the purified essence of alcohol, devoid of any trace of earth, water, fire or air, purer than *acqua vitae* or *acqua ardens* – the true 'quintessence' (DeVun 2009: 70).

The search for a quintessential elixir, evident at the end of de Gordon's otherwise 'scholarly' treatise, permeates the concerns of medieval scholars, almost despite themselves (Crisciani 2005: 370–6). But it was only when Paracelsus burst on the scene, in the early 16th century, that this 'alternative' approach led to a headlong collision with traditional medical theory. Up to that time, numerous alchemical and astrological treatises had been written that were attributed to established 'scholastic' doctors and impeccable Galenists such as de Villanova and Roger Bacon, which over subsequent centuries achieved widespread recognition as their authentic works. The division between theory and practice permeating medieval medicine seems to have permitted the learned doctors an unproblematic engagement with a variety of empiric practices – involving herbal medicines, various elixirs and 'secret' concoctions designed to restore health and vitality (and lusty vitality at that), and, some claimed, 'youth'. But when Paracelsus (Theophrastus Bombastus von Hohenheim, 1493–1541) made his appearance in the 16th century, almost at the dawn of the scientific revolution, what made him distinct was not so much his embrace of 'alchemical' practices as his wholesale rejection of the Hippocratic–Galenic corpus, its doctrines of humours, qualities and temperaments, in short the rejection of its underlying natural philosophy.

Although Paracelsus wrote little concerning old age and longevity, by denouncing the canon, by rubbishing both Hippocrates and Galen and the scholastic Latin tradition, he effectively challenged everything about it, including the Galenic model of ageing and longevity, and its links to the humours (see e.g. Paracelsus 2008: 421). What he proposed as an alternative is less clear since he frequently employed neologisms, drew allusions to Biblical texts and re-interpreted aspects of Christianity, Greek philosophy and alchemy into a diffuse ‘pan-philosophy’ of nature. At its heart, his philosophy expressed a kind of pre-Socratic belief in three ‘primordial’ elements, salt sulphur and mercury, which were akin to earth, fire and water; these primordial elements determined life, health and sickness (Paracelsus 2008: 411–5; see also Ball 2007: 269). As Ball points out, ‘Paracelsus did not do science’ (2007: 356), and despite a small but enthusiastic following, his ‘philosophy’ had no long-lasting impact upon medical theory. But reading between the lines, as it were, the impact of his work brought about important changes – for example, the argument that diseases entered the body rather than as dysfunctions of the humours within the body; that chemistry was an important part of medicine; that experiment and experience outweighed scholastic theorising; and that effective therapeutic agents could be concocted from inorganic materials such as antimony, mercury and sulphur, using techniques other than simple compounding and mixing. Perhaps Ball is right when he says that despite the mystical framework attached to his pills and potions, ‘without the translations of Paracelsus’ works . . . it is hard to see what later medical chemistry would have looked like’ (2007: 379).

Post-Galenism

In the end most of the 17th-century Galenists came round to accepting chemical cures – even if this did not involve the search for the universal solvent, the ‘*alkahest*’, the life-restoring ‘*spiritum vitae*’ or the generic healing powers of ‘*mumia*’. Descartes’ mechanical philosophy would eventually overshadow the ‘iatrochemists’, while his medical ideas would in their turn be overshadowed by the ‘vitalists’ and so on until the new medicine of the 19th century and its more general eschewal of doctrine in favour of observation, experimentation and application (Bernard 1865). Although Paracelsus was more of an exception ‘proving’ the rule, Galenism was struck a much more serious blow not by any challenge to his ‘physiology’ but to his status as an anatomist by the work of the Belgian anatomist, Vesalius. In his anatomical treatise, *De Humani Corporis Fabrica* (*On the Fabric of the Human Body*, Vesalius 1998), based upon the detailed dissection of numerous recently executed convicts, Vesalius contradicted Galen on over 200 points

of anatomical ‘fact’. Galen, Vesalius claimed, must never have performed a dissection on human bodies. Less than a century later, in 1628, Harvey’s work on the circulation of the blood was published. His demonstration of the circulation of the blood further exposed Galen’s empirical error in imagining that blood was produced in the heart and in the liver. Despite their growing awareness of Galen’s errors, neither Vesalius nor Harvey sought to displace Galen entirely from the head of the canon. Harvey, for example, wrote that ‘I do not believe that my theory destroys Galenic medicine; rather it enhances it’ (cited in Wright 2012: 151). Indeed Harvey continued to employ the idea of the four humours and the qualities of heat, cold, moisture and dryness associated with them. In a way much as Galen (and Aristotle before him) had done, he too saw the heart as the source of the innate heat of the body and merely revised the anatomical framework, while still arguing that the heart re-circulated that heat ‘again through the body, being fraught with spirits’ (cited in Wright 2012: 173–4).

Despite the shifting sands beneath his theories, Galen’s physiology remained influential. As Roger French has pointed out “‘anatomy’ survived the crisis in theory because it was a semi-autonomous discipline based on experience which could supply medical theory but was not . . . an essential theory of its own’ (2003: 223). In continental Europe and in Britain, Galen’s theoretical works still provided the dominant framework for medical teaching. Throughout this period, for example, Galen’s texts provided the core curriculum of the College of Physicians in England (Cook 1986: 73). Indeed the classical canon received a kind of fillip following the demise of Descartes’ ‘iatromechanical physiology’ as a ‘Hippocratic revival’ was triggered by such notables as Thomas Sydenham, Richard Mead and William Heberden (Brown 1974: 209–12). Even as the College of Physicians’ power declined in the wake of the successive challenges to its monopoly and even as Galen’s physiological theories foundered, Galen’s model of ‘healthcare’ persisted. Galenist ‘hygiene’, for example, formed the basis for two of the first English-language books published on ‘geriatrics’ (Cheyne 1742; Floyer 1724). Though both were written in the first half of the 18th century, they employed more or less the same application of the six Galenic ‘non-naturals’ that had dominated similar writings in the Renaissance.

Despite the transformation in medical thinking that took place over the course of the 18th and 19th centuries, with the shift from the model of the ‘sick-man’ to that of ‘diseased tissue’ (Jewson 1976) and the birth of the ‘clinic’ and its dispassionate ‘clinical gaze’ (Foucault 1973), there was little concomitant interest in re-thinking or re-theorising ageing. Old people were by and large excluded from the new hospitals and their care confined to the large infirmaries attached to the workhouse or the huge charitable hospitals where care and piety were provided in mixed and uneven quantities.

Old people were of concern neither to the doctors nor the hospitals of the 19th century, and the status of old age that preoccupied the authorities was that of old people's actual or potential poverty and the appropriate means of preventing or relieving it, not their health (Conrad 1998; Smith 1990). When Charcot gave his lectures on old age and its diseases at the end of the 19th century, he felt able to say that:

if you except the little treatise of Floyer published in 1724 . . . and . . . that of Fisher which dates as far back as 1766 most of the medical works of the past century which touch . . . upon the senile period of life have a literary or a philosophical bearing; they are more or less ingenious paraphrases of the famous treatise 'De Senectute' of the Roman orator. (Charcot 1881: 18)

Having said as much, Charcot himself offered little theoretical development despite a greater degree of clinical observation of illness in later life. He remained sanguine about old age, noting that although ageing is associated with a general atrophy, 'enfeebling the greater number of our functions, it [old age] is far from paralyzing all of them and rigorous observation shows . . . that in certain respects the organs of the aged perform their tasks with quite as much energy as those of adults' (Charcot 1881: 24).

The shift away from humours, fluids and mixtures to tissues and organs – what French has called 'solidism' (2003: 215–21) – did not lead to any major development in theorising ageing. Arguably it had the opposite effect, curtailing physiological thinking about ageing by focusing almost exclusively upon the signs of disease. Only after the arrival of 'cell theory' and the new sciences of bacteriology, biochemistry, endocrinology and immunology would there be further development. Then, towards the end of the 19th century, a flurry of ideas appeared seeking to 'explain' ageing, either in terms of a decline in internal secretions (Edouard Brown-Séquard; Eugen Steinach; Serge Voronoff) or a corruption of the body by waste matter (Eli Metchnikoff). By pursuing the implications of these post-Galenic theories, new attempts were made to prolong human life (Haycock 2008: 158–87). In a sense, this was a kind of 'Galenism redivivus', acceding to the possibility that while human beings are evidently mortal, the extent to which that mortality is 'naturally built into their bodies' remains to be seen. By seeking to replenish the depleted secretions or flush out the corruption engendered by their superfluities, the prospect of living longer and healthier lives remained alive and well, and still modestly and rationally stated.

New juice for old? The origins of modern anti-ageing medicine

Since the theories of Metchnikoff, Séquard-Brown and Steinach have already been outlined elsewhere, I will not go over already covered ground

(Haycock 2008; Sengoopta 2006; Tauber 2003). Arguably, what most distinguished their emergence was less the distinct theoretical paradigms they engendered than the huge public response they created. In seeking to reverse ageing, under the conditions of the 20th century and the modern world, they saw rejuvenation become a mass phenomenon. Accounts of the popular clamour, amongst the older male elite particularly, for various forms of dietary, endocrinological or surgical rejuvenation have been given elsewhere (Haycock 2008; Hirshbein 2000; Rothman and Rothman 2004; Schultheiss, Denil and Jonas 1997) and I do not intend to rehearse them here. Instead I want to ‘fast forward’ to the present century. Arguably, the contemporary development of gerontological theory, like developments in Galenism in the past, far surpasses any demonstrable effect on the length of most people’s lives. But unlike the centuries when Galenism reigned supreme (200–1700 CE), life expectancy has increased substantially over the last half century or so (1950–2010 CE). With much greater emphasis now placed upon identifying and intervening in mid-life disease, there is a widespread assumption that living to 100 is a realisable goal – a viewpoint that we share with our classical and medieval scholars. Hence there is a broad consensus that most human beings can live for at least 100 years if ‘external’ or ‘accidental’ events can be controlled, but there is also a consensus that ‘senescence is built into the life history of all sexually reproducing organisms [and so] while the death rate can be altered ... death itself can never be eliminated’ (Carey 2003: 178). This is not far from Galen’s conclusion in *De Marasmo*. But since the 1980s, theoretical and empirical developments in bio-gerontology have raised major problems for any simple model of ageing as a unitary process based upon either the progressive consumption of bio-resources (*e.g.* progressive decline in the rate of living; diminution of a vital principle or the timed unwinding of a genetic programme) or the ‘self-destruct’ accumulation of irreparable errors and/or build-up of toxic superfluities.

In the first place, there is considerable evidence that the age of a population increases the greater the size of the population observed (Carey 1993); secondly, that the upper limits of the human age distribution have been rising for over a century in a manner inconsistent with a fixed lifespan (Manton and Stallard 1996); thirdly, that traits most essential to the survival of an organism, including longevity, show little heritability due to the strength of selection and fixation (Strickberger 1996); and fourthly, that in many, perhaps most, sexually reproducing species, mortality rates seem not to accelerate but *decline* at extreme ages (Carey 2003). These points imply a fundamental indeterminacy to ageing and death; that lifespan is contingent and that multiple parameters influence the nature and rates of senescence in ways that are dependent upon external and internal contingencies.

That all sexually reproducing organisms are mortal is not disputed; the question of when and how fast, however, is still not known. Perhaps as Arnaldo de Villanova once argued, it depends upon rates and ratios that are incapable of exact computation. As long as such unknowables apply, the temptation to propound magical solutions may always be there.

Conclusions

The aim of this paper has been to outline the rational tradition toward understanding ageing and longevity illustrated by the works of Galen and extended and modified during the Middle Ages, first in the new Arabic empires, later in the Latin West. The essential features of that model are fourfold; firstly, that ageing is an inevitable consequence of conception and growth; secondly, that while external factors may reduce life expectancy and lead to premature mortality, intrinsic, innate factors ultimately determine a finite human lifespan; thirdly, that the clue to ageing resides either in the 'using up' or '*consumptio*' of these intrinsic metabolic factors (loss of 'heat' or loss of 'moisture') or the introduction of errors or '*corruptio*' in these metabolic processes as a result of necessary but non-natural materials supporting life; and fourthly that lifestyle or regimen, at all ages, offers the most practical means of ensuring a long and healthy life.

The medieval scholars, in particular, were concerned with elucidating the nature of the body, and the fundamental principles of life, of generation and growth. The terms they used are perhaps strange and difficult to treat seriously now because of their dated metaphors and the overly concrete way by which many of their concepts were described. But 'heat' and 'moisture' were not really thought of as lamp flames and lamp oil; nor was 'spermatic' seen simply as semen. The radical moisture might now be thought of as mitochondrial RNA, and innate heat as cellular metabolic energy. But the search for a rational materialist theory of development, decline and death and the implications that may have for modifying these processes remains as vital a concern now as then. What is different is the practice of science. Theoretical biologists are now thoroughly outnumbered by an army of 'empirics' with generally less interest in the modification of lifestyle than in the manipulation of the germ line. And that remains a task as difficult as ever, even if it is no longer framed as the '*restauratio*' of the '*humido radicali*'.

NOTES

- 1 According to Nutton, Galen 'affirms that the physiology of Hippocrates with its elements, mixtures and humours is far more satisfactory than that of the

- Stoics or the atomistic universe of Asclepiades and the Methodists' (Nutton 2012: 31).
- 2 The authorship of *De Natura hominis* is unclear; it may not be a single treatise (Jones 1931: xxvii), some of which may have been written by his son-in-law, Polybus. Galen, however, seems to have believed that it was the work of Hippocrates himself (Galen 1978).
 - 3 'Reddit hominem insenesibilem quantum est possibile per naturam, quoniam confortat cor et viscera et expellit omne superfluum et addit in calorem naturalem et pertinet paululum caliditati, . . . ex altiori potentia processit quam sit quelibet perspicacitas luminis naturalis' (*De Marasmode*, de Gordon 1992: text, ll. 538–9).
 - 4 See especially Crisciani's discussion on the 'prolongevity' literature of the late Middle Ages and their misattribution to such established medical authors as Arnaldo de Villanova, Roger Bacon and Raymond Lull, each of whom evinced an interest in alchemical and astrological matters (Crisciani 2005: 364–5).

References

- Avicenna, 1930. *A Treatise on the Canon of Medicine, Incorporating a Translation of the First Book*. Translator O. C. Gruner, Luzac & Co., London.
- Ball, P. 2007. *The Devil's Doctor: Paracelsus and the World of Renaissance Magic and Science*. Arrow Books, London.
- Bernard, C. 1865. *Introduction a l'étude de la médecine expérimentale*. Baillière et Fils, Paris.
- Brown, T. M. 1974. From mechanism to vitalism in eighteenth century English physiology. *Journal of the History of Biology*, 7, 2, 179–216.
- Browne, R. 1683. *Roger Bacon's The Cure of Old Age and Preservation of Youth; Translated Out of Latin*. London.
- Carey, J. R. 1993. *Applied Demography for Biologists*. Oxford University Press, New York.
- Carey, J. R. 2003. *Longevity: The Biology and Demography of Life Span*. Princeton University Press, Princeton, New Jersey.
- Charcot, J. M. 1881. *Clinical Lectures on the Diseases of Old Age*. Translator L. Hunt, William Wood & Company, New York.
- Cheyne, G. 1742. *An Essay on Health and Long Life*. London.
- Conrad, C. 1998. Old age and the health care system in the nineteenth and twentieth centuries. In Johnson, P. and Thane, P. (eds), *Old Age from Antiquity to Post-modernity*. Routledge, London, 132–45.
- Cook, H. J. 1986. *The Decline of the Old Medical Regime in Stuart London*. Cornell University Press, Ithaca, New York.
- Crisciani, C. 2005. Aspetti del dibattito sull'humido radicale nella cultura del tardo medioevo (Secoli XIII–XV). *Arxiu de Textos Catalans Antics*, 23/24, 332–84.
- Crisciani, C. and Ferrari, G. 2010. Introduzione. In McVaugh, M. (ed.), *Arnaldo de Villanova: Opera Medica Omnia. Volume 2. Tractatus de Humido Radicali*. University of Barcelona Press, Barcelona, 319–570.
- de Gordon, B. 1992. The manuscripts and text of Bernard of Gordon's 'Treatise de Marasmode'. *Traditio*, 47, 287–307.
- Demaitre, L. 1980. *Doctor Bernard de Gordon: Professor and Practitioner*. Pontifical Institute of Medieval Studies, Toronto.

- Demaitre, L. 1992. The medical notion of 'withering' from Galen to the fourteenth century: the treatise on marasmus by Bernard of Gordon. *Traditio*, **47**, 259–86.
- DeVun, L. 2009. *Prophecy, Alchemy and the End of Time: John of Rupescissa in the Late Middle Ages*. Columbia University Press, New York.
- Drummond, J. 1544. *The Defence of Age and Recovery of Youth. Translated Out of the Famous Clarke and Ryght Experte Medycyne, Arnold de Noua Villa*. London.
- Dunne, M. 2003. Thirteenth and fourteenth-century commentaries on the De Longitudine et Brevitate Vitae. *Early Science and Medicine*, **8**, 4, 320–35.
- Durling, R.J. 1988. The innate heat in Galen. *Medizinhistorisches Journal*, **23**, 3/4, 210–2.
- Eamon, W. 1994. *Science and the Secrets of Nature: Books of Secrets in Medieval and Early Modern Culture*. Princeton University Press, Princeton, New Jersey.
- Ferrari, G. 2005. Il trattato *De Humido Radicali* di Arnaldo da Villanova. *Arxiu de Textos Catalans Antics*, **23/24**, 281–331.
- Floyer, J. Sir 1724. *Medicina Gerocomica: Or the Galenic Art of Preserving Old Men's Health*. London.
- Foucault, M. 1973. *The Birth of the Clinic*. Tavistock Publications, London.
- French, R. 2003. *Medicine Before Science: The Business of Medicine from the Middle Ages to the Enlightenment*. Cambridge University Press, Cambridge.
- Galen 1916. *On the Natural Faculties*. Translator A. J. Brock, Loeb Classical Library, Volume **71**, Harvard University Press, Cambridge, Massachusetts.
- Galen 1951. *Galen's Hygiene*. Translator R. M. Green, Charles C. Thomas, Springfield, Illinois.
- Galen 1971. *On Marasmus*. Translator T. C. Theoharides. *Journal of the History of Medicine and Allied Sciences*, **26**, 4, 369–90.
- Galen 1978. On the doctrines of Hippocrates and Plato. Translator P. De Lacy. In De Lacy, P. (ed.), *Corpus Medicorum Graecorum*. Volume **5.4.1.2**, Parts 1–2, v.I, 65–358, Akademie-Verlag, Berlin.
- Galen 1984. *Galen on Respiration and the Arteries: An edition with English translation of De Usu Respirationis, De Usu Pulsum and De Causis Respirationis*. Translator D.J. Furley and J.S. Wilkie. Princeton University Press, Princeton, New Jersey.
- Galen 1996. On the elements according to Hippocrates. Translator P. De Lacy. In De Lacy, P. (ed.), *Corpus Medicorum Graecorum*, **5.1.2. Galeni, De Elementis ex Hippocratis Sententia. Akademie-Verlag, Berlin, 53–159.**
- García-Ballester, L. 1993. On the origin of the 'six non-natural things'. In Kollesch, J. and Nickel, D. (eds), *Galen und das hellenistische Erbe: Proceedings of the 4th International Galen Symposium*. Verlag, Stuttgart, 105–15.
- García-Ballester, L. 2002. The circulation and use of medical manuscripts in Arabic in sixteenth century Spain. In Arrizabalaga, J., Cabré, M., Cifuentes, L. and Salmon, F. (eds), *Galen and Galenism: Theory and Practice from Antiquity to the European Renaissance*. Ashgate/Varorum, Aldershot, UK, 183–99.
- Gilleard, C. 2013. Renaissance treatises on 'successful ageing'. *Ageing & Society*, **33**, 2, 189–215.
- Hall, T. S. 1971. Life, death and the radical moisture. *Clio Medica*, **6**, 1, 3–23.
- Haycock, D. B. 2008. *Mortal Coil: A Short History of Living Longer*. Yale University Press, New Haven, Connecticut.
- Hirshbein, L. D. 2000. The glandular solution: sex, masculinity and aging in the 1920s. *Journal of the History of Sexuality*, **9**, 3, 277–304.
- Jewson, N. D. 1976. The disappearance of the sick-man from medical cosmology, 1770–1870. *Sociology*, **10**, 2, 225–44.

- Jones, W. H. S. 1931. *Hippocrates, Nature of Man*. Loeb Classical Library, Volume 150, Harvard University Press, Cambridge, Massachusetts, 1–42.
- Jordan, M. 1991. The disappearance of Galen in thirteenth century philosophy and theology. In Zimmerman, A. and Speer, A. (eds), *Mensch und Natur im Mittelalter*. *Miscellanea Mediaevalia*, 21/1, Berlin, 703–17.
- Manton, K. G. and Stallard, E. 1996. Longevity in the United States: age and sex-specific evidence on life span limits from mortality patterns 1960–1990. *Journals of Gerontology: Biological Sciences*, 51A, 5, B362–75.
- Maurach, G. 1978. Johannicius: Isagoge ad Techne Galieni. *Sudhoffs Archiv*, 62, 2, 148–74.
- McVaugh, M. 1974. The ‘humidum radicale’ in thirteenth-century medicine. *Traditio*, 30, 3, 259–83.
- McVaugh, M. (ed.) 2010. *Arnold de Villanova’s Tractatus de Humido Radicali*. *Opera Medica Omnia*, Volume 2, University of Barcelona Press, Barcelona.
- Middleton, T. 2007. It’s a mad world, my masters. In Taylor, G. and Lavagnino, J. (eds), *Thomas Middleton: The Collected Works*. Oxford University Press, Oxford, 414–50.
- Niebyl, P. H. 1971. Old age, fever and the lamp metaphor. *Journal of the History of Medicine and Allied Sciences*, 26, 4, 351–68.
- Nutton, V. 2012. *Physiologia* from Galen to Jacob Bording. In Horstmanshoff, M., King, H. and Zittel, C. (eds), *Blood, Sweat and Tears—The Changing Concepts of Physiology from Antiquity into Early Modern Europe*. Brill, Leiden, 27–40.
- Paracelsus 2008. *Essential Theoretical Writings*. Translator and editor A. Weeks, Brill, Leiden.
- Principe, L. M. 2013. *The Secrets of Alchemy*. University of Chicago Press, Chicago.
- Reynolds, P. L. 1999. *Food and the Body: Some Peculiar Questions in High Medieval Theology*. Brill, Leiden.
- Rothman, S. M. and Rothman, D. J. 2004. *The Pursuit of Perfection: The Promises and Perils of Medical Enhancement*. Vintage Books, New York.
- Schultheiss, D., Denil, J. and Jonas, U. 1997. Rejuvenation in the early 20th century. *Andrologia*, 29, 6, 351–55.
- Sengoopta, C. 2006. *The Most Secret Quintessence of Life: Sex, Glands and Hormones, 1850–1950*. University of Chicago Press, Chicago.
- Smith, F. B. 1990. *The People’s Health, 1830–1910*. Weidenfeld & Nicolson, London.
- Strickberger, M. W. 1996. *Evolution*. Second edition, Jones and Bartlett Publishers, Boston, Massachusetts.
- Strohmaier, G. 1998. Reception and tradition: medicine in the Byzantine and Arabic world. In Grmek, M. D. (ed.), *Western Medical Thought from Antiquity to the Middle Ages*. Harvard University Press, Cambridge, Massachusetts, 139–69.
- Tauber, A. I. 2003. Metchnikoff and the phagocytosis theory. *Nature Reviews: Molecular Cell Biology*, 4, 11, 897–901.
- Temkin, O. 1977. Byzantine medicine: tradition and empiricism. In *The Double Face of Janus, and Other Essays in the History of Medicine*. Johns Hopkins University Press, Baltimore, Maryland, 202–24.
- Vesalius, A. 1998. *On the Fabric of the Human Body. A Translation of De Humani Corporis Fabrica*. Translators Richardson W.F. and Carman J.B., Norman Publishing, San Francisco.
- Wright, T. 2012. *Circulation: William Harvey’s Revolutionary Idea*. Chatto & Windus, London.

Ziegler, J. 1998. 'Ut dicunt medici': medical knowledge and theological debates in the second half of the thirteenth century. *Bulletin of the History of Medicine*, **73**, 2, 208–37.

Accepted 3 October 2013; first published online 29 November 2013

Address for correspondence:

Chris Gilleard, Mental Health Sciences Unit,
UCL, Charles Bell House, 67–73 Riding House Street,
London W1W 7EY, UK.

E-mail: CGilleard@aol.com