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THE CIRCLES OF WILLIS: PHYSIOLOGY, CULTURE, AND THE FORMATION OF THE "NEUROCENTRIC" BODY IN ENGLAND, 1640-1690

by

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DISSERTATION

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Preface and Acknowledgments

Impetus to pursue the subject of this dissertation came from two sources. The first were my experiences as a physician practicing in hospital emergency departments in the multi-cultural port of San Francisco. The approximately forty thousand patients I have helped care for have come from a variety of cultures, speak a variety of languages, and have a variety of ideas about how their bodies work in health and disease. These experiences reinforced my desire to write a history that paid attention to cultural issues. They also fueled an interest in the social construction of knowledge.

The second arose from tracing the origin of a brain image currently used as a visual aid to teach the gross anatomy of the brain to medical students at the University of California, San Francisco. A chance encounter with the work of Willis in a first-year seminar revealed that the source of the brain image was an engraving by Christopher Wren from Willis's *Cerebri anatome* of 1664. When I then read a facsimile of that text and learned that many of his anatomical models were prosperous Anglicans, I was hooked. Why did they volunteer?

None of this would have been able to take form without the advice and incisive criticism I have received from the members of my committee: Guenter Risse, M.D., Ph.D. (chair), Robert Frank, Ph.D., and Barbara Shapiro, Ph.D. They have been generous of their time and knowledge, and I am most grateful. In addition, the work has benefited from the advice and encouragement of Roy Porter, who has patiently followed its various versions as well. Additional helpful observations on earlier versions have been received from Harold Cook, Christopher Goodey, David Harley, Thomas Laqueur, Scott Mandelbrote, Dorothy Porter, and Jack Pressman. Jack, who has been my faculty advisor, has

been particularly helpful on issues relating to the social construction of knowledge.

During the course of doctoral work I have had the good fortune of receiving several awards and grants. I gratefully acknowledge fellowship support from the Regents and President of the University of California as well as a travel award from the Wellcome Trust. In addition, support for the dissertation year was provided by the Department of the History of Health Sciences here at U.C.S.F.. Also, the Graduate Division of U.C.S.F. provided funding for a research trip to U.C.L.A. and the Huntington Library.

ABSTRACT

The Circles of Willis:

physiology, culture, and the formation of the "neurocentric" body in England, 1640-1690

by Robert L. Martensen

This dissertation is concerned with the historical formation in early modern England of two related ideas and their corollaries: 1) the human mind is located in the brain and 2) the brain (and nerves) are the most important constituents of the body. The people most responsible for developing what the author terms the "neurocentric" body were a group of men, most of whom assembled when young at Oxford in the 1640's, where they began an active experimental program in what have come to be known as physiology, chemistry, and anatomy. Led by the physician Thomas Willis (1621-1675), and including Christopher Wren, Richard Lower, Ralph Bathurst, they published several learned works on the blood and heart in the 1650's, and, with Willis, a number of influential texts on the blood and brain and nerves in the 1660's and 1670's. As a group they also achieved remarkable professional and financial success.

Whereas the purely scientific contributions of Willis and his colleagues have been well chronicled, relatively little attention has been paid to points of contact between the theoretical explication of the blood, brain, and nerves by the Oxford physiologists and the larger culture in which they worked. They are emphasized, however, in this dissertation.

Particular themes include: 1) the relation of Anglican ideas of reason and church governance to the models of the brain and nerves which were constructed; 2) explication of early modern attitudes towards death, with a particular emphasis on the cultural acceptance of post mortem examinations in a setting in which institutions played a negligible role; 3) the relation of English

medical characterizations of the body to their Continental counterparts; 4) the relation of neurophysiology to gender and the boundaries between humans and other animals; 5) the decline of Oxford physiology in the later seventeenth century and the rise of the empiricist approach championed by Thomas Sydenham and John Locke.

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Introduction

"Physitians in their *Anatomie Lectures*, though the whole body lye before them, yet they read chiefely upon some more noble and Architectonical parts, the braine, the heart, the stomach, or the like." William Spurstowe, 1643[1]

"In science, just as in art and in life, only that which is true to culture is true to nature." Ludwig Fleck[2]

I. Nowadays most people in the West--and virtually all those who practice Western medicine--believe two related notions: 1) the human mind is located in the brain and 2) the brain (and nerves) are the most important constituents of the body. Most of us also believe that the properly operating mind governs the (properly operating) emotions. Widely held as well are the beliefs that the devil or the holy spirit is not a material entity capable of taking over our minds or bodies. Furthermore, when most people now imagine the mind, they imagine it as a series of operations which take place in the solid tissues of the brain. These operations are mediated chemically and in turn depend on an adequate circulation of properly constituted blood. Although issues of gender are scientifically (and culturally) alive, both women and men are felt to be subject to the same general conditions.

Until the middle of the seventeenth century, however, these thoughts were not widely held, at least in England. Traditional medical theories held that the brain was an important organ, but not more important, and probably less so, than the heart, or the triad of heart, liver, and brain. None of the solid tissues of the body, however, were felt to be as important as the humors, the diverse liquid and ethereal substances which generated themselves in different areas of the body and circulated as needed. In these conceptions, the hollow spaces of the brain (and heart) were given prominence because they stored, processed, and

distributed the important juices. In contrast, the solid tissues were felt to be of lesser importance, and comparatively little effort was made to discriminate among them.

Educated and uneducated people alike commonly imagined their bodies as operating subject to natural *and* supernatural forces. Epileptics, for instance, were seen by some as being subject merely to natural derangements, but many endowed their statements with supernatural meaning. The existence of diabolical possession was actively debated. Astrological medicine was a discipline of its own. Furthermore, many believed that women's (non-reproducing) bodies acted in fundamentally different ways from men's. The idea that women were physiologically governed by their wombs was an axiom. Some even believed that women had no souls. If they did, they probably resided, like men's' souls, in the blood. Among the educated, many of these ideas began to change beginning in the late 1640's and continuing through the Interregnum (1650-1660) and Restoration (1660-1688). Different and often incompatible ideas of the body's organization and operations were put forward by different groups.

This dissertation is concerned with the English formation of the most successful of them: the related ideas that our minds our located in our brains, that our brains and nerves were the crucial organs of our bodies, and that cognitive ability of mind was a defining quality of our species. Corollary to these were theories which argued that abnormal behaviors and emotional expressions were a function of abnormally functioning brains and nerves and that cognitive deficits put one on the borderline between human and beast. Furthermore, the body as well as the inferior portions of the brain were assumed to operate like a "machine"; supernatural forces were not active in it.

The people most responsible for developing what I will be calling the "neurocentric" body were a group of men, most of whom assembled when young

at Oxford in the 1640's, where they began an active experimental program in what have come to be known as physiology, chemistry, and anatomy. Mostly Anglican in background, a number of them arrived in Oxford intending on religious vocations but changing to medicine and natural philosophy during the Civil War. Although some eventually became Anglican ministers after the re-establishment of the Church of England in 1660, a number remained in natural philosophy and medicine. Led by the physician Thomas Willis (1621-1675), they published several learned works on the blood and heart in the 1650's, and, with Willis, a number of influential texts on the blood and brain and nerves in the 1660's and 1670's. As a group they also achieved remarkable professional and financial success.

The "neurocentric" body, however, was by no means an uncontested series of ideas. A diverse group of healers and lay people did not accept the "neurocentric" model. Influenced by the animist and vitalistic ideas of Paracelsus (1494?-1541) and Jean Baptiste van Helmont (1577-1644), they promoted a conception of the body as activated by a number of souls (*Archei*) which resided in each organ. The brain (and reason) in these conceptions were secondary to the stomach and spleen (and "inner light"). Every particle of the body (and universe) was alive, and blood-letting, a mainstay of learned medical therapy, should be abandoned. Nonetheless, the Oxford physiologists incorporated a number of vitalistic ideas in their work. Early in the 1660's the medical men who self-identified as Helmontians sought to organize a separate professional entity to rival that of the learned establishment, the College of Physicians.

The framers of the "neurocentric" body also contended with another intellectual, if not professional, rival: the physiological theories of Descartes and his Continental disciples. Although Descartes was one of the early supporters of Harveian circulation theory, his matter theory as well as his cardiac and

neurological ideas remained problematic for the Oxford group. Nonetheless, Cartesian biology was felt to be too important to ignore. In handling Descartes as well as framing their own theories, an important intellectual resource became the work of Descartes' Continental rival, the French Catholic priest, Pierre Gassendi. Gassendi, who managed to reconcile Christian thought with Epicurean atomism, also developed a *schema* of mind and body interaction which was particularly attractive to Willis.

Supporting the theoretical work of Willis and the Oxford physiologists were large numbers of vivisections on animals, chemical experiments, and anatomical investigations of animals and sick and healthy human corpses. In this they were following the example of Harvey, who, in turn, followed his Paduan teachers in doing direct physiological and anatomical investigation. But the situation for anatomy in England was quite different than on the Continent.

Whereas by the early seventeenth century, the cities of northern Italy, Holland, and to a lesser extent France and Germany had developed public anatomy theaters, England had no truly public spaces for such activities. Anatomies were performed irregularly in the chambers of the College of Physicians and the London Barber Surgeons. Partly as a consequence, until the early seventeenth century English learned medicine was both institutionally and intellectually backward in comparison to Continental developments.

However, this changed with the generation that followed Harvey, whose work from the 'teens and twenties became accepted in England in the 1640's. Willis and his principal colleagues, who included Richard Lower, Christopher Wren, Edmund King, Ralph Bathurst, and Thomas Millington, as well as others at Oxford, Cambridge, and London, began anatomizing regularly in the 1650's and increasingly in the 1660's and 1670's. But this was anatomy with a difference. In the first place, the public anatomies of Continental Europe were

performed only on the bodies of "public" persons, e.g. condemned criminals. "Private" anatomies, which were most often performed by teachers for pay by medical students, might be on any body. Most of them, however, came from communally sponsored clinics which housed the indigent ill. In both cases, correlations between ante-mortem condition and anatomical findings were relatively unformed. The main thrust, instead, was either on teaching audiences the normal structures or recording the unusual and monstrous.

In contrast, the post mortem exams which mattered most to Willis and his colleagues were those on known patients from the Anglican gentry, academic, and clerical groups. Correlations were extensive between normal and abnormal anatomical findings and disease processes. Relatives and friends of the decedent permitted and occasionally watched the dissections for a variety of reasons. Furthermore, these findings, which were labeled as "ocular demonstrations" and "case observations" were used to support the "hypotheses" Willis constructed regarding the neurophysiology of reason, emotion, and unreason. Some normal and abnormal findings were illustrated by Willis and Christopher Wren in a series of engravings of the brain and nerves which remain influential today.[3]

As part of the process of becoming prominent medical theorists and practitioners in the Restoration, Willis and his colleagues were the beneficiaries of significant patronage dispensed by the Archbishop of Canterbury, Gilbert Sheldon. This reflected not only their long time association from the 1640's at Oxford, but also an affinity between Willis's deeply held and orthodox beliefs and those current among his friends with religious vocations. Indeed, in dissecting human brains, Willis believed that he was simultaneously advancing medicine *and* exposing the "Chapel of the Deity".[4] To that end he cited not only Gassendi, who entertained similar feelings, but an Anglican divine, Henry Hammond, as the main authorities for his neurophysiological musings.

In the meantime, the efforts of the Helmontian physicians to gain an official place in the Restoration hierarchy failed. But this did not mean that the Willisians had a clear field. Indeed, their ideas and methods, although fashionable with both the public and learned physicians in the 1660's and 1670's, were subject to repeated criticism. Not only did the Helmontians not care for the "neurocentric" body, but so, too, some traditional physicians found it wanting. Furthermore, by the late 1670's and 1680's, empiricism was gaining in respectability among learned physicians as the investigational practices of the Oxford physiologists were coming into increasing doubt. The upshot was that physiological experimentation and rigorous anatomical programs did not remain vigorous after the deaths or retirements of the principals among the Oxford group. However, even those champions of empiricism, such as Thomas Sydenham and John Locke, made use of "neurocentric" physiology when it suited their needs.

II. The purely scientific contributions of Willis, Boyle, Harvey, Lower, Wren, and others have been well chronicled. What has received little attention, however, are some points of contact between their physiological ideas, particularly Willis's neurology, and the larger culture. If the broad subject of this dissertation is the formation of the "neurocentric" body, most of its arguments have to do with the cultural supports and pressures which I believe underwrote the developments outlined above.

These arguments are distributed in the chapters, the first three of which follow the chronological development of Willis's thought. Effort is made to place Willis's theories in relation to their traditional antecedents as well as their contemporary intellectual and social setting. The fourth chapter deals with the specifics of Willisian anatomy and its cultural appeal. The fifth chapter collects

and analyzes the principal contemporary criticisms received by Willis and his colleagues. Specific attention is paid to the ambigious place of the anatomical method in the medical empiricism of Sydenham and Locke which began to come into vogue in England in the century's final decades.

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[1] William Spurstowe, *Englands Patterne and Duty in its Monthly Fasts,* (London, 1643), p. 21.

[2] Ludwig Fleck, *The Genesis and Development of a Scientific Fact*, (Chicago: U. of Chicago Press, 1979), p. 35.

[3] See, for instance, Frank Netter, M.D., *Nervous System,* (Ciba, 1957) and subsequent editions, plate 20, p. 42.

[4] Thomas Willis, *Cerebri anatome,* (London, 1664), "Epistle Dedicatory". The text was translated into English in 1683 by Samuel Pordage and published in several editions in English and Latin into the mid-eighteenth century. In English it has been referred to commonly as *The Anatomy of the Brain* and *Cerebral Anatomy*. I will be quoting from the Pordage edition of 1684, which was re-printed in a facsimile edition by McGill University Press in 1964.

Chapter One

The Place of the Blood

Introduction

When an elderly William Harvey (1578-1657), physician to the recently executed Charles I , Anglican, and former officer of the London College of Physicians, published in 1651 that, "It is therefore evident...the blood is...the builder and preserver of the *body* and *principal part* wherein the *Soul* hath her *Session*," he was amending his 1628 belief that the heart was "sovereign" in the body.[1] Intervening work on embryo development in various animals, along with the opinion of Aristotle, had convinced him that the blood was formed prior to the heart. Arguing in 1651 that the soul could not be an incorporeal substance, Harvey's friend, the mechanist philosopher Thomas Hobbes, cited as his authority the ancient Hebrew taboo on eating blood in Deuteronomy 12:23: "Eat not the blood, for the blood is the soul, that is the life."[2] When Harvey's protege, Nathaniel Highmore, M.D. (1613-1685) argued for the primacy of the blood in the 1660's and 1670's, it was to "bring down and destroy" a rival theory put forward by his fellow Oxonian Thomas Willis, M.D. (1621-75) that the brain and not the blood was primarily involved in the etiology of hysteria.[3] Yet Willis had been the Englishman whose Interregnum work on the blood was primarily responsible for establishing its status as a thing-in-itself in Europe. In the early Restoration (1660-1688) "Helmontian physicians", such as George Thomson, described the blood as "a most pure Sweet....Vital Juice...made by the *Archeus*...the principal matter for Sense."[4] While they credited Harvey, Willis, and other Oxford physiologists for their work on the blood, they had no interest in pursuing the investigative methods on which that work depended. At the same time traditionally trained physicians, such as Edmund O'Meara, attacked

Willis and the Oxford group for their emphasis on the heart and blood at the expense of the bodily humors of classical medical theory. When Harvey's kinswoman, Lady Anne Conway (1631-1679), the former patient of both Harvey and Willis, noted her belief in the primacy of the blood in the late 1670's, it was after she had spent at least two decades studying alchemical texts and made a recent conversion to Quakerism.[5]

The purpose of this chapter is to consider English interest in the blood as its meaning(s) evolved both physiologically, culturally, and politically in the second half of the seventeenth century. At different times and for different sub-cultures in this period, blood served as a center of physiological interest and a repository of political and religious meanings. Additionally, competing therapeutic approaches to the blood made it a focus of professional disputes regarding the content and place of learned medicine within the emerging urban medical marketplace. My premise is that ambiguities about the place of the heart and blood in the body and medical therapy reflected contemporary social and religious tensions regarding spirit, form, and the possibilities of human knowledge.

The central question to be considered is this: Why did a "hematocentric" or "cardiocentric" model of the human body not achieve dominance in seventeenth century English physiology or culture? After all, Harvey's model of the operation of the heart and the circulation of the blood achieved international prominence in beginning in the 1640's. Moreover, his disciples at mid-century Oxford, London, and Cambridge succeeded in re-defining his principal themes in light of recent Continental work on matter theory and biological transformation.[6] Furthermore, the concepts of "blood" and "heart" stimulated research at the Royal Society and elsewhere into the 1680's.[7] In short, in mid-century the "hematocentric" or "cardiocentric" body had all the earmarks of a

scientific model Thomas Kuhn might characterize as on the "route to normal science."[8] Moreover, it put English medicine for the first time in the vanguard of European medical thought.

Nonetheless, throughout the Restoration (1660-88) a variety of challenges were mounted against the "hematocentric" models as formed by Harvey and his followers. How and why did this happen? In attempting to both describe and analyze this transit, my premise is that important historical factors in addition to the formal content of physiological theories played a decisive role. Among these are the demographics and patronage of the Oxford group, the nature of English responses to the vitalistic approaches of Paracelsus and J.B. van Helmont and French mechanism, and the re-establishement of the monarchy and Church of England in the Restoration.

I should emphasize at the outset that the situation of the blood in the middle decades was both dynamic and complex. Some people who were "bloodists" in the 1640's and 1650's later became partisans of the brain or brain and blood in the middle 1660's. New concepts in disease were taken up in the middle of the period and helped shape subsequent medical thought. The balance of political and professional power, problematic throughout most of the century, often shifted subtly but suddenly, even after the Restoration. As a consequence, institutional responses, particularly those from medical, scientific and religious groups seeking government favor or tolerance, tended to be nimble, though often tentative and partial.[9]

I: The Oxford Physiologists and the Blood

Formation of the Oxford group

The make-up of both the English scientific community as well as its Oxford sub-set during the Revolutionary, Commonwealth, and Restoration periods has been considered in detail by others.[10] Following the influential approach of the turn-of-the-century sociologist Max Weber regarding the influence of Protestant values on the formation of capitalism, Robert Merton argued in the 1930's that Puritan ideology underlay the devlopment of seventeenth-century English science, particularly that recorded in the records of the Royal Society. In the 1970's the English historian Charles Webster published an influential series of papers and books supporting and extending this analysis backward into the Civil War and Interregnum periods. While both of these theses has received extensive commentary and criticism, it was not until 1980 that the mid-century Oxford scientific community received detailed analysis. Avoiding in large measure the ideological bent of Merton, Webster, and their followers, Robert Frank instead sought to portray the process of scientific thought in communal terms in his well-received analysis, *Harvey and the Oxford Physiologists*.[11]

My intention here is not to re-capitulate this work, but rather to emphasize and develop several points relating to the background of the English approach to the blood. In doing so, I take issue with the general notion put forward by Merton and Webster that Puritan values (Merton) and/or Puritan/Latitudinarian values (Webster) were of decisive importance in English physiology. The demographic reality is that the Oxford physiology of the blood was developed by young men who tended to be drawn from Anglican families of some rank and property. Moreover, the relative fluidity of movement between religious and scientific and medical vocations in this group provided a reservoir of

sophistication about the "new" philosophy of the body to Anglicans after they were "restored" in 1660. While many men from Puritan families studied medicine in the universities in the 1630's and 1640's, a similar situation did not exist for "Puritan" natural philosophers and their churches. Not only was there a comparative paucity of "Puritan" minister/physician-physiologists, but also Anglican efforts in the early Restoration to reclaim religious offices (and revenues) did not cause a large movement "Puritan" ministers to take up medical vocations in what would have been their middle age. Secondly, although educated in the humanism that pervaded the established curriculum,[12] the Oxford physiologists were inculcated into a scientific culture that included what nowadays would be termed "bench work" from the very beginning.

Finally, a young investigator's political and religious commitments did not divide him from the larger community. Even when Oxford was occupied by forces of either side, freedom of conscience seems to have been respected within the experimental clubs in which the bulk of scientific work was carried on. Why was this so? In large measure the internal tolerance exhibited by the Oxford physiologists in the 1640's and 1650's reflected the conscious efforts of its principal patron, John Wilkins (1614-1672), to establish the scientific movement as non-dogmatic in matters of religion and politics. Educated for the ministry, Wilkins, who pursued mathematics as an avocation, was a proponent of the spread of scientific knowledge and published several books on astronomy and communication aimed at the general public.[13] Assuming the Wardenship of Wadham College in 1648, he was able at the same time to satisfy Puritan oversight committees as well as retain some Anglicans.[14] Importantly for physiological research, Wilkins was able to continue informal gatherings that had begun around Harvey and regularize them as a weekly experimental club. As was the case in parallel groups in London with which Wilkins and John Wallis

(1616-1703) had been involved, one of the *de facto* rules of the experimental club(s) was the exclusion of "all Discourses of Divinity, of State-Affairs, and of News, (other than what concern'd our business of Philosophy)."[15]

It was a policy that was later adopted by the Royal Society as well. But such an impulse to exclude political, religious, and metaphysical discussion from science was not unique to the English. When the French, well aware of Bacon as well as mid-century English natural philosophy, formed their Academy of Sciences in the late 1660's, they too forbade "discussion of the mysteries of religion or the affairs of state; and if there is at times talk of metaphysics, morals, history, or grammar, it will only be in passing and in relation to physics or to exhanges among men."[16]

Insistence on an explicit ideological neutrality particularly suited the temperament of Wilkins. In the political tumult of mid-century England, many were able to move nimbly when the political climate changed abruptly, but few managed with the aplomb and success of Wilkins. Despite being an object of suspicion from all sides during a long and public career, Wilkins managed to make the transit from being Oliver Cromwells brother-in-law (as of 1656) to becoming Bishop of Chester (1668) despite the disapproval of the Archbishop of Canterbury, Gilbert Sheldon.

Prior to George Ent's 1641 *Apologia* for Harvey's landmark work of 1628, *Exercitatio anatomica de motu cordis et circulatione sanguinis in animalibus*, the only major support for Harvey's theories, first published in 1628, came from Descartes, who discussed them at length in his *Discours de la methode* of 1637.[17] This delay in acceptance had the consequence that when Harvey's ideas were taken up in earnest in England in the 1640's, many investigators were not his chronological peers, but instead young men who learned their first physiology through the interpretive framework of Harveian ideas. This is not to say that

Aristotelian ideas and Galenic humoral physiology were not still central in Oxford medical curricula, for they were. But it did mean that the age cohort that came to intellectual maturity in mid-century, unlike the men of Harvey's generation, absorbed the new physiological thought and practiced the newly important methods of comparative anatomy and physiological experimentation as they learned the text-based medicine of the scholastics. Although centered in Oxford from the mid-1640's to the early 1660's, investigative physiology was also carried on in London among the "1645 group" organized by John Wallis and at the Royal College of Physicians and the Company of Barbers and Surgeons in the 1650's.[18] Francis Glisson, Regius Professor at Cambridge from 1636 and a participant in the London groups, encouraged his students to practice the two key Harveian methodologies, vivisection and comparative anatomy.[19]

Prior to the Restoration, however, the center of mid-century circulation physiology was Oxford, where, even as early as 1631, the Regius Professor, the Galenist Thomas Clayton, was not unsympathetic to student affirmation of Harveian theory.[20] Additionally, Oxford possessed a number of endowments dating from the 1620's which provided sustained institutional support for the sciences. The Savilian Professorships of Geometry and Astronomy (1619), the Sedleian Professorship of Natural Philosophy (1626), the Physick Garden (1621) and the Tomlins Readership in Anatomy (1624) all provided incomes which potentially could support active scientific investigation.[21] If the Puritan oversight committees were successful in inserting some of their men into these posts during the Commonwealth, such as the Presbyterian Joshua Crosse as Sedleain Professor, they did not capture all of the posts. Largely through Wilkins' efforts, for instance, the Anglican divine and natural philosopher Seth Ward was named as Savilian Professor of Astronomy in 1649.

Importantly, when Harvey was in residence at Oxford in the 1640's, a sizable community of young investigators assembled there who pursued a parallel but extracurricular program based on Harveian problems. Aside from Harvey, who was 64 when he came to Oxford, the thirteen investigators named by Robert Frank as "major" in an Oxford scientific community which numbered over time in excess of 110 over the period 1640-75, had an average age of 21 (median age 18) when they first came to Oxford.[22] In contrast to the make-up of the London groups, the young men who became most involved in Harveian physiology at Oxford came from predominantly Anglican backgrounds. Moreover, several of them entered Oxford with the intention of a priestly vocation in the Church of England. Major figures, such as Thomas Willis, as well as minor but significant contributors, such as Ralph Bathurst, changed their academic emphasis when a career as an Anglican divine seemed not possible.[23] As did Bathurst, others, such as the major figure, Seth Ward (1617-1689) and the (unrelated) virtuoso John Ward (1629-1681), earned part or all of their livlihoods practicing natural philosophy (Seth Ward became Savilian Professor of Astronomy at Oxford in 1649) or medicine (John Ward) until the Restoration settlement made Anglican religious vocation again possible.[24] Furthermore, although public Anglican services were forbidden during the 1650's well-attended covert Anglican services took place without repression in Willis's home.

In terms of family background, five of the thirteen had fathers who had Anglican religious vocations.[25] They also tended to come from established families, some of whom enjoyed considerable property and social station. Three came from families headed by gentlemen or above. Two were from yeoman stock, and the fathers of the remaining three were a goldsmith, a clothier, and an attorney.[26] Political ties during the Civil War covered the spectrum from inactivity to participation in either the Royalist or Puritan cause. Richard Lower

(1632-1691), for example, who became well-known in the early Restoration for his transfusion experiments, came from a landed family and was educated at Westminster. His family was also noted for its Puritan sympathies. Lower's elder brother Thomas (1633-1720), also qualified as a physician, spent most of his adult life promoting Quakerism and served as the Quaker leader George Fox's amanuensis.[27] Lower's investigative colleague and fellow vivisectionist, Christopher Wren (1632-1723), whose father was Dean of Windsor, came from a well-established Anglican family that included a bishop.[28] Thomas Willis (1621-75), who worked with both of them in the 1650's and early 1660's, came from a humble but Royalist family. When he left Oxford during the Puritan siege of 1646 to fight for the Royalist cause, no evidence exists that he was negatively sanctioned by his colleagues upon his return.[29] However, for the older generation of Royalists, including Harvey, such was not the case. Many of them, including Harvey and Wren's early anatomy teacher , Charles Scarburgh (1616-1694), settled in London after Oxford fell to parliamentary forces in 1646.[30]

The distinction between "discourses of Divinity" and "our business of Philosophy," or between divine knowledge and other knowledge, was an important distinction to Wilkins. Wilkins wanted a natural philosophy that proceeded by reason and tentativeness.[31] He realized that this required "Philosophical Liberty."[32] He also appreciated that arguments about religion and spiritual knowledge easily became arguments about philosophy and politics. Wilkins was particularly chary of the mystical aspects of religious and scientific argument. Perhaps this resulted, in part, from his personal interest in subjects that were also central interests of "hermetic" philosophers. Wilkins pursuit of astronomy, mathematics and a universal language was mirrored by widespread interest on the part of the "hermetics" and mystical philosophers in astrology, numerology, and universal characters. Indeed, one cannot tell from the titles of

some of Wilkins texts--e.g. *Mathematical Magick, Mercury; or, The Secret Messenger; Discourse Concerning* the *Possibility of a Passage to the World in the Moon*--on which side of the fence he sat. Yet it was clear to him and his colleagues, as well as to Interregnum critics of the universities, that there was a fence and that they were on opposite sides. This sense of viewing the same object yet seeing something quite different-- an incommensurability of epistemological outlooks--is conveyed in the debate between Wilkins and Seth Ward (1617-1689), on one side, and John Webster (1610-1682) on the other regarding the state of the universities. I will postpone discussion of this, however, until chapter five, when it may be placed in the broader context of debates that occurred throughout the period over the place and content of learned medicine.

In characterizing the Oxford experimental club(s), of which Wilkins' was important but not singular, Charles Webster and others have attempted to make fine distinctions between the experimental interests of the different groups.[33] Nonetheless, scholars have agreed on the wide overlaps in interest and approach between Boyle, Petty, Highmore, Charleton, Lower, Willis, Wren, and other major investigators. Not only were the physiologic "problems" of animal heat, sanguification, and respiration generated by Harvey's work large and amenable to a variety of approaches, but the very notions of distinct discipline conveyed by such words as chemistry, anatomy, and physiology were only beginning their modern formations in England.

The term "physiology" had a particularly loose definition. As John Lesch has noted, until the eighteenth century, "physiology" was generally synomynous with "study of nature." In writng on the heart and circulation, for instance, Harvey described its *function,* but he entitled the work *"anatomical exercises."*[34] The change to a more modern usage of physiology as the study of the function of living things seems to be gradual and non-uniform. In writing on the functions

of the brain and nervous system in the 1660's, Willis distinguished between anatomy and physiology. Knowledge of structure implied knowledge of function, but normal function carried the separate designation of "physiologie."[35] However, in listing the contents of *The Sceptical Chemist* in 1661, for example, his occasional colleague, Robert Boyle (1627-1691) subtitled them, "Physiological Considerations touching the Experiments wont to be employed to evince either the Four Peripatetick Elements, or the three Chymical Principles of Mixt Bodies." In his *Certain Physiological Essays*, also of 1661, Boyle listed "Chemistry, Anatomy, Botanick, or some other particular part of Physiology" as his subject.[36]

"Anatomy" was also used broadly. Of the twenty -six published texts whose first title word is "Anatomy" listed in the *Short Title Catalogue 1641-1700*, only two or three treated the structure of animal bodies.[37] Indeed, in its purely medical meanings, not to mention its increasing employment as a trope for analysis, the meaning of "anatomy" had been expanding since at least the sixteenth century. Generally based on the premise that structure implied function, "anatomy" was performed on fluids, substances such as minerals thought to be therapeutically active, diseased organs, as well as "normal" animal corpses, including humans.

Also, in early modern formulations, there was often no clear distinction between what we consider the animate and inanimate worlds. For example, when Bacon listed the contents of his *Silva Sylvorum, or a Natural History in Ten Centuries* (published posthumously in 1626), he included thirteen works as "physiological Remains." Of these, seven were on minerals and six on attractive force and transformation of inanimate bodies.[38] Later in this chapter I will develop some implications of this posture.

The Harveian models themselves were sufficiently ambiguous to admit of many meanings. Indeed, Christopher Hill and Gweneth Whitteridge engaged in

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an extended debate in the 1960's in the journal *Past and Present* regarding possible shifts in Harvey's political outlook as he moved from "heart" to "blood."[39] I must say that I agree with Whitteridge that Harvey remained a monarchist to the end. What is more salient than Harvey's possible ideological shift is recognition that during the Interregnum, the community of experimental physiologists in Oxford never developed self-consciously ideological models of the body. One cannot find the "heart" attracting the more politically conservative, for instance, and the "blood" the more radical. What one finds is that the questions Harvey's work posed regarding the nature of blood, animal heat and fever, and respiration were the ones the younger generation of investigators sought to answer. In doing so they formed informal and fluid working groups based on individuals' current experimental interests and their respective skills. Although it is true that many of an older generation of Royalist natural philosophers had been driven from their university sinecures during the early Commonwealth, there is no indication that their presence or absence would have made any difference regarding the ideological content of Oxford research. Prior to the Restoration and within the community of English physiologists, I would argue, human physiology was not ideologically charged. In large measure this resulted from the freshness and richness of the scientific problems opened up by Harvey.

I would also suggest, however, that it was a result of the conscious efforts of Wilkins, Wallis, and others to keep ideologically charged issues out of experimental philosophy and its communities of practitioners from the very beginning. If this allowed Interregnum natural philosophy at Oxford to take on a form recognizable to later generations as progressive "science," I shall argue later in this chapter that the same policy also established an orthodoxy regarding the place of the blood which invited challenge when it went public in the

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Ontologies of the Blood

The purpose of this section is to set out in brief form selected major developments in blood physiology during the 1640's and 1650's. I am particularly interested in those ideas, texts, and authors which proved most controversial in the 1660's and 1670's. No intention is made to be comprehensive. The work of Harvey and Highmore on the role of blood in generation and embryology will be ignored, for example, as it did not prove especially problematic in the Restoration. Having discussed methods at some length in another chapter, the primary emphasis here will be on ideas. As they are taken up in the next section, foreign influences will be noted minimally here.

If Harvey had established that the heart was a pump that circulated the blood continuously through the arteries and veins, he left to his successors the explanation of animal heat, the purpose of respiration, and the formation of the blood. Whereas in *De motu cordis* he had viewed the heart as the possessor of an innate heat, by the late 1640's if not earlier Harvey had decided that the "innate heat belong(s) to the blood alone."[40] Never a great believer in chemical analysis, however, Harvey had little idea how the blood sustained life. As he put it in 1653 regarding his attitude toward chemical analysis: "It is, however, an argument of no great cogency to say that natural bodies are primarily produced or composed of those things into which they are ultimately resolved."[41] On the other hand, he had since his Lumelian lectures of 1618 recognized the importance of the lungs, which he found superior to the liver: "Without the liver you cannot survive for a prolonged period, but without the lungs not even for a moment....The lungs generate spirit, or rather, in my opinion, they imbue the aliment (with spirit)."[42] Other than saying that "spirit" was not air, however, Harvey never precisely defined the term.[43]

In the 1650's English physiologists based primarily at Oxford , but including Francis Glisson (London and Cambridge), undertook sustained investigations of these related areas of blood function and structure, heat, and respiration. By the beginning of the Restoration they had formulated a coherent theory that related animal heat to respiration and the composition of the blood. Representing a synthesis of much current thought on the blood was a volume written by Willis in 1656 that contained three treatises entitled *De fermentatione, De febribus*, and *De urines*. Published in 1659 in London as *Diatribae duae medico-philosophicae,* the essays on ferment and fever represented both a physiological and pathological account of the blood based on a matter-theory adapted from Paracelsus. Cited approvingly in medical texts as late as 1737,[44] the *Diatribe* (and Willis) were also subject to strong criticism from an Irish physician , Edmund O'Meara, and others in the Restoration. In his published defense of Willis, his assistant Richard Lower made additional points about the Oxford approach to the blood. When taken together, the *Diatribe,* O'Meara's attack, and Lower's *Vindicatio* illustrate several of the main issues and tensions among physicians regarding Oxford physiology in the 1650's. As I present the debate later in chapter five, I would first like to discuss Willis's text in its own terms.

In terms of its matter theory, the *Diatribe* described matter and life in terms that borrowed heavily from both Paracelsian ideas and the Epicurean atomism of Gassendi that made its first appearance in English in 1657. The Epicurean philosophy appealed to Willis because it "...avoids occult qualities, sympathy, and other refuges of ignorance."[45] Nonetheless, his praise was not unqualified. The problem was that atomism was not demonstrable. It "rather supposes than demonstrates....and induces notions extremely subtil and remote from the sense."[46] Even so, Willis praised the "famous Gassendus" for the comprehensiveness of his philosophy. His "Epicurean Philosophy most aptly

deduces the phenomena, almost of all meteors, and the reasons of them, from the exhaltations of sulphur, and salts, either nitrous, vitriolick, aluminous, or armonical."[47]

Although Willis (and the Oxford physiologists in general) were later to define "spirit" in increasingly material terms, in "On fermentation" spirits, which accounted for all natural phenomena, were ethereal and came from the fiery heavens. In language redolent of Paracelsian rhetoric, these spirits joined "primigeneous seeds" which contained chemically active principles of spirit, salt, and sulphur. Spirit and seed together explained growth, change, and individuation. By their action on each other ("intestine motion"), these agents caused fermentation. Fermentation was a consequence of these "subtil particles" acting with heavier and thicker earthly ones to produce heat. Fermentation was thus the key natural process that both linked animate and inanimate forms and governed life and death.[48] In animal bodies, life was sustained by a "fermentation or accension" that took place in the heart. As a consequence of the agitation of the particles of spirit, salt, and sulphur in the heart, the blood "boiled up" and carried the heat to all tissues of the body.[49] In this scheme of five chemical elements--spirit, salt, sulphur, water and earth--the blood contained "...very much Water and Spirit, a mean of Salt and Sulphur, and a little of Earth."[50] By distilling the blood in healthy and sick bodies (a physiological experiment Willis performed as early as 1650/1), one could then learn something of the nature of its "affections" in health and disease.[51]

In this early scheme Willis, like Glisson in his *De hepatis* of 1654, did not entirely dismiss the humors of classical Galenic thought. But he did describe them in the same chemical framework as that of the blood. Furthermore, unlike Van Helmont, who did not accept the circulation of the blood and assigned specific ferments to specific organs, Willis had all his humors circulating in the

blood :

> "the Blood is an only humor; not one thing about the Viscera, and another in the habit of the Body, nor is it moved at one time by Phlegm, and another time with Choler, or Melancholy, (as is commonly asserted) but the Liquor growing hot in the Vessels, is only Blood, and wheresoever it is carried through all the parts of the Body, it is still the same, and like it self."[52]

In the second treatise of the *Diatribe*, Willis developed the concept of fever as a consequence of one of several possible chemical problems with the blood.[53] Fever was a "Fermentation or immoderate Heat, brought into the blood..." that caused it to be "stirred up with a rage through the Vessels"[54] Given that fever was an unwanted form of fermentation that circulated throughout the body, the goal of therapy was to regulate ferment. Alien matter was to be expelled through blood-letting, emesis, purgation, or sweating. Fever was to be regulated through measures to promote cooling. Blood was to be strengthened through administration of medicines including those containing mineral salts, such as steel. Fevers were classified as intermittent, continuous, or putrid and their periodicities detailed. "Peruvian bark," or quinine was suggested as a specific remedy. In addition to the above, there were also descriptions of fever associated with child-birth and nursing, as well as descriptions of "pestilential" fevers including the plague and smallpox.

As Don Bates has pointed out in his review of seventeenth century fevers literature, none of this by itself was original. But by combining a chemical explanation of the blood and fever with circulation theory, "Willis's treatise exchanged Aristotelian qualities, ancient humours, and Galenic physiology for Cartesian corpuscles chemical constituents, and Harveian circulation."[55] In this sense, the early work of Willis, who was regarded at the time by his Oxford

colleagues not as the famed anatomist or Sedleian professor he was to become in the Restoration, but as a first-rate chemist,[56] represented a synthesis of the "new philosophy," to borrow John Wallis's term,[57] regarding the blood during the period 1645-1660.

Missing in Willis's early treatises was an adequate explanation of the role of the air in respiration. Describing the air as a collection of various fumes made up of particles of sulphurous and saline atoms, Willis borrowed a concept from Glisson[58] that a *pabulum nitrosulphureum* in the atmosphere was necessary for life.[59] But by placing primary fermentation, or the interaction of the particles of the *pabulum nitrosulphureum* and those of the blood in the left ventricle, he "unwittingly perpetuated the very kind of Galenic preoccupation with the heart that Harvey had striven so long to overthrow."[60] Both the chemistry of the air and its physical properties as well as the physiology of respiration were to receive sustained attention in the 1660's from Boyle, Petty, Lower, and others. Despite Willis's loyalties to the left ventricle of the heart (a position from which he departed in the 1660's), what the work of the 1650's at Oxford established was a particular theoretical view of the blood as an organ. Imagining the blood as a more or less homogenous entity whose operations were mediated chemically, the Oxford physiologists had formulated a theoretical construct capable of explaining large amounts of animal health and disease.

Foreign Influences

The influence of vitalist and mechanistic thought, particulary that of the alchemists Paracelsus and J.B. van Helmont and their followers and the Cartesians and Gassendi, on English medicine has been the subject of several book-length treatments. Indeed, as the work of Allen Debus has shown, the influence of just one Continental thinker, Paracelsus, on English thought has

many ramifications that merit a lengthy analysis.[61] In discussing English handling of foreign work on circulation physiology my intention, then, is not to be synoptic. Instead, I want to look in a selective and limited way at aspects of contemporary Continental thought on bodily matter that were problematic for English Harveians at mid-century . The vitalism of Paracelsus and van Helmont, as well as the mechanism of the Cartesians, loomed large in that respect. Within the Oxford and London groups, reception of their ideas was partial and highly qualified. On the other hand, work by Continental anatomists that confirmed and expanded the Harveian models was incorporated promptly and (more or less) completely by the Oxford and London groups.

For instance Jean Pecquet's discovery of the thoracic duct, disclosed in 1651 in his *Experimenta nova anatomica*, stimulated considerable work at Oxford on chlyle and the role of the liver in blood production within three years of its publication.[62] Though Pecquet's work presented a conceptual problem to humoralists like Edmund O'Meara, it did not for the Oxford physiologists. Also, unlike Paracelsus, Descartes, or van Helmont, Pecquet and other continental anatomists, such as Malpighi and de Graaf, wrote as specialists on specific problem areas of anatomy and physiology. They not only accepted the circulation of the blood as outlined by Harvey and amended by his mid-century followers, they also were not in the business of constructing physiologies that also made large claims of a cosmological nature. In contrast, Paracelsus, Descartes, Gassendi, and van Helmont all had written at great length not only about bodily organization, but also about the nature of spirit and matter and their interactions. As the Oxford physiologists developed their ontologies of the blood in the 1640's and 1650's, they chose selectively from the more cosmologically inclined of the foreigners. In this they reflected the reluctance of

Boyle and Wilkins, to name the two most explicit in this matter, to be wary of large epistemological claims of a philosophical nature.

Like his colleagues and students, Willis was well aware of a full specturm of Continental work on matter-theory and the body. With regard to the texts on the blood that emerged from the Oxford groups in the 1650's and 1660's, the most frequently cited Continental authors in the works of Willis, Glisson, Ent, Lower, Highmore, and Boyle were Jan Baptista van Helmont, Helmont's pupil Franciscus de la Boe, or Sylvius (1614-72), Descartes and his desciples Cornelis van Hooghelande and Henry Regius, Daniel Sennert (1572-1637), Pierre Gassendi, Niels Stensen (1648-86) and other contemporaries as well as those of an earlier generation including Jean Fernel and Paracelsus. Early references to contemporary continental writers, particularly the Cartesians, tended to be indirect. In his *Apologia pro circulatione sanguinis* of 1641, for example, George Ent, who received his M.D. from Padua in 1636 and traveled in Europe for sometime afterward, did not mention Descartes by name.[63] Nonetheless in the introduction Ent praised the work of Henry Regius, perhaps the most well-known of Descartes medical followers. As did Descartes in his *Discourse on Method* of 1637, Ent also denigrated the existence of various bodily "faculties."[64] Even Oxford undergraduates in the early 1650's, such as John Locke, were reading recently published continental works such as van Helmont's *Ortus medicinae* (1648).[65]

In Willis's published works, beginning with the influential trio *De fermentatione*, *De febribus*, and *De urinis* (1659) and continuing through the *Rational Therapeutics*, first published posthumously in Latin in 1675, there are numerous references to Paracelsus, Helmont, Gassendi, the Cartesians, and Sylvius. Of English authors, Harvey was by far the most often cited by all the Oxford physiologists, but they also cited Francis Bacon and each other. Willis,

for instance, referred to Harvey frequently as well as to Ent, Glisson, Charleton, and Highmore. Willis made fewer references to Descartes, Sennert, Steno, and Regius. Of the ancients, Aristotle and Galen received respectful mention from Willis and Lower in numerous places, but Hippocrates was essentially ignored. Willis was particularly generous in acknowledging sources as well as the help of colleagues. However, it should be mentioned that no standard existed for acknowledgment of sources in seventeenth century natural philosophy. The works of J. B van Helmont's contemporary, the Wittenberg medical professor Daniel Sennert, for instance, contained numerous footnotes whereas van Helmont seldom acknowledged sources.[66]

It is important to note the continuity of *intellectual interest* evidenced by English investigators in foreign thought of all persusasions throughout the Civil War, Interregnum and Restoration periods. Responses and interpretations changed, to be sure, from the 1640's to the 1670's, but the work of the Englishmen under consideration in this dissertation reflected continuing interest in issues of matter-theory, blood, disease and bodily organization that engaged many European investigators (as well as ideologues) in the middle decades of the seventeenth century. Widespread translation into English during the 1650's and 1660's of many of the works of "alchemical" continental authors mentioned above reflects a broader social interest as well. Walter Charleton's selected translations of van Helmont, the *Deliramenti Catarrhi* (London, 1650), A *Ternary of Paradoxes* (London, 1650) and *Spiritus Gorgonicus* (Leyden, 1650) preceded by twelve years John Chandler's more complete translation of van Helmont's *Ortus medicineae* of 1648.[67] Chandler's version appeared in English as *Oriatrike Or Physick Refined* in 1662.[68] Major translations of Paracelsus, the first in English, appeared in the 1650's, including his *Archidoxies* and the (suppositous) *Philosophy to the Athenians*. England experienced a veritable flood of alchemical publications

beginning with the collapse of censorship in the 1650's and extending through the Restoration. Among the more important vernacular versions of Paracelsian and Helmontian doctrines published in the 1650's were Jacob Boehme's *De signatura rerum* (translated by John Sparrow) of 1650, and George Starkey's *Natures Explication and Helmonts Vindication* (London, 1657) and *Pyrtotechny Asserted and Illustrated* (London, 1658). A general collection of alchemical texts of diverse kinds was published by Elias Ashmole in 1652 as the *Theatrum chemicum Britannicum.* When he turned away from van Helmont in the early 1650's to take up atomism, Charleton completed an extensive explication of Gassendi's matter theory, which was published in 1654 as the *Physiologia Epicuro-Gassendo-Charlotoniana.* However, Gassendi's own work remained largely untranslated, only a highly edited version entitled the *Mirrour of True Nobility and Gentility* (W. Rand translator) appearing in London in 1657.[69] In considering some of the Oxford selections (and omissions), I will take up the major foreign cosmologies in order of their appearance in England.

Paracelsus

By the middle of the seventeenth century, Theophrastus Bombastus of Hohenheim (1494?-1541), the man known as Paracelsus, had been so long dead and his work so amended by followers that determining English response to an authentic Paracelsian corpus seems impossible. From a bibliographic point of view, then, discussion of Paracelsian influence is severely compromised. The matter theory in Paracelsus's *Philosophia ad Athenienses*, for example, had been strongly attacked for its impiety in the sixteenth century by the Dutch philosopher Erastus.[70] When that text was translated into English in the Interregnum, it was again taken up (and attacked) for its matter theory. According to Walter Pagel, however, Paracelsus' authorship of that text is

doubtful. Similarly, "R.B." 's emendation in 1595 on Paracelsian theory, "The difference betwene the auncient Phisicke...and the latter Phisicke," may be based on inauthentic sources.[71] Compounding this bibliographic mush was the practice of Willis and Boyle, to mention only the most prominent of mid-century Oxford chemists, to make reference to Paracelsus without citing specific texts. Regarding the place of Paracelsian thought in Oxford physiology of the blood, the question must be asked, then: Did the Oxford physiologists know what they were talking about when they referenced Paracelsus? In one sense they did. The (then) new reading room of the Bodleain Library contained Paracelsus among the names of eminences engraved on its frieze. Mention should also be made that the Oxford physiologists were also familiar with transitional figures, notably Robert Fludd (1574-1637) and Daniel Sennert (1572-1637), who attempted to integrate Paracelsian chemical ideas into medical theories.[72] Regarding their knowledge of specific texts, however, caution seems in order.

By the third quarter of the sixteenth century, English physicians were accepting chemical remedies, which is to say remedies based primarily on metals and elements such as mercury and antimony, with increasing comfort. Paracelsus was cited along with others as a main source of these formulations. Allen Debus has argued that the theoretical basis of his therapies, however, was regarded tentatively. Writing in 1602, for instance, William Clowes indicated he would be "thankful to God" for "anything that may be to the good of the Patients.....be it eyther Galen or Paracelsus."[73] Despite the success of Paracelsian medicines, however, Clowes found Paracelsus's "Doctrine hath a more pregnant sence then my wit or reach is able to construe"[74] Nonetheless, in its first *Pharmacopoeia* (1618), the London College of Physicians included several Paracelsian compounds of mercury and antimony, including calomel, in its forumlary of approved drugs.[75] These were included in the second edition,

published in 1650, an English version of which gained notoriety for its translator, Nicholas Culpeper.

It is not self-evident to me, however, that Debus's claim that turn of the (sixteenth) century Englishmen eschewed Paracelsian theory survives scrutiny. A recently discovered manuscript of Francis Bacon, which will be considered shortly, suggests that not only were chemical medicines accepted early on, but also that Paracelsian theory was taken seriously, at least by Bacon, early in the seventeenth century. Paracelsian influence in the work of the transitional physician and philosopher, Robert Fludd, is well known. But Fludd, though perceived as an excellent physician and imaginative thinker by his contemporaries, had only minimal influence on mid-century physiological thought. Bacon, by contrast, was on everybody's lips from the 1640's on. Indeed, virtually anyone who wrote on chemical matters or medical theory in the second half of the seventeenth century either self-identified as a Baconian, cited Bacon approvingly, or was cited by friendly colleagues as a Baconian. Indeed, the chief criterion of being a Baconian during the period of this study seems to have been being an English person with a professed curiosity about the natural world.

All of this about Bacon is by way of saying that a comparison of his matter theory with Paracelsian ideas may indicate a depth of chemical and vitalist thinking in orthodox English natural philosophy at an earlier date than heretofore appreciated. As I hope to demonstrate, it was not that Bacon thought so much as a Paracelsian, but that when he about the matter of animal bodies, he thought chemically and vitalistically in ways that both echoed Paracelsus and were distinct. When this brief analysis is then carried forward into the mid-century thought of Willis and Boyle on the blood, a pattern may emerge that supports a somewhat different interpretation of the status of Paracelsian and alchmeical influences in subsequent English medical theory than those given by

a number of recent historians including Debus, C. Webster[76], P. Rattansi[77], M.C.. and J.R. Jacobs[78], T. Brown[79], and J. Mendelsohn.[80]

When Paracelsus wrote about the prime matter of the world, as he did in the *Opus Paramirum*, an authentic text of 1531, he equated it with "fiat." [81] In the *Book on Minerals*, the first principle "was with God, the beginning, that is ultima matera; this ultima materia He made into prime matter."[82] When he talked about the prime matter of individual objects, and the necessity of the phsyician to understand their chemistry, Paracelsus wrote: "God created all things, something from nothing. This something is a seed....all things are created as *prime matter* and after that the vulcan follows and turns them into ultimate matter through the art of alchemy."[83] The "seed" referred to here was "the element of water."[84] The transformation of "*fiat*" into" *materi*a" happened through the spiritual agency of Paracelsus's famous three principles: Salt, Sulphur, and Mercury. These principles were the origin of the elements and the material principle of all animal bodies.[85] Matter then individuated into individual objects through the agency of their individual "blacksmiths"--the vulcan and *Archei*--on the object's original prime matter, or seed.[86]

According to Walter Pagel, the above passages on *fiat* and *materia* alluded to the prologue of the Gospel according to John: In the beginning was the Word.[87] According to Paracelsus's first English commentator, Robert Bostocke, or "R.B.," the allusions were to St. Augustine.[88] Also worth noting is the use Plato made of the seed concept in his late work, the *Timaeus*. The Platonic connection is especially important, I think, in light of the interest displayed in alchemical theories, including Paracelsus's, by English Neoplatonists in the Restoration. Henry More, for instance, regularly studied chemical theory not only with Robert Boyle, but also through conversations with van Helmont's son,

F.M. van Helmont.[89] Though he never believed that spirit and matter were interconvertible, More maintained that spirit, despite its immateriality, was real.

Francis Bacon and Paracelsianism

Francis Bacon's (1561-1626) most extensive discussion of the relations between spirit and matter occurs in a manuscript first translated in 1984 by Graham Rees and Christopher Upton.[90] Entitled "De viis mortis", the manuscript, which exists as a heavily annotated mix of prose and aphorisms and dates from 1610-1620, deals with the prolongation of human life and may have been intended as the basis for a never-completed section of Bacon's *magnum opus*, the *Great Instauration*. Many of the ideas in "De viis mortis" do appear, however, in Bacon's published *Historia vitae et mortis* (1623) and the *Novum organum*.[91] Nonetheless, assessment of the influence of Bacon's vitalist cosmology on Oxford physiological thought remains problematic. In 1661 Boyle and Wilkins did attempt to reproduce a Baconian thought-experiment on planetary creation, which indicates some knowledge on their part of Bacon's more speculative thought.[92] However, while the Oxford physiologists as a group paid verbal obeisance to Bacon, they did not make a practice of citing specific texts. At one point in a lecture in 1664 Locke noted Willis as describing blood as oil and the heart as a lamp in a manner that echoed Bacon's characterization, but the reference was not explicit.[93]

For Bacon "all spirit of things is a breath compounded of an airy and flamy substance."[94] Moreover, "every tangible being possesses and holds a spirit within itself.....However this spirit is certainly not some force, or energy, or trifling thing but is clearly a thin body distributed and invested in the grosser parts of the object. (Nor again is this spirit outer air which has covertly stolen in or insinutaed itself but simply a thin and innate body different from air)."[95] Spirits

differed one from another and were "compound" substances.[96] On the subject of matter, Bacon was explicit that it had a quantifiable mass: "For we do not understand matter in the fashion of the schools as something abstract or potential but in fact as a real thing whose bulk can be determined in the case of any (object), be it greater or smaller, as far (indeed) as calculations are concerned."[97]

In this formulation, all bodies had a dual nature: "Every tangible being here within the surface and outer parts of the earth has a spirit hidden in the grosser body; nor is there any tangible body known to us which is not made up of a dual nature, namely of spirit and gross matter."[98] Spirit was a "corporeal substance (albeit invisible and intangible) which occupies the spaces."[99] It was "simply...another body envoloped and invested in the grosser body." Moreover, it was "native" and "individual": "For the juice fo the grape is not water but wine, a liquid very different from water. In the same way that spirit is not air but a tenuous substance...very different...from ordinary air."[100] All of these conditions pertain "within the surface of the earth and its outer crust (which certainly does not extend very far into the depths)."[101] The remainder of the earth was lifeless and inert to Bacon. In his elemental thought, Bacon retained the Paraclesian principles of sulphur and mercury, but he regarded them only as natural substances. Salt was not a prinicple to him, but only a compound of sulphur and mercury.

In Bacon's forumlation of matter and spirit, there was no sharp distinction between inanimate and animate forms. Living spirit, as opposed to inanimate spirit, however, had the ability to be "branching" as well as being possessed (more or less) of a "kindled flame."[102] The "kindled spirit" was "like a gentle flame" which needed "alimentation" to avoid "consumption and dissolution."[103] Both animal and vegetable forms of "every living spirit" possessed this flame "differing greatly in degree" from one to another.[104] The principal distinction

between animal and vegetable forms was that the branching forms of animal spirits had the additional feature of a spirit repository he called the *ventriculis cerebri,* or ventricles of the brain.[105]

Death and destruction "of animals (is found) (much more in inanimate bodies than in those living beings themselves.)"[106] The reason was that the vital spirits in animal bodies could repair themselves. The spirits tended to escape, and, once escaped, left matter inert. The key to life and health was to retain the spirits in the body in such a way that they did not irritate their container(s) or escape.[107] Within the body, the juicier portions were easier to maintain: "the blood and humours are repaired without difficulty. But the bloodless parts (prinicpally)--as are nerves, membrances, tunicles, bones, and the like--are scarcely restored once they have lost their flexibility, softness, and juiciness."[108] (In practical terrms, this belief in the necessity of moisture retention led Bacon to recommend wearing oiled underwear (to keep the spirits in) and admire the "paint" and consequent long-life) of native Americans for a similar reason.[109])

If Bacon revealed some of his debts to Paracelsian theory in the foregoing, he also displayed some profound differences. One of the most striking similarities was the shared assumption that the universe, or at any rate that portion of the thin crust of the earth where his life took place, was a chemically mediated experience. Secondly, both spirit and matter were necessary for the existence of all things. Thirdly, there was no sharp dividing line between animate and inanimate forms. Fourthly, the study of medicine occupied an important place in the program of natural philosophy, for mastery of it held the potential for prolonging life.

In each of these areas, however, Bacon, even at his most speculative, differed from the outlook of Paracelsus and his followers. In the first place, unlike almost any excerpt from Paracelsus, the tone of "De viis mortis" is

remarkably secular. Stripped from the account of matter and spirit are allusions to Christianity as well as the supernatural. In contrast to Paracelsian thought, spirit, if intangible, had become corporeal. Things existed dualistically, not pantheistically. Whereas Paracelsus had become known (and notorious for) his analogies between the microcosm (living things) and the macrocosm (the stars), Bacon fixed his attention on that portion of the earth (its "outer crust") that interacted with the air. The rest may have been "matter" to Bacon, but its existence did not seem to matter in a consequential way. In terms of animal bodies, blood was important, as it was to Paracelsus, because it was thought to be an appropriate *locus* of therapetic intervention. However, Bacon added a layer of distinction between the animal and vegetable forms that was lacking in Paracelsus: the ventricles of the brain.

Although the point is not developed in the fragment "De viis mortis," elsewhere Bacon described quite a different relation between man and scientific knowledge than that common among the alchemists.[110] In Bacon's utopia, Solomon's House, knowledge accumulated through cooperative work over time by industrious members of a team, a description that became self-applied by members of College of Physicians in the 1650's and the Royal Society in the 1660's. In contrast, Paracelsus and his followers operated in the framework of what Pagel has termed "the invidual "Savant" and his "World."[111] In this model the physician was akin to the charismatic priest in that his knowledge was from an individual divine illumination regarding the secrets of nature. As such, institutional frameworks, acknowledgement of predecessors, and efforts to transimit knowledge to successors were of minimal importance.

Paracelsian influence on the Oxford version of the blood

The most speculative of the Oxford physiologists, Willis was also the most chemical in his approach to the blood. On first reading, particularly of his early works, Willis can sound surprisingly Paracelsian. As mentioned earlier in the section on his *Diatribae duae,* Willis described spirits in a manner amenable to a non-material interpretation. Behaving like Bacon's, they were "ethereal" and came, if not directly from God, from the "fiery heavens." Matter existed as the consequence of "primigeneous seeds" which contained spirit, salt and sulphur. Furthermore, these "seeds", which existed as "subtil particles," explained growth and individuation. Furthermore, when Willis described the separation of the "animal spirits" in the brain, he employed a distillation analogy in language redolent of alchemy: "the Brain with a Skull over it and the apending Nerves, represent the little Head or Galssie Alembic."[112] Describing the contraction of muscles in 1667, Willis described the reaction as an "explosive copula" consequent to the reaction of nitrous and sulphur spirits, a popular reactive mechanism among the Paracelsians.[113] Moreover, in the conclusion to his dedication of his *magnum opus* on the brain, the *Cerebri anatome* of 1664, Willis described Vulcan--the trope for alchemy--as the "midwife" in assisting the process of discovering the "truth" of the body.[114]

Having described some of the similarities, mention should also be made of where the Oxford physiologists, Willis included, parted company with Paracelsus. As had Bacon, they dispensed with the *Archei,* or individuating force, in living and inanimate bodies. For whatever their other reasons, such an exclusion was a plausible outcome of their belief in Harveian circulation theory. There simply was no room in their form of the body for independent immaterial but causative forces to be present in individual organs. Regarding the conceptual scheme of elements and chemical principles put forward in the *Diatribe,* Willis

also dispensed with mercury except as the element it has come to be known by. This was an omission of consequence, I would argue, for mercury in the Paracelsian *schema* was the principle of transformation that mediated between sulphur and salt in both living and inanimate bodies. In its place, Willis relied on the biological concept of fermentation. Given that he and his colleagues believed that it was the primary chemical acitivity in the body as well as having its site in the blood (Willis (1664), Lower (1669) and Mayow (1774)), the implicit substitution of ferment for the spirit of mercury shifted the focus of therapeutic interest onto the blood and away from the visceral organs. Interestingly, Bacon, who had not the conceptual benefit of Harveian theory, also identified the blood as a preferred site of therapeutic intervention.

Robert Boyle, on the other hand, was concerned that Paracelsian chemistry was too much concerned with effects and not enought with systematic investigation. Writing on "Fluidity and Firmness" in his *Certain Physiological Essays* of 1661, Boyle had this reservation about Paracelsus's three principles:

> "the chemical motion of which (the three principles of salt, sulphur, and mercury and the like) though of very good use in some other (especially of the more practical) parts of Physiology, seems not as yet to have brought any great light to such matters as we have been treating off, having been hitherto directed not so much to the indagation of Causes, as to the production of Effects."[115]

Helmontian influences

Both fermentation and the "subtil particles" of Oxford physiological chemistry also had foreign antecedents. As noted earlier, the works of J.B. van Helmont were cited frequently by the physiologists of the "clubs" in the late 1640's and 1650's. Most often this occurred in concert with a reference to

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Paracelsus. Both Walter Pagel and Allen Debus have produced extensive studies on van Helmont (as well as Paracelsus).[116] While it is true to say that Willis borrowed his term "ferment" from van Helmont, the latter's conception of chemical change in the body rested on quite different principles than those of either Paracelsus or Willis. Like Paracelsus, van Helmont imagined each body, both living and non-living, as having its own immaterial spirit, the *Archeus*.

The basis of van Helmont's chemical transformations was the reaction of materials to acid, a process he termed "ferment." Helmontian ferment, however, was not about animal heat or a "vital flame." Because his primary reaction was that of acid-alkali, he had little use for the notion that was central to Oxford conceptions of the blood. Likewise, in van Helmont's thought there was little need of the Paracelsian three principles of mercury, salt and sulphur, and van Helmont did not consider them of major importance. Also, of the classical four elements of air, earth, fire, and water, he considered only two--air and water--as basic elements. In addition to the acid-alkali ferment, the other major transforming agency was fire. Matter was conserved, and the universe was full.

Within the body, the foremost *Archei* were in the stomach and spleen. The spleen was important because it supplied acid to the stomach, where the resident *Archeus* directed the first of six transformations that turned food into blood. The blood received its final form in the left chamber of the heart, where an acid-alkali reaction occurred that imbued it with its vital spirit.[117] Despite his rejection of the Harveian model of the circulation, van Helmont thus had a conception of the blood that, like the Oxford physiologists, had an ontological status not seen in Galenic humoral theory or Paracelsian chemistry. However, despite his replacement of the Galenic coctions, or cookings, of the food into humors in the visceral organs, he had placed an even greater number of *Archei* all over the body (and universe).

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Although none of them took up the spiritual aspects of Van Helmont's matter theory, his work appealed to the Oxford physiologists on methodological grounds. Both Robert Boyle and the minor investigator Robert Sharrock appreciated van Helmont's experimental efforts to show that water was the basic element. Sharrock, who later became an Anglican divine who incorporated Willis's neurological theories in a sermon on Christian virtue,[118] did a number of plant experiments in the 1650's and published his findings in Oxford in 1660 as *The History of the Propagation and Improvement of Vegetables by the Concurrence of Art and Nature*. Citing Bacon's recommendation of horticulture as his inspiration, Sharrock (in collaboration with Boyle) attempted to extend van Helmont's well-known willow tree experiment.[119] Attempting to prove that water was one of the two primary elements, van Helmont had weighed a willow tree shoot and planted it in a tub of soil which had been weighed when dry. Five years later, van Helmont weighed the willow (weight gain 164 pounds) and the dry soil (loss two ounces), and ascribed the young tree's increase in mass wholly to the biological transformation of water.[120] Desiring to speed up the process, Sharrock planted a number of different root-stocks in separate vials of water and weighed the surviving plants after a month. Boyle performed a similar experiment. While both appreciated van Helmont's experimental findings, however, neither one accepted van Helmont's larger claims that water was the basis of life and that all living and non-living objects were capable of transformation.[121]

Van Helmont also developed an ontological concept of disease that departed considerably from humoral theory as well as received Paracelsian doctrine. Both Paracelsus and van Helmont believed that disease was a thing-in-itself. Diseases were specific objects that had their own *specific seeds*.[122] Both charachterized disease as an alien force or poison with its own *Archeus* that caused the *Archeus* (*Archei*) of the body to react. Disease, then, was the body's

experience of a dialogue or battle between the resident and invading *Archei* for control of the body. Alternatively, morbid events could happen as a consequence of the resident *Archeus* becoming decadent. Whereas Paracelsis emphsized macrocosmic influences (the stars) in disease creation, van Helmont focused on the local interactions between the alien disease *seed*, its *Archeus*, and the host's *Archeus*.

As a consequence of his preoccupation with the *Archei*, the principal ones of which were seated in the stomach and spleen, Helmontian therapeutics had a distinct approach. Since much of the interaction that caused disease took place in the visceral organs, van Helmont did not place primary emphasis on the blood. Instead, his therapeutics were oriented toward causing evacuation of the harmful products of the *Archeinal* interaction. Powerful purgatives, laxatives, and emitics were to be administered. Fever and the blood, which had been the *leitmotif* of Oxford conceptions of disease, were but side issues in this conceptual framework. One consequence was that self-identified Helmontian physicians, believing in the primacy of spirit and water as they did, had no use for blood-letting, an ancient practice which was compatible with the new Oxford ontologies.

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French influences

Neither Paracelsus nor van Helmont (nor Harvey, for that matter) were atomists. The Oxford physiologists who succeeded Harvey were, however, though in their own particular way. In this regard, the two most important influences on the Oxford and London groups active in the 1640's and 1650's were the matter theories of Descartes and Gassendi. Often these were referenced in concert. Despite striking dissimilarities in their thought, English physiologists tended to bracket the two only to then indicate that Gassendi's theories were

more appealing.[123] The example of Willis's response in his *Diatribe* has been noted earlier.

From the vantage point of the heart and circulation, preferential acceptance of Gassendi over Descartes seems paradoxical. Gassendi, after all, had little use for the Harveian models, while Descartes accepted the circulation of the blood before it was popular in England.[124] In contrast to Descartes, however, Gassendian matter theory had an explicit place for God. According to Gassendi, there was more than just matter in its various forms and random motion in the universe. God was responsible for all motion and could intervene at any time.[125] It may be, as the Jacobs have argued, that acceptance of a completely mechanical universe in the 1650's was qualified because purely mechanical thinking, as evidenced by Hobbes in his *Leviathan* of 1656, "sucked too much spirit out."[126] If so, the acceptance of Gassendi, with his problematic circulation physiology, represented an instance of Oxford group's trimming their scientific sails to suit a purely ideological wind. In any case, atomic philosophy was only one-half of the spirit/matter formulation that formed the base of Oxford physiological chemistry.

Among those who investigated the blood, I would argue that there were other powerful reasons to explain the limited impact of Cartesian physiology in English theories of the blood.[127] Perhaps the most important objection of Willis, Lower, and their colleagues to Cartesian physiology arose from their differing explanations of the heart's contractility. As is well known, Harvey had argued that the heart was a pump. The blood moved through the arteries because the heart muscle contracted. In contrast, Descartes and his Continental followers had argued the heart moved because the transference of its innate heat to the particles of the blood contained in the ventricles so caused the blood to expand that it went into the pulmonary artery and the aorta.[128] In the Cartesian scheme the

motion of the heart was completely dependent on the blood. Though occupying a central place in Cartesian theory, physically the Cartesian heart was a passive vessel. An additional weakness, in the eyes of the Oxford experimenters, was the lack of a strong experimental component in Cartesian physiology.

Resolving this difference was a major project of English physiologists from the time they were first aware of Descartes until the late 1660's. In the 1650's, for example, Robert Boyle dissected a flounder, removed its heart, and cut it in two. Removing the excess blood from the now divided heart, he noted that the heart continued beating. How could this be if Descartes had been correct? The flounder was a cold-blooded animal; its heart beat even when it was without blood.[129] Even in the late 1660's Oxford investigators were still troubled by Cartesian physiology. Richard Lower's *Tractatus de corde*, published in 1669, began with a detailed discussion of the heart's muscular structure. Based on numerous boilings of hearts to reveal their muscular detail, Lower argued that the helical patterns of fibers indicated that the ventricular contractions in systole must expel the blood completely and with considerable force.[130] Furthermore, if one substituted another liquid for blood into the veins of a living dog, the heart continued beating regularly until the dog's blood had been almost completely replaced. This could not be true if the heart's motion depended on an *in situ* exothermic chemical transformation of the blood. This was so even though Descartes imagined the body's heat as an innate ferment of the heart, a position originally taken by Willis in the 1650's. Instead, it was clear from these (and other) experiments, that the heart was only a muscle and that the prinicpal chemical reactions (and heat) happened in the blood[131]

It should be noted by the mid-1660's, the Oxford physiologists, including Willis, had agreed that the blood was the source of bodily heat. Ferment, however, was for some less and less a working model. In criticising Willis's

earlier characterization of ferment as a "vital flame", John Mayow wrote in 1674 that, "we do not need to have recourse to an imaginary Vital Flame that by its continual burning warms the mass of the blood.."[132]

Thus, even though Descartes developed an elaborate cardiocentric model that incorporated the circulation of the blood, it was cardiocentric in a radically different way than the heart-and-blood model of mid-century experimental English physiology. This is not to say that English physiology did not make use of a particulate matter theory or mechanical analogies. Nor is it even to say that these analogies, such as Willis's later characterization of the brain as the "chief mover in the animal machine,"[133] did not owe an influence to Descartes. But machine analogies were made at the level of the body as a whole. And, as I intend to show in chapter two, even at that level of metaphor, the acceptance of Cartesianism was qualified by the most influential English physiologists.

Summary of the Oxford response to bodily vitalism and mechanism

Perhaps beginning with Robert Boyle himself, chroniclers of English natural philosophy in the mid-seventeenth centuy have characterized it as either the "corpuscular philosophy," the term Boyle used, or as the "mechanical philosophy."[134] The implication of this label is that English natural philosophers, a group which included Willis, Lower, Wren and the others mentioned in this chapter, thought mechanically or in primarily mechanistic terms about the body. Harvey's vitalistic, if admittedly inchoate, characterization of the blood, an interpretation which was well-known to seventeenth-century investigators, has been ignored in most of these recent interpretations. So, too, has that aspect of Francis Bacon's natural philosophy which speculated that nature was a dualistic affair of matter and spirit in which animate and inanimate forces existed on a continuum.

Historians have handled the influence of Paraclesus somewhat differently. In reassessing the influence of alchemical thought in general on seventeenth century medicine and science, the work of Allen Debus in the 1970's had the important effect of increasing the historiographic presence of Paracelsus in the history of early modern science. His characterzation of Paracelsian influence in late sixteenth century and early seventeenth century England as a "compromise" in which therapeutic inplications were taken up and theoretical issues avoided has tended to reinforce descriptions of orthodox Interregnum and Restoration medicine as mechanical in outlook, however.

The works of J.B. van Helmont, popular in the 1650s and 1660's, also have been interpreted in different ways by historians. Some, such as the Jacobs, have taken the reaction of Walter Charleton, who switched allegiance from van Helmont to Gassendi early in the 1650's, as illustrative of a general tendency at the time to read out vitalism from the universe.[135] Looking at the other side of the coin, Charles Webster has emphasized the emergence of alchemy in the Revolution and Interregnum periods as a sign of the emeregence of Puritan values. According to Webster, Paracelsus, van Helmont, and the vitalists generally are presented as manifestations of Puritan challenge. The "establishment", in this view, is made up, one presumes, of Galenists, such as O'Meara. The problem with this interpretation is that it fails to take into account just how eclectic and encompassing the "new" physiology was. In the meantime Robert Frank and Audrey Davis have contributed valuable studies on the development of mid-century orthodox physiology. Their focus, however, has not been on the social or cultural aspects of these developments.

In re-examining this enormous but well-mapped terrrain, I have attempted to lay the basis for a somewhat different interpretation of these developments as they relate to the body prior to the Restoration. Let me

summarize: In the first place, it seems to me that the "De viis mortis" manuscript of Bacon as well as Harvey's unelaborated vitalism argues for a long-standing tradition in English thought that may be characterized plausibly as vitalistic. If not strictly indigenous, it suggests nonetheless that the mid-century practitioners of the "new" philosophy of the blood inherited a physiological tradition in which vitalism was well represented. Particulary in reference to Bacon, this interpretation calls into question the assertion, made by Webster[136], that Paracelsian theory was only taken up significantly in England in the 1640's, and then by "Puritans" for self-consciously political reasons.

If the reader will grant that England entered the 1640's with a more or less native vitalism--of which Bacon's recommendation to wear oiled underwear may serve as a penant--I have attempted to make the case that certain vitalistic attitudes can be found within it that continued beyond the Civil War, Interregnum, and Restoration in the work of the Oxford physiologists. Among these I would include a general tendency to define "spirit" ambiguously. Thus, in my view, English thinkers from Bacon to Willis granted "spirit" a certain divine and transformational quality. In contrast to Paracelsus and van Helmont, however, they always had an overwhelmingly material "spirit" in mind. Despite that reservation, they granted "spirit" considerable power to transform matter. Secondly, although they never imagined matter as bereft of qualities as the Cartesians, they did not view the earth as alive as did the Paracelsians or Helmontians. Indeed, Bacon was only concerned with the "outer crust." In other words, from Bacon forward to Willis or Boyle, they tended to consider large parts of the material world as inert.

In terms of what might be called the architectonics of the Interregnum body, the Oxford approach may have been internally consistent, but the English situation remained unsettled. By the Restoration both the "new" philosophers

and the Helmontians had a well-developed ontology of the blood. Furthermore, both discussed the blood in chemical terms, as did the Cartesians. Yet the term common to all three of them--ferment--meant quite different things in the three schemes. Heat, which was important to the Cartesians and the Oxford physiologists, was not of central importance to the Helmontians. Digestion, which was of crucial importance to the Helmontians, was not central in Oxford thought. Cartesians and the Oxford physiologists likewise accorded central importance to the heart. Given Descartes' early acceptance of the circulation of the blood, it might seem at first pass as though the outlooks of the two groups were similar. Despite their shared "cardiocentricity", however, the two groups seemed to imagine different hearts. As time went on, they also seemed to imagine different bloods as well. Compounding their conceptual differences were their differences of method. A strong experimental basis of theory, such as that evidenced by van Helmont, went a long way in gaining the respect of the English Harveians. The weakness of the Cartesians in this area may have diminished their influence in England. Similarly, in the case of disease and fever, a central problem in seventeenth century medical theory, the Helmontians, Paracelsians, and "new" philosophers had well-developed ideas that seemed to overlap. Nonetheless, their ontologies of disease were quite different.

Furthermore, they had different therapeutic implications. Thus, even though both groups favored a chemical explanation and chemically-based medicines, they ended up with distinctive approaches to illness. It seems historically accurate to say that when the "new " philosophers of the body that emerged from the mid-century clubs looked at the body as developed in foreign thought, they were seeing something that nominally was similar but substantively quite different. In addition to all the theological and political

factors that may have contributed to this result, factors internal to the English physiological tradition of Bacon and Harvey played a large role.

II: Blood on the Restoration Stage

The overall effect of these dissonances and slippages between the "new" philosophers and foreign thinkers became apparent in a public way in the early Restoration. The emergence of the Royal Society and its attendant publication, the *Philosophical Transactions*, early in the Restoration both reflected and promoted a growing interest in natural philosophy among the educated and powerful.[137] Publication of large numbers of natural philosophical subjects, particularly those in medicine and alchemy, continued at a large volume.[138] Furthermore, royal patronage of the Society seemed to be the expression of a genuine interest on the part of the monarch in scientific matters, particularly chemistry. It was widely known among the genteel that Charles II had set up a chemical laboratory at Whitehall and imported a court (al)chemist, Nicaise Le Fevre, in October 1661.[139]

Adding to the process of increased diffusion of perspectives drawn from the "new" philosophy was the reestablishment of the Church of England as the state church. Anglicans who had become familiar with the new philosophical concepts in their sequestration in the universities during the Civil War and Interregnum were now in pulpits. Furthermore, Anglican control of the universities was once again in place. The new brooms could (and did) sweep out "Puritan" office holders and professors from their institutional sinecures. The loyal Willis, for example, became Sedleian Professor of Natural Philosophy at Oxford in 1660 ; the previous occupant, the Presbyterian Joshua Crosse being summarily ejected from the chair within months of the monarch's return.

In terms of the physiological organization of the body, I would suggest that the linkage of a new official presence of natural philosophy and the restoration of the monarchy and Church of England had several consequences. In a curious way, everything about physiology was now open in a way it had not been in the Civil War and Interregnum. Although publication had been quite free in the 1650's, the actual discussion spaces of the new physiology, particularly those at Oxford and Cambridge, had been relatively closed. As the the Webster-Ward debate on education indicated, that reality had not been lost on Interregnum critics and utopians. Now, however, matters were both more open, in the sense of more public, and more controlled, in the sense that Society membership was by election of the members.[140] If Society meetings were more about the demonstration of rather than an actual working-out of physiological concepts, nonetheless they were in an explicitly public space of high prestige. Moreover, they were in a space subject to the same controls on ideology as had been the experimental clubs. Because both the physical and social space of natural philosophy was now public, however, I would argue that there was more at stake. It was one thing when Wilkins sponsored what was, in the context of the nominal Oxford curriculum as well as the Civil War and Interregnum, an informal program of investigative natural philosophy. Now they were producing the official line(s). As we shall see in chapter five, the traditional physician O'Meara was particularly irked that Willis had become an official, a *professor* at Oxford.

The most useful questions for an historian to ask, then, may not have much to do with who was a vitalist or who was a mechanist. Or, for that matter, who was an alchemist as opposed to a chemist. As I have attempted to establish earlier, strong currents of English vitalism and alchemy flowed through seventeenth century physiology. Not only was alchemy itself enormously

popular among otherwise disparate groups in the Restoration, but alchemical theory informed all the major physiologies of the period.

Instead, I would argue that Restoration educated society, the audience for natural philosophy as well as the source of most of its major practitioners, was more interested in issues of discernment and control. In other words, the question is not whether or not the framers and major intellectual contributors of the Royal Society had a substantial interest in transmutation, but rather how they determined the existence of what was to them the crucial matter, the nature of a *real* transmutation. Who or what was the real alchemist (alchemy)? What was the real blood, and what did it do in the body? Or, to put the matter in a religious context: What was the distinction between true religious spirit and an overly enthusiastic spirit? In a sense I think these are all the same question, or at least reflect a similar tension. Moreover, the tension was felt in epistemological, religious, and social terms. When a "new" substance, such as elemental phosphorous appeared, how should knowledge of it be handled? What was the proper degree of enthusiasm and by whom should it be expressed? How do we find a balance between new theories, some of them quite strange and exciting, and the need for knowledge to be, if not certain, at least reasonably certain? Given that we want a state church, how do we handle quite different Christian interpretations and observances of spirit.? How do we find a balance between the need for social order (and therefore hierarchy) and the need for popular expression of political spirit?

In terms of the place of chemistry and the blood in medicine and human physiology, these tensions were expressed in at least three ways in the first decade of the Restoration. Generally considered separately by historians, they include the controversy of the mid-166's between self-identified "Helmonitan" physicians and members of the College of Physicians, the transfusions

experiments of the Oxford group and the Royal Society, and the movement away from the blood and toward the brain by Willis and his research group. Linkages between them included overlapping chronologies as well as medical personnel and patrons common to one or more. The consideration of phosphorus by the Royal Society in the 1670's and 1680's, while it falls outside the strict limits of this chapter, suggests continuing interest in bodily chemistry by a cross-section of establishment figures at the same time it illustrates their concern about the public handling of potentially transforming substances.

The failure of the Helmontians to gain official place

Seeking to gain status for "chimical medicine" as a separate institution, a number of Restoration notables as well as Court hangers-on petitioned the Court for a royal charter for a Society of Chimical Physicians in 1665. Initially promoted in a pamphlet by Thomas O'Dowde, a groom of the royal bed-chamber and sometime empiric, the petition for a royal charter was signed by a mix of self-identified "Helmontian" physicians, Court hangers-on, and Restoration notables including Gilbert Sheldon (Archbishop of Canterbury), his (then) ally Henry Hyde (the Earl of Clarendon and Lord High Chancellor), and the Presbyterian ally, amateur chemist and confidant of Charles II, George Villiers (the Duke of Buckingham). Most prominent among the physician sponsors was George Thomson (1620-1679), a Leiden-trained physician who published a number of medical texts. As Harold Cook has noted, "aside from an interest in chemistry, members of the group appear to have lacked much in common."[141] Although their petition attracted impressive initial support, the Society of Chimical Physicians never received officical approval from either the Court or Parliament.

Writing from the viewpoint of medical institutions, particularly the College of Physicians, Harold Cook has assigned this failure to a falling-away of influential backers from O'Dowde, who was portrayed as a "quack" by his opponents. In examing the same controversy, Piyo Rattansi has emphasized the role of the "chemical physicians" as a stalking horse for the apothecaries long-standing efforts to gain power relative to the College. Both Cook and Rattansi note the loss to plague, which took some 100,000 lives, or approxiamtely a quarter of the population, in London in 1665-6, of leading promoters of the chemical physicians' cause. Rattansi's particular view is that the chemical physicians failed to gain institutional status not only because their promoters could not sustain the patronage of important people, but also because the apothecaries, having emerged from the plague in a favorable public light, no longer needed them: "The larger battle, in which the Helmontians had acted for a time as third party, was now joined again."[142] By the turn of the century, Rattansi has correctly pointed out that the apothecaries had gained considerable latitude from their former overseers, the College.

One of the key points in the dispute was over what (or who) constituted true chemical medicine. Early on in the petition drive, the self-identified Helmontian, George Thomson, distanced himself from O'Dowde, as did a number of others, on the basis of O'Dowde's supposed quackery. It was noted by his enemies that O'Dowde was illiterate regarding Latin.[143] But I think the issue of discernment was operative at a more important level. It is one thing to note, as Rattansi does, that chemical therapies were already in the College formulary. They had been as well in the College formulary of 1619. However, a reading of "Helmontian" texts from the decade reveals deeper levels of both therapeutic and theoretical difference between the Helmontians and their more traditionally educated brethern. While it is not clear that these differences were of material

significance in the failure of the Society to gain official stature, they do suggest why Helmontianism stopped being an independent force in learned English medicine within a few years of the Society's set-back.

Both the mid-century Harveian physiologists and English Helmontians agreed that the body's soul was in the blood. Beyond that, however, they seemed to be talking past one another. So deep were their differences regarding physiology and therapy that their "bloods" seemed to contemporaries to be incommensurable. Whereas the Harveians described the soul and the blood in increasingly material terms from the 1650's on, the Helmontians, following their leader, maintained that the blood had a spiritual character that enodowed it with psyche-like qualities. Writing in 1670 , George Thomson described the blood as "the seat of Life and the principal matter for Sense, Motion, Nutrition, Accretion and Generation."[144] It was the "immediate instrument of the Soul" and displayed its "Radiant Beam every way that Sensation, Motion, Nutrition and all other functions may exquisitly be performed."[145] The blood's "Womb" was the stomach.[146] Both the "Galenists" as well as that promoter of the three principles of Paracelsus, "his *Sectary Dr. Willis*," were therefore "far from solid truth" in their explanations of diseases.[147] Declaring that analyses of them would not lead to any increase in diagnostic understanding, Willis's "five principles" in particular were a "perversion to man's life."[148]

Echoing John Webster and the radical empirics of the Civil War and Interregnum, Thomson and most of the Helmontians believed anatomy and physiological theory were also of little help. Anatomy had a place to be sure. As Thomson noted in 1665, at the height of the controversy between the Helmontians and the College: "'Tis certain every mechanick ought to have a competent insight of that machine, as a Watch or Clock, etc."[149] Indeed, Thomson believed that "without (anatomy) we are certain a physician must be

much defective in Physick."[150] The problem was that the lodging place of disease is seldom to be discovered by the knife."[151] Anatomy would "never (be) able to teach you how to destroy the Rampant Diseases daily breaking silently into these Houses."[152]

So, too, with Harveian theories of the circulation of the blood. They helped solve problems in "physiologie and aetiologie" but were of "little use for therapeutics."[153] The true way was with chemical analysis, or "Pyrotechnical Anatomy."[154] By this method alone the physician "can reclude the Secrets of Nature and shew us where every disease is seated and by what effectual ways it may be disturbed."[155]

Other writers, such as the Helmontian Robert Godfrey, did not have any problem with Paracelsus, or with Willisian fever theory, for that matter. Helmontian physiology, particularly its location of the body's center in the stomach, was praised. But the author's main point was that therapy should be simple and cheap. Much as had Culpeper in the 1650's, Godfrey objected to the greed of learned physicians and the expense of their complicated medicines. In this view both Galen and Hipoocrates were to be honored for the value of their *materia medica*. In contrast to the "mercurial and antimonial remedies" of expensive chemical physicians, van Helmont, here fashioned by Godfrey into a radical Hippocratic, was praised as preferring "decoctions of a simple."[156] People would be much better off if only "honest Country Gentlewomen or Ladies...would but make use of some such simple herbal medicines as...the long experience of Mothers, Grandmothers, and Great Grandmothers have told them is good."[157]

The anonymous author of *The Method of Chemical Philosophy and Physick* of 1664 argued for a similar modesty on the part of philosophical investigators in

their approach to nature. Praising the chemical philosophy of Paracelsus, the introduction cautioned that :

> "None can open and unlock the doors of Nature which are shut and lock't, much less can he enter into the inmost closts of Nature, which Knoweth not and thorought seeth the nature of this undefiled Virgin. What can Philosphers perform, or what can physicians, or what can chemists, unless they kiss this Virgin with a sweet kiss." [158]

Thomson was not so delicate in his sensibilities. Reluctant to "contradict or thwart Dr. Willis" at greater length because he was "endowed with Learning and great worth," he decided in 1670 that there was only one way to settle matters: a therapeutic trial in the presence of witnesses. The disease in question was the "Chronick Malady" of scurvy. Willis was wrong to recommend any phelbotomy in its treatment. Thomson would show him by taking "ten or twenty scorbutical persons" divided into two groups. Dr. Willis would "let forth a little (blood from those) whose blood is polluted and corrupted" in his group. [159] Thomson would give his group treatment with his "Arcana" for two weeks. Then there would be another round of parallel treatments. Money would have been wagered, and in the "presence of those that are my Lord Bacon's followers (we) will demonstrate ourselves to the judgement of some of this Royal Society."[160] The idea of the public therapeutic duel, incidentally, seems to have originated with van Helmont.[161]

The problem was that the Royal Society was not having much of this. It was not that they were opposed to demonstrations of therapeutic efficacy, though efficacy seemed to be appreciated more in the context of the potential of an idea than as an end in itself. But the idea of professional "arcana", or hidden knowledge, did not sit well with a Society whose influential members, almost all men of the rank of gentleman or above, wanted free and open discussion.[162] The

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Society was not about trade in the narrow sense. Of course, not all self-identified Helmontians advertised their "secret remedies," but enough did (including Thomson) that they were perceived by some as engaging in trade.[163] Even among the Helmontians there was tension between the *persona* of the physician/ chemist as dispenser of special knowledge (e.g. George Starkey) or as marketer of proprietary remedies (e.g. Lionel Lockyer and his "pills"). Underlaying the skepticiams regarding both approaches was the belief that if commerece was the primary purpose, how could one's judgement be free, in the sense of disinterested? The idea that learned physicians especially should be gentlemen who were sober, industrious and free of venal motive had a tradition in England from at least the mid-sixteenth century.[164] Indeed, one of the few personal criticisms Willis, who otherwise was respected for his piety and industriousness, received had to do with his avariciousness regarding the non-disclosure of proprietary recipes.[165]

Another factor was the lack of "fit" between Helmontian physiology and the Harveian models dear to the major intellectual contributors to the Society. Whether the Helmontianism was of a variety amenable to lucrative private practice, such as Thomson's, or whether it tended to the radical Hippocratic tradition of Culpeper, such as Godfrey's, its denial of the value of anatomy, physiological experiment, and Harveian circulation theory ran counter to the medical developments receiving the most attention in learned circles from the 1640's on.

If the Helmontians and Paracelsians experienced the co-option of many of their ideas and therapies by the "new" philosophers of medicine, such as Willis, as well as a lack of success in gaining official sanction, many of their philosophical beliefs about the relation of blood, spirit, and matter were taken up in the Interregnum and Restoration by religious groups, most notably the

Quakers, who favored an unmediated personal access to Christ and a relatively horizontal social order. Van Helmont's son and principal torch-bearer in England, the physician F.M. van Helmont even joined the Quakers for a few years in the late 1670's and early 1680's.[166]

Injection experiments and the failed promise of transfusion

English work in the experimental clubs of the 1640's and 1650's on embryology and chemistry had been highly descriptive and theoretical. It provided a new interpretative framework for understanding bodily processes in health and disease, but it did not promise rapid and revolutionary change in practice. One other development that had its beginnings in Commonwealth Oxford did, however. Originally conceived to investigate the action of poison, specifically snake venom in the body, the injection experiments in animals that began in the mid-1650's among Wilkins, Wren, Boyle, Willis, Bathurst, and others provided another level of support to the concept of the blood as an organ. As early as the summer of 1656 Wren could write to Petty (then in Dublin) that, "I injected wine and ale into the mass of blood in a living dog by a vein in good quantity till I made him drunk but soon after he pissed it out...."[167] In the same epistle Wren also related that he had injected a powerful emitic into a dog's vein. In contrast to the theoretical work previously mentioned, injection techniques were immediately felt to have both therapeutic and practical effects. As Wren indicated in the same letter:

> "It will be too long to tell you the Effects of Opium, Scammony & other thing that I have tried this way: I am now in further pursuit of the Experiment, which I take to be of great concernment, and what will give great light both to the Theory and Practice of Physick."[168]

As an investigatory technique, injections of colored dyes soon became central in the kinds of vascular mapping investigations carried on primarily by Willis and Lower and epitomised in Willis's *Cerebri anatome* (1664) and Lower's *Tractatus de corde* (1669).

With the eager support of Wilkins, Boyle, and Lower in 1665, injection soon became transfusion.[169] In contrast to the injection experiments, which had mainly been "private," however, transfusion demonstrations and experiments had a markedly public character. This was true not only in England, but on the Continent as well. During its brief heydey in France, Italy, and Germany as well as in England in 1666-8, numerous public and fewer private transfusions of blood between large animals and animals to humans took place.[170] In England, Lower and the surgeon Edmund King, who was later to collaborate with Willis on brain dissections, performed the first English transfusion between an animal (sheep) and a human (Arthur Coga) in before the Royal Society in Boyle's Arundel House on 23 November, 1667.[171] All of this came to a halt, however, with the deaths of two human transfusees in France in 1668.

Although the experiments were too few to hazard more than a speculative assessment of their social meaning in England, it may be worth noting some extant contemporary views. The potential of a personal and social benefit from transfusion did not go unnoticed. At least to some observers, a successful transfusion seemed to offer the prospect of an improved personality. As Pepys recorded after hearing from a Dr. Croone of a Gresham College dog to dog transfusion on 14 November, 1666: "This did give occasion to many pretty wishes, as of the blood of a Quaker to be let into an Archibishop, and such like."[172] As for the aforementoned Mr. Coga, an Oxford undergraduate whom Wilkins described to Pepys as "a little frantic" and "a kind of minister," the addition of twelve ounces of sheep's blood was perceived to have a good effect.

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Previously appraised by Wilkins as a "poor and debauched man," Coga told the Royal Society he found himself "much better since." Pepys noted that Coga gave his account in Latin, "but he is cracked a little in his head, though he speaks very reasonably, and very well."[173] Interestingly, Willis, who was later to write on the social benefit of "rational therapy" of a category of the afflicted long-identified with spiritual excess, the "epileptics", did not participate in the transfusion work.

Phosphorus

The public space of Restoration science also made room for a more purely chemical kind of physiological interest. Although they occurred later than its first decade, the investigations by Boyle into phosphorus and its demonstrations by Robert Hooke, Frederick Slare and others in the Royal Society and elsewhere in the 1670's and 1680's attest to the continuing interest of prominent Society members in the Oxford model of the blood.[174] With its cool light, elemental phosphorus, which was brought to the Royal Society in the late 1670s, was immediately valued as a substance with physiological significance.

If the more cautious philosophers, such as Boyle, shied away from "conjectures" about its philosophical meaning,[175] others, such as Fredercik Slare, thought they had found in phosphorus Willis's veritable vital flame. Describing Boyle's recovery of elemental phosphorus from human urine, Slare wrote in 1681: "The learned Willis (were he alive) would rejoyce to see such a Product out of our Bodies.....that did kindle and impregnate our blood."[176] Even John Evelyn, who became an Anglican bishop and was usually attuned to the risks of enthusiastic discourse, got a bit carried away, at least in his diary entry of 13 December, 1685:

> "It (phosphorus) seemed to exhibit a theory of the education of light out of the chaos, and the fixing or gathering of the universal light into luminous bodies. This matter, or phosphorus, was made out of human

blood and urine, elucidating the vital flame, or heat, in animal bodies. A very noble experiment."[177]

The very spectacle that prompted Evelyn's expressions of rapture was felt by Society notables to carry a significant risk. Display and discussion of phosphorus must be carefully controlled for two reasons. First, the public display of such an arresting visual phenomenon without adequate philosophical discussion might mislead the audience into conflating natural philosophers with showmen or magicians. How could the audience tell the difference? Secondly, casual display of such a bedazzling substance carried a moral danger: audiences might respond only at the level of the senses and fail to develop their reasoning.[178] In light of the Helmontians' reputation for the handling of their *arcana*, it is significant to note that Boyle left his receipt for the preparation of phosphorus in a sealed note to the Royal Society, whose secretary published it in the *Philosophical Transactions* after Boyle's death.[179]

Conclusion

Inspired by the methods and theories of William Harvey, a group of mostly young and mostly Anglican investigators began doing experiments on the heart and blood in the 1640's in London and at Oxford and Cambridge. Working informally in clubs, they were patronized at Oxford by John Wilkins. Due primarily to its possession of facilities and institutionally-sponsored personnel, Oxford was the primary center of human physiology. One consequence of this sponsored informality was that the work took place privately but was known publicly in a selective way. Another was that the efforts of its principal patron, John Wilkins, to divide explicit spiritual concerns from natural philosophy, made for a particular kind of physiology which sought to divorce experimental work from cosmological and political issues. Nonetheless, the

Oxford physiologists were open to many new and foreign bodily philsophies and incorporated a number of them, if only partially. Among them were acceptance of both atomistic and vitalistic conceptions of matter as propounded by Paracelsus, Bacon, van Helmont, Descartes, Gassendi, and their followers. The consequence was that the Interregnum Oxford physiologists developed an eclectic conception of the blood and circulation which displaced not only traditional approaches, but also those of the foreign thinkers mentioned above.

With the establishment of the Royal Society in 1663, a movement in which key Oxford thinkers were influential, debate about the organizational pattern of the body and its care became public and heated. Buoyed by the interest in (al)chemical matters at Court, a disparate group of self-identified Helmontians petitioned the crown for separate recognition as a Society of Chymical Physitians. In the meantime Oxford-trained investigators sought to modify injection techniques of physiological investigation into therapeutic techniques of transfusion. Also, among elite learned physicians, traditional theories of physiology were losing influence to the Oxford models. These occurrences and trends reflect the fact that learned England increasingly was experiencing at least three incommensurable models of bodily organization. Both the efforts of the Helmontians for official sanction and the transfusionists for therapeutic success failed in the mid-1660's. Although the Royal Society continued to interpret "new" phenomena, such as elemental phosphorus, in light of the Interregnum Oxford models into the 1680's, "official" and "alternative" learned medical groups were unable to establish a settled place for the heart and blood in the early Restoration.

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[1] William Harvey, *Anatomical Exercitationes Concerning the Generation of Living Creatures*, (London: James Young, 1653). p. 281. Wellcome 26836/B/1.

[2] Thomas Hobbes, *Leviathan* (Everyman's Library), p. 337.

[3] Nathaniel, Highmore, *De hysterica et hypochondriaca passione*, (London: Robert Clavel, 1670), p. 7 of an English translation by Richard Trapp and myself..

[4] George Thomson, T*he True Way of Preserving the Bloud* (London: N. Crouch, 1670), p. 31, 2.

[5] Anne Conway, *The Principles of the Most Ancient and Modern Philosophy* (1692), ed. Peter Loptson, (The Hague: Martinus Nijhoff, 1982), p. 218; T*he Conway Letters*, ed. by Marjorie Hope Nicholson, rev. Sarah Hutton, (Oxford: Clarendon Press, 1992), pp. 378-87.

[6] For general reviews of English circulation physiology, see Robert G. Frank, Jr., *Harvey and the Oxford Physiologists*, (Berkeley: U.C. Press, 1980), chapters 3 & 4.; also, Audrey Davis, *Circulation Physiology and Medical Chemistry in England 1650-1680*, (Lawrence, Kansas: Coronado Press, 1973).

[7] See J.V. Golinski, "A Noble Spectacle: Phosphorus and the Public Cultures of Science in the Early Royal Society," *ISIS*, 1989, 80: 11-39, esp. 22-4.

[8] Thomas S. Kuhn, *The Structure of Scientific Revolutions*, (Chicago: University of Chicago Press, 2n ed., 1970), chapter 2.

[9] For medical institutions in London, see Harold J. Cook, *The Decline of the Old Medical Regime* in *Stuart London*, (Ithaca: Cornell University Press, 1986); for Restoration science, see Michael Hunter, "Reconstructing Resoration Science: Problems and Pitfalls in Institutional History," *Social Studies of Science*, 12: (1982), 451-66; idem, *Science and Society in Restoration England*, (Cambridge: Cambridge U.P., 1981).

[10] See Robert Merton, "Science, Technology and Society in Seventeenth Century England,"*Osiris*, 1939 supplement; Charles Webster, *Great Instauration*, (London: Duckworth, 1975), pp. 51-7, 144-178. See also the criticism of Webster's analysis by Lotte Mulligan and Glenn Mulligan, "Reconstructing Restoration Science: Styles of Leadership and Social Composition of the Early Royal Society," *Social Studies of Science*, 11 (1981), 327-64. In addition to Frank and Dewhurst, see Barbara Shapiro, *John Wilkins 1614-1672*, (Berkeley: University of California Press, 1969);

[11] Robert G. Frank, Jr., *Harvey and the Oxford Physiologists*, (Berkeley: U.C. Press, 1980).

[12] See Barbara Shapiro, "Latitudinarianism and science in seventeenth-century England," *Past & Present*, xl (1968), p. 16-40.

[13] See John Wilkins, *The Discovery of a New World* (London, 1638; idem, *Mercury, or the Secret and Swift Messenger* (London, 1641); and idem, *Mathematical Magick* (London, 1648); also Shapiro, op. cit., chapter 2.

[14] Ibid, chapter 4.; Webster, op. cit., 1975, pp. 154-5.

[15] John Wallis, "Dr. Wallis's Account of Some Passages of His Own Life," in Thomas Hearne, ed., *Peter Langtofts's Chronicle*, 2 vols. (Oxford, 1725), p. cl. See Frank, 1979, pp. 80; also Barbara Shapiro, *John Wilkins (1614-1672)*, (Berkeley: U.C. Press, 1969), chapter 4.

[16] Christian Huygens, *Oeuvres Completes*, (La Haye, 1888-1950), 22 vols., IV, p. 328. Quoted by Roger Hahn, *The Anatomy of a Scientific Institution: The Paris Academy of Sciences 1666-1803*, (Berkeley: U.C. Press, 1971), p. 11-12, n. 21.

[17] George Ent, *Apologia pro circulatione sanguinis*, (London, 1641); Frank, op. cit. pp. 21-3.

[18] Robert G. Frank, Jr., "The Physician as Virtuoso in Seventeenth-Century England", (Los Angeles: William A. Clark Library, 1979), pp. 80-92.

[19] Robert G. Frank, Jr., 1980, op. cit., pp. 22-3.

[20] Frank, op. cit., 1979, , p. 76, n. 32.

[21] Ibid., p. 75.

[22] Ibid, , pp. 43-4; 64-7.

[23] On Willis, see J. Trevor Hughes, *Thomas Willis 1621-1675*, (London: Royal Society of Medicine, 1991), p. 3;

[24] Ward, who had lost his Cambridge fellowship in the mid-1640's on account of his staunch Anglicanism and Royalist sympathies, moved near Oxford. In 1649 he was able to gain appointment as Savilian Professor of Astronomy. He also modified his oppostition to Parliamentary rule sufficiently to take the Oath of Engagement in 1650. Ward was self-taught in mathematics and astronomy. For more, see his entry in the *Dictionary of National Biography*.

[25] From Robert G. Frank, Jr., 1980, op. cit., pp. 64-7. Walter Charleton's father was a rector, as was the father of Nathaniel Highmore. John Wallis and Robert Hooke had fathers who were vicars. Christopher Wren's father ended his career as dean of Windsor.

[26] Ibid

[27] *Dictionary of National Biography*, (London: 1909), pp.203-4.; George Fox, *Journal*, rev. ed., John L. Nickalls, (Cambridge: Cambridge University Press, 1952).

[28] *Dictionary of National Biography* (1909), pp. 995-1011; also Christopher Wren, *Parentalia*, (London, 1750).

[29] Thomas Willis, *Oxford Lectures*, ed. and trans. Kenneth Dewhurst (Oxford: Sandford Publications, 1980), intro.

[30] Charles Webster, *The Great Instauration*, (London: Duckworth, 1975), pp. 153-78.

[31] Shapiro, op. cit., 1969, pp. 54-6.

[32] Ibid, p. 55

[33] Webster, 1975, op., cit., p. 155; Frank, 1980, op. cit. pp. 51-7.

[34] John E. Lesch, *Science and Medicine in France*, (Cambridge: Harvard U.P., 1984), p. 15-6.

[35] Thomas Willis, *Cerebri anatome*, (London, 1664), "Preface to the Reader."

[36] Robert Boyle, *Certain Physiological Essays*, (London, 1661), "Proemial Essay," p. 3.

[37] Wing, *Short Title Catalogue 1641-1700*, (New York: Columbia University Press, 1945), v. 1, pt. 1.

[38] Francis Bacon, *Works*, "Table of Contents," (London, 1879), v. 1.

[39] These papers have been collected in Charles Webster, ed., *The Intellectual Revolution of the Seventeenth Century*, (London: Routledge & Kegan Paul, 1974), pp. 160-96.

[40] William Harvey, *Anatomical exercitationes concerning the generation of living creatures* (London, 1653), p. 458. Jerome Bylebyl has developed the argument that as early as Harvey's anatomy lectures of 1618, he believed that the blood was primary in the body. See his, "The Medical Side of Harvey's Discovery," in idem, editor, *William Harvey and his Age*, (Baltimore: Johns Hopkins U. P., 1979), pp. 65-7. Robert Frank, op. cit, 1980, , chapter 2, links Harvey's belief in the blood to his embryological studies in the 1630's and 1640's.

[41] Harvey, *Generation*, pp. 468-9.

[42] William Harvey, *The Anatomical Lectures of William Harvey*, edited and translated by Gweneth Whitteridge, (London: Livingstone, 1964), p. 87r. Cited by Bylebyl, "The Medical Side of Harvey's Discovery," op. cit., p. 66, n. 186.

[43] Ibid, p.p. 292-3.

[44] According to Audrey Davis, Phillip Hecquet, in *La Medicine naturell* of 1737 praised the fermentation/fever theory as being the first medical theory to take into account the circulation of the blood. See her "bibliographical Comments" in Audrey Davis, op. cit, 1973, pp. 250-1. Willis's *Diatribe* was published in Latin in three later editions in London (1660, 1662, 1677), two in Amsterdam (1663, 1669), two in Geneva (1676, 1694), and in Dutch in 1676. See ibid, p. 154, n. 49.

[45] Thomas Willis, *Diatribe duae*, "On Fermentation," p. 2

[46] Ibid., p. 2.

[47] Ibid., pp. 11-12.

[48] Ibid., p. 9

[49] Ibid., p. 12.

[50] Ibid., p. 48.

[51] Ibid., p. 48; on Willis's use of distillation in assessment of a patient's condition in 1650/51, see Willis's *Casebook 1650-1651*, ed. Kenneth Dewhurst, (Oxford: Sandford, 1980), p.52

[52] Willis, *Diatribe*, " Of fevers,", p. 48. See also Davis, pp. 84-87.

[53] For a survey of the fevers literature in seventeenth century medicine and an extensive discussion of Willis's place in it, see Donald G. Bates, "Thomas Willis and the Fevers Literature of the Seventeenth Century," *Medical History*, Supplement No. 1, 1981:45-70.

[54] Willis, *Diatribe*, "Of fevers", p. 48. See also Davis, pp. 154-8.

[55] Don G. Bates, op. cit., 1981," p.p. 50-1.

[56] Anthony A. Wood, *Athenae Oxonienses* (London, 1817), facsimile reprinted by Johnson Reprint Corporation, New York, 1967; p. 1051.

[57] John Wallis, "Account of some Passages of his own Life," written in 1696 and printed in Thomas Hearne, *Works* (Oxford, 1725), I, clxii-clxiii. Cited in Shapiro, *Wilkins*, p. 25.

[58] Francis Glisson, *De hepatis*, pp. 495-8, 5

[59] Willis, *Diatribe*, "On Fevers," pp. 143-5.

[60] Robert G. Frank, Jr., op. cit., 1980, p. 169.

[61] Allen G. Debus, *The Chemical Philosophy*, 2 vols., (New York: Science History Publications, 1977) ; idem, *The English Paracelsians*, (London: Oldbourne, 1965).

[62] Frank, op. cit., 1980, pp. 104-5; Pecquet's discovery, however, was not reviewed until number 7, 1667 of the *Philosophical Transactions*, pp. 461-4.

[63] On Ent's education, see Charles Webster, "George Ent, " in *Dictionary of Scientific Biography*, (New York: Scribner's, 1971), v. IV, pp. 376-7.

[64] George Ent, *Apologia pro circulatione sanguinis*, (London, 1641), pp. 40ff. See also Lester S. King, "The transformation of Galenism," in Allen G. Debus (ed.), *Medicine in Seventeenth Century England* (Berkeley: University of Calfiornia Press, 1974), pp. 7-31.

[65] John Locke, "Notebooks", Bodleian Library, MS. Locke e. 4 (c. 1652-59). See also Frank, op. cit., 1980, p. 49., n. 23.

[66] Sennert's *Opera omnia* was first published in Paris in 1641. For a discussion of the relation between the two, see Peter H. Niebyl, "Sennert, Van Helmont, and Medical Ontology," B*ull. Hist. Med.*, March 1971, XLV, 2: 115-137.

[67] J.B. van Helmont, *Deliaramenta catarrhi: or, The incongruities, Impossibilities and Absurdities, Couched under the Vulgar Opinion of Defluxions*, translator and paraphrast, Dr. Charleton (London, 1650);idem, *Ternary of Paradoxes. The Magnetick Cure of Wounds. Nativity of Tartar in Wine. Image of God in Man*, translated, illustrated and ampliated by Walter Charleton,)London, 1650. On Charleton and van Helmont, see Allen G. Debus, *The Chemical Philosophy*, v. II, (New York: Science History Publications, 1977), pp. 469-73.

[68] Charles Webster, who stated that little was known of Chandler, noted that a Quaker author of the same name was active at the time. See Webster, *Great Instauration*, p. 276, n. 88.

[69] Gassendi's major atomistic work, the *Syntagma philosophicum*, was first published in Paris in 1658. His collected works were published in six volumes in Florence in 1727.

[70] Walter Pagel, "The Prime Matter of Paracelsus," *Ambix*, (1961) 9: 3: 118-135, p. 127.

[71] Pagel, op. cit., p. 126; see also Allen Debus, "The Paracelsian Compromise in Elizabethan England," *Ambix*, 1960, 8: 2:71-94.

[72] Nicholas Culpeper translated a version of Sennert's medical chemistry in the 1650's; on Sennert, see Bates, op. cit., as well as Allen Debus, *The Chemical Philosophy*, (New York: Science History Publications, 1977), vol. 1, pp. 191-204. On Flood, see Ibid, pp. 205-93.

[73] William Clowes, *A Right Frutefull and Approved Treatise for the Artificiall Cure of that Malady called in Latin Struma* (London, 1602), "Epistle to the Reader." Cited by Debus, op. cit., 1977, p. 178.

[74] Ibid.

[75] Ibid., p. 190

[76] Charles Webster, "English Medical Reformers of the Puritan Revolution: a background to the "Society of Chymical Physitians," *Ambix*, 1962, 14:16-42; idem,

[77] P.M. Rattansi, "The Helmontian-Galenist Controversy in Restoration England," *Ambix*, 1964, 12:1:1-23.

[78] J.R. and M.C. Jacob, "The Anglican Origins of Modern Science: The Metaphysical Foundations of the Whig Constitution," *ISIS*, 1980, 71:251-267.

[79] Theodore M. Brown, "Physiology and the Mechanical Philosophy in Mid-Seventeenth Century England," *Bull. Hist. Med.*, 1977, 51:25-54.

[80] J. Andrew Mendelsohn, "Alchemy and Politics in England 1649-1655," *Past & Present*, 1992, 135:30-79.

[81] Walter Pagel, "The Prime Matter of Paracelsus," *Ambix*, 1961, 9:3:118-135. p. 118.

[82] Ibid., p. 119

[83] Ibid.

[84] Ibid, p. 119.

[85] Ibid, p. 121.

[86] Ibid., p. 123.

[87] Ibid, p. 119; for recent analysis of John, death, and the transformation of spirit and matter, see Henry Staten, "How the Spirit (Almost) Became Flesh: Gospel of John," in *representations*, 41: 1993: 34-57.

[88]Ibid, pp. 124-5.

[89] *The Conway Letters*, op. cit., 1992, pp. 317-20.

[90] Francis Bacon, "Francis Bacon's Natural Philosophy: a new source," with translation and commentary by Graham Rees and Christopher Upton, British Society for the History of Science, 1984.

[91] Francis Bacon, *Historia vitae et mortis* and *Novum organum*, ch. 4., sect. c, and ch. 5. sct. b. in *Works*, Ed. J. Spedding, R.L. Ellis and D.D. Heath, 7 vols. (London: 1857-1861). Cited by Rees and Upton, op. cit., p. 62, n. 33.

[92] Graham Rees, "The fate of Bacon's cosmology in the seventeenth century," *Ambix*, 1977, 24:27-38, p. 29. For more on Bacon's influence on seventeenth-century thought, see Charles Webster, *The Great Instauration*, 1975, op. cit.; Michael Hunter, *Science and Society in Restoration England*, (Cambridge, U.K.: Cambridge U.P., 1981), chs. 1, 2, 4. For more on Bacon's cosmology, see Graham Rees, "Francis Bacon's semi-Paracelsian cosmology and the "Great Instauration," *Ambix*, 1975, 22:161-73; idem, "Matter theory: a unifying factor in Bacon's natural philosophy?", *Ambix*, 1977, 24:110-125; idem, "Francis Bacon's semi-Paracelsian cosmology," *Ambix*, 1975, 22:81-101.

[93] Thomas Willis, *Oxford Lectures*, ed. Kenneth Dewhurst, (Oxford: Sandford, 1980), p. 53. Rees and Upton, op. cit., p. 28.

[94] Ress and Upton, op. cit., p. 135

[95] Ibid, p. 131.

[96] Ibid, p. 143.

[97] Ibid, p. 139.

[98] Ibid, p. 151.

[99] Ibid p. 151

[100] Ibid, p. 151.

[101] Ibid, p. 151

[102] Ibid., p. 169.

[103] Ibid, p. 171.

[104] Ibid., p. 169

[105] Ibid., p. 36.

[106] Ibid., p. 171.

[107] Bacon's thinking on moisture in living bodies was well represented in classical thought. Voicing a common opinion, Aristotle's student Theopohrastus (ca. 290 B.C.) wrote that "every plant like every animal has a certain amount of moisture and warmth which essentially belong to it; and if these two fall short, age and decay ensue, whereas if they fail entirely, death and withering." Quoted in Thomas S. Hall, "Life, Death, and the Radical Moisture," *Clio Medica*, vol. 6, 1971, pp. 3-23, p. 6.

[108] Ibid, p. 149.

[109] Ibid., p. 123.

[110] For Bacon's general conception of learning see idem, *The Advancement of Learning*, ed. G.W. Kitchin, (London: Everyman's Library, 1973); for his philosophical utopia, see *The New Atlantis*, ed. G.C. Moore, (Cambridge: Cambridge U.P., 1900).

[111] Walter Pagel, *Paracelsus*, (Basel: Karger, 1982), p. 2.

[112] Thomas Willis, "Of Fermentation,", op. cit., pp. 14.

[113] Thomas Willis, *The Pathology of the Brain and Nervous Stock*, 1667, "Of Convulsive Diseases," p. 2.

[114] Thomas Willis, *Cerebri anatome*, 1664, "Dedicatory Epistle", n.p.

[115] Robert Boyle, *Certain Physiological Essays*, (London, 1661), p. 249.

[116] Walter Pagel, *The Smiling Spleen*, (Basel: Karger, 1984); idem, "The Religious and Philosophical Aspects of van Helmont's Science and Medicine," supplement to the *Bull. Hist. Med.*, no. 2, 1944; idem, "Van Helmont's Concept of Disease--To Be or Not to Be? The Influence of Paracelsus," *Bull. Hist. Med.*, 46:5:419-54; Allen Debus, *The Chemical Philosophy*, op. cit., 1977; on van Helmont, see also Audrey Davis, op. cit., 1973, pp.46-58.

[117] J.B. van Helmont, *Oriatrike*, trans. John Chandler, (London, 1662), p. 183.

[118] Robert Sharrock, *De finibus virtutis* Christianae, (Oxford, 1673).

[119] For a discussion of the background of Sharrock's and Boyle's work and their attitude to van Helmont, see Charles Webster, "Water as the Ultimate Principle of Nature: the Background to Boyle's Sceptical Chymist," *Ambix*, 1966, 13:2: 96-107.

[120] J.B. van Helmont, *Oriatrike*, trans. John Chandler, (London, 1662), pp. 690-3; see also C. Webster, op. cit., 1966, pp. 98-9.

[121] C. Webster, op. cit., 1966, p. 100; on van Helmont's philosophical and religious claims, see W. Pagel, op. cit., 1944.

[122] Walter Pagel, "Van Helmont's Concept of Disease," op. cit., p. 420.

[123] Regarding differences between the thought of Gassendi and Descartes on the nature of the soul, see Margaret J. Osler, "Baptizing Epicurean atomism: Pierre Gassendi on the immortality of the soul," in M.J. Osler and P.L. Farber, eds., *Religion, science, and worldview*, (Cambridge, U.K.: Cambridge U.P.)

[124] Descartes indicated his acceptance of Harvey's work on circulation as early as 1631. Descartes to Mersenne, Nov. or Dec. 1632. Cited by Everett Medelsohn, "The Changing Nature of Physiological Explanation in the Seventeenth Century," in *Melanges Alexander Koyre*, (Paris: Herman, 1964), vol. I, pp. 375.

[125] J.R. Jacob and M.C. Jacob, "The Anglican Origins of Modern Science: The Metaphysical Foundations of the Whig Constitution," *ISIS*, 1980, 71:257: 251-67, pp. 254-5.

[126] Ibid, p. 257

[127] Theodore Brown has argued, in contrast, that Descartes was a major influence on English physiology in the seventeenth century. However, he does indicate that acceptance of Cartesian physiology was more pronounced in Interregnum London than in Oxford. See:Theodore M. Brown, "Physiology and the Mechanical Philosophy in Mid-Seventeenth Century England," *Bull. Hist. Med.* 1977, 51:25-54.

[128] Rene Descartes, "Discourse on Method," in *The Philosophical Works of Descartes*, trans. E. Haldane and G. Ross (Cambridge: Cambridge, University Press, 1931), v. 1, pp. 110-112.

[129] Robert Boyle, "Some considerations touching the usefulness of experimental naturall philosophy "(Oxford, 1663), pt. 2, pp. 14-18. R. Frank indicates this section was written in 1656-7. See Frank, op. cit., 1980, p. 140, n. 2.

[130] Richard Lower, *Tractatus de corde*, (London, 1669), pp. 20-36. See also R. Frank, op. cit., 1980, pp. 210-213.

[131] Lower, op. cit., 1669 , pp. 65-68.

[132] John Mayow, *Tractatus quinque*, (London, 1674), p. 120; cited by Frank, op. cit., 1980, p. 270.

[133] Thomas Willis, *Cerebri anatome*, 1664, "Epistle Dedicatory," n.p.

[134] e.g. Marie Boas, "The Establishment of the Mechanical Philosophy," Osiris, 1944?; Theodore Brown, "The College of Physicians and the Acceptance of Iatromechanism in England, 1665-1695," *Bull. Hist. Med.* 1970, 46:1: 12-30;

[135] Jacobs and Jacobs, op. cit., 1980, pp. 253-5.

[136] Charles Webster, *Great Instauration*, op. cit., pp. 273-5.

[137] *The Philosophical Transactions, or an account of the Ingenious and Accompt*, with Henry Oldenburg as its editor and reviewer, commenced publication in 1665; the Royal Society received its first charter in 1663.

[138] See Webster, G.I., p. 489; also J. Andrew Mendelsohn, "Alchemy Politics in England 1649-1655," *Past & Present*, May, 1992, 135: 31-78, p. 31, n.9 and p. 72.

[139] J. Andrew Mendelsohn, op. cit., 1992, p. 31.

[140] For a discussion of the role of witnessing and the place of experiment, see Steven Shapin, "The House of Experiment in Seventeenth-Century England," *ISIS* 1988, 79: 373-405.

[141] Harold Cook, "The Society of Chemical Physicians, the New Philosophy, and the Restoration Court," *Bull. Hist Med.* , 1987, 61:61-77, p. 71.

[142] P.M. Rattansi, "The Helmontian-Galenist Controversy in Restoration England," *Ambix*, 1964, 12:1: 1-23, p. 23.

[143] Harold Cook, op. cit., 1987, p. 75-6.

[144] George Thomson, *The True Way of Preserving the Bloud* , (London: N. Crouch, 1670), p. 2.

[145] Thomson, op. cit., p. 2

[146] Ibid, p. 7.

[147] Ibid, p. 30.

[148] Ibid, p. 37.

[149] George Thomson, *Galeno-pale: or a chymical trial of the Galenists that their dross to physick may be discovered*, (London, 1665), p. 28.

[150] Ibid, p. 26.

[151] Ibid, p. 26.

[152] Ibid, p. 29

[153] Ibid, p. 27.

[154] Ibid, p. 29.

[155] Ibid, p. 29.

[156] Robert Godfrey, *Various Injuries and Abuses in Chymical and Galenical Physick committed both by Physicians and Apothecaries Detected*, (London, 1674) Huntington Library #474247, p. 15.

[157] Ibid, p. 57.

[158] anonymous, *The Method of Chemical Philosophy and Physick*, (London, 1664), Huntington Library #474249, "Introduction."

[159] George Thomson, *The True Way of Preserving the Bloud*, (London: N. Crouch, 1670), p. 85.

[160] Ibid, p. 85

[161] See van Helmont, *Oriatrike*, op. cit., p. 526.

[162] Steven Shapin, "The House of Experiment," op. cit., 1988.

[163] Harold J. Cook, op. cit., 1986, pp. 157-8.

[164] Edward Edwards, *The cure of all sorts of fevers*, (London, 1636), p. 3; Edwards is cited by David Harley, to whom I am indebted for sharing with me his manuscript version of "From Providence to Nature: the moral theology and godly practice of maternal breasfeeding in late Stuard England," (unpublished Ms.), p. 11.

[165] J. Trevor Hughes, *Thomas Willis 1621-1675*, (London: Royal Society of Medicine, 1991), p. 31. Hughes asserts that Willis was criticized by the College of Physicians. Based on a non-exhaustive check of the College *Annals*, I cannot find confirmation of this rebuke. In the "Introduction" to *Willis's Oxford Lectures*, (Oxford: Sandford, 1983), Kenneth Dewhurst states that Willis was criticized by contemporaries for gaining the bottling rights to waters from a spa at Alstrop. Based on reading Anthony A. Wood, who generally is not sympathetic to Willis, as well as entries in the eighteenth century *Biographia Britannica* and nineteenth century editions of the *Dictionary of National Biography*, I cannot confirm the criticism. Willis's large income, however, occasioned much comment, some of it envious in tone, from contemporaries.

[166] See Marjorie H. Nicholson, revised by Sarah Hutton, *The Conway Letters*, (Oxford: Clarendon Press, 1992), pp. 309-322, 378-384.

[167] Christopher Wren, *Parentalia*, (London, 1750), p. 228. See also Frank, op. cit., 1980, pp. 171-8.

[168] Ibid.

[169] Robert Boyle, *Works*, VI, p. 480. in Frank, 1980, p. 176, n. 82; See also Audrey Davis, op. cit, 1973, pp. 173-205; N.S.R. Maluf, "History of Blood Transfusion," J. *Hist. Med.* 19 (1954):59-107;

[170] Richard Lower, "De Transfusione Sanguinis ex animali alio in aliud: Quo tempore et qua occasione ab Authore inventa sit," in *Tractatus de corde*, (London, 1669); Wren, op. cit., pp. 228, 233-7.

[171] Regarding the sheep/Coga experiment, see *Philosophical Transactions*, 1667, 30: 557

[172] Samuel Pepys, *Diary (1633-1703)*, (London, 1825), November 14, 1666.

[173] Ibid., entries for 21 & 30 November, 1667.

[174] See J.V. Golinski, "A Noble Spectacle: Phosphorus and the Public Cultures of Science in the Early Royal Society," *Isis* 1989, 80:11-39, pp. 20-6.

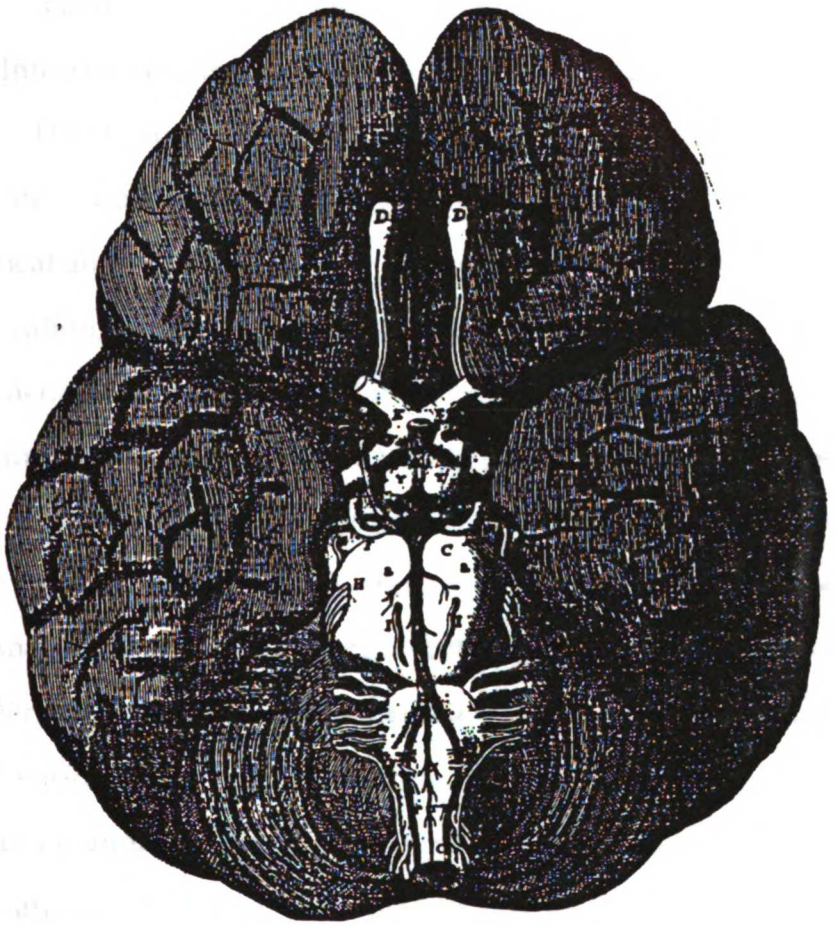
[175] Robert Boyle, "Aerial Noctiluca....a Factitious Self-Shining Substance," in *The Works of the Honourable Robert Boyle*, ed. Thomas Birch, 2nd ed. (London, 1772), vol. 4, p. 389; cited by Golinski, op. cit., p. 23, n. 41.

[176] Golinski, op. cit., p. 23.

[177] *The Diary of John Evelyn*, ed. E.S. de Beer (London: Oxford University Press, 1959), pp. 835-6. Cited by Golinski, op. cit., p. 23, n. 42.

[178] Golinski, op. cit., pp. 24-7.

[179] "A Paper of the Honourable Robert Boyle's...Being an Account of His Making the Phosphorus," *Philosophical Transactions*, 1693, 17(196):583-4; cited by Golinski, op. cit., p. 19, n. 27.



Cerebri anatome, 1664

Engraving of the brain from below
(Varolian view)

Chapter Two

The Physiology of Reason

Introduction

If Willis and his colleagues unhesitatingly located the soul in the blood during the Interregnum, their unanimity of outlook began to falter early in the Restoration. The person most responsible for this was Willis, who became Sedleian Professor of Natural Philosophy at Oxford in 1660, largely as a reward for his political and religious loyalty.[1] Willis, who originally had intended a religious vocation, suddenly had the opportunity to augment his clinical and chemical practice with philosophical lectures on the nature of the soul. Nominally mandated to lecture from traditional Aristotelian texts,[2] Willis followed the example of his fellow experimenters John Wallis and Seth Ward[3]--the Savilian Professors of Geometry and Astronomy, respectively--and fashioned his own mandate: "I should Comment on the offices of the Senses, both external and also internal, and of the Faculties and Affections of the Soul, as also of the Organs and various Provisions of all these."[4]

It was a mandate Willis claimed from then on. The soul as organism--or, to put the matter another way, the connections between mind and body--became the central concern of Willis, clinician *cum* natural philosopher, for the remainder of his life. What is the soul, how does one know it, and how does one heal its physical and mental distresses? The goal, as Willis put it in 1664, was "to unlock the secret places of Mans Mind."[5] Over the next fifteen years he assembled a research team(s) which attempted to provide some of the answers. Their results were published in four texts, authored by Willis, including *The Anatomy of the Brain and Nervous Stock* (1664), the *Pathology* of the same (1667), *Two Discourses on*

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the Soul of Brutes (1672), and *Rational Therapeutics*, which was published posthumously in 1675.

This chapter has two purposes. In the first place I want to explicate the principal aspects of Willisian neurophysiology in its contemporary intellectual context. The first three books noted above were the first comprehensive texts on the brain and nervous system to be published in European history. Most of the published secondary literature on Willis, although extensive, has had a persistent presentist bias. Generally written by specialists in neurology and neurosurgery, it has tended to view Willisian thought as it has related to subsequent developments within the neurological field.[6]

Additionally, prior to Willis, no English physician or natural philosopher had made a systematic case for the brain and nerves as primary in the human body. Yet as late as 1659 Willis himself as well as virtually every other established English investigator was involved with Harveian issues of the blood and circulation. The brain and nerves were not on the research agenda. Nonetheless, within the next three years Willis had not only assembled a research team and guided them in the performance of numerous anatomies and experiments, but also formulated a comprehensive neurology and arranged for its illustration and publication. A question arises: How and why did Willis and his colleagues make the shift from blood to brain? A definitive answer remains elusive. Willis's correspondence is not significantly extant, and his published works as well as those of his colleagues did not specifically address this issue. In examining the movement from heart and blood to brain and nerves, my thesis is that several factors were involved. In addition to the Restoration settlement itself, these include the intellectual pressure on the English of foreign cosmologies of the body as well as Anglican formulations of the place of reason.

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The Hierarchy of Souls

It should be emphasized at the outset that Willis and his colleagues, who at this time numbered chiefly Richard Lower, Ralph Bathurst, and Christopher Wren, never abandoned their attachment to the blood. Indeed, as indicated in the injection and transfusion experiments of Lower, Wren, and King (a surgical collaborator of Willis's in his London years), Willis's colleagues seem to have maintained their own independent interests in the heart and blood at the same time they worked on the brain and nerves. Lower, Willis's principal collaborator on the *Anatomy*, also authored a major work on the heart, his *Tractatus de corde*, in the late 1660's.

If this reflects a continuation of the collegial and fluid associations characteristic of the Interregnum clubs, it also reflects the multi-part nature of the soul that Willis himself sought to establish. For Willis, humans were "imbued with many distinct Souls."[7] Man had both a Rational Soul and a Sensitive Soul. The Rational Soul was equivalent to the human mind. [8] It was "Superior and Immaterial," and "incorporeal substance, and therefore Immortal, which is Created Mediately by God, and infused into the Body." [9] The sensitive soul, on the other hand, which was termed also the "animal soul" and the "corporeal soul" in man, was shared by humans with other animals. A further division was made, albeit inconsistently, in the "corporeal soul" between the "Vital Portion living in the Blood" and a "Sensitive" portion, which contained "an heap of Animal Spirits everywhere diffused throwo the brain and Nervous Stock." Both man and brute had a "Soul Co-extended to the whole Body, and Parts not only many and distinct, but after a manner dissimilar." Only humans, however, had a Rational Soul.[10]

The Rational Soul was chiefly located in the brain. However, in one passage Willis also indicated that it was also located in the "Bosom" of the

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"corporeal Soul."[11] More specifically it was located in the cerebrum, at least most of the time. The brain in turn was the primary organ of the animal body. As Willis explicated the matter in *Cerebral Anatomy*:

> "The Brain is accounted the chief seat of the Rational Soul in a man, and of the sensitive in brute beasts, and indeed as the chief mover in the animal Machine, it is the origine and fountain of all motions and conceptions."[12]

Worth noting is the fact that Willis's use of term "brain" indicated something different than its present-day referent. In common with many of his medical contemporaries, Willis used the term "brain" ambiguously. When he was writing generally, "brain" often included the cerebral cortices, the cerebellum, the medulla oblongata and their appendages in a sense more or less congruent with twentieth-century neurology. However, when he explicated brain and nervous structure, Willis took pains to restrict reference of the term "brain" to the cerebrum. The common restriction of brain to cerebral tissue did not change markedly until the middle of the eighteenth century, when its structural meaning expanded in conformance with modern usage. Willis regarded the cerebellum ("cerebrel") and medulla oblongata ("oblong marrow") as common to the sensitive souls of man and beast.

In terms of functions of the sensitive and rational souls, all depended on the cerebrum, but some "more immediately" belonged to it while others "depend ..mediately and less necessarily upon it." Among those which belonged to the cerebrum proper were the imagination, memory and appetite. As for the balance of the soul's functions, "Sense and Motion, also the Passions and Instincts merely natural, though they depend in some measure upon the Brain, yet they are properly performed in the oblong Marrow and Cerebel, or proceed from them."[13]

The hierarchy of souls indicated above was consistent with Willis's view of human character as being "of a middle nature and order, between angels and brutes."[14] Man's uniquely rational soul was able to fashion the sense impressions delivered to it by the corporeal soul into abstract and pure thoughts. These included such categories as rationality, fortitude, spirituality, whiteness, and temperance as well as contemplation of God, eternity, and "many other notions, far remote from sense and imagination."[15]

In this scheme natural instincts came from God and consisted of that practical knowledge by which animals knew what was useful and hurtful.[16] Animals could learn and remember; thus, the more clever ones were often thought of as capable of reasoning. As for the term "Passions", Willis used it in a manner akin to present-day use of "emotion." Simple passions depended on "custom" and more elaborate emotions derived from "opinion." Because they were a function of opinion, as well as of the imagination working upon sense impressions, they were not as reliable as the thought products of the rational soul.[17]

Although the rational soul or mind was immaterial and "survives (bodily death) and is Immortal,"[18] it was linked at times with the Corporeal Soul. Especially in "sicknesses" it could be affected by the Corporeal Soul. The truth of this had not been established scientifically, but by the study of "moral and theological writings" and the experience of a "good Life and Pious Institutions."[19] The duality of our material and immaterial souls matched the duality of human reality, where we constantly experienced "Wars and Strivings between our two Appetites, or between the Flesh and Spirit."[20] If the Rational Soul was always "striving after a divine state," the sensitive or corporeal soul drove one toward a number of "infinite wishes" based on "emotional custom."[21] When at full liberty,

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these "wishes" in turn would have humans "role in the mud of sensual pleasure."[22]

The Sensitive Soul possessed a faculty relatively rare in Willisian fluid physiology: the capacity to prepare its own medium of transmission from the raw material of the blood. Consistent with Aristotelian and Platonic notions of gender, Willis characterized the agency of the Rational Soul and "nervous juyce" as "male" and the "matter" of the body as "female." In the meantime, the remainder of the head and body carried on the work in the fashion of an "animal machine."

If the liquid agency of the Sensitive Soul was relatively immaterial--"very spirituous and subtil"--the "machine" aspects of the body were characterized as "matter." These could take on substance from the blood, but they could only take on proper form from the direction of the "nervous juyce" and routine operation from the corporeal or sensitive soul. As the operations of these parallel systems of soul were circular, all this normal order could be de-stabilized in disease states. The central biological process of the souls' operation was fermentation.

Willis viewed the explication of the souls as a "great and difficult" thing.[23] There were many, they were distinct, and they could interact in complicated and dangerous ways. "Man" could "design" by turns a "legitimate Subordination of them, and sometimes wicked Combinations, troublesome Contests, and more than Civil Wars." Mere description of them risked "Censure" by either the "Church" or the "Schools."[24]

The influence of Pierre Gassendi (1592-1655)

Just as Willis and the Oxford physiologists made use of Gassendi's Christianized atomism in formulating their corpuscular matter-theory, Willis acknowledged the influence of the French priest and natural philosopher on his

conception of the souls.[25] Likewise placing humans "a little less than the angels," Gassendi argued for a dual human soul consisting of a rational soul, or *animus*, which was immaterial and immortal, and a sentient vegetative soul, or *anima* .[26]

Sounding every bit as tortuous in his reasoning as did Willis, Gassendi also located the immaterial but Rational Soul or mind in the brain:

> "because of the influence of ....the nerves from all the sense and parts of the body is in the brain, the seat of the Phantasy is established in the brain..it seems congruous that also the mind or rational soul...is united not without another corporeal or sensitive soul so that it can think and understand by the intervention of the Phantasy; it is congruous, I say, that it has the same seat as the Phantasy, the brain."[27]

Despite his siting of the Rational Soul in the brain, Gassendi's *schema* maintained some loyalties to the cardio-centric models of scholastic Aristotelianism. Emotions, for instance, might originate in the operations of the fantasy and imagination in the brain, but they were to be experienced by the body through the agency of the heart's contraction or expansion in response to the messages carried to it by the nerves from the brain.[28] Gassendi may not have developed Willis's elaborate theories of cerebral localization, but he did provide Willis with the concepts of the dual souls which mediated their bodily messages through transmission of a juice which flowed from the brain to the nerves. If he maintained a loyalty to old Aristotelian ideas about the heart, it is worth noting that Willis located his vital flame there as well in the 1650's.

Establishing the cerebrum as free and independent

In terms of the ability of his approach to deflect subsequent anatomical thought on the brain, one of Willis's more important innovations had little to do directly with anatomical "facts" or neurological theory Nonetheless, it strongly

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influenced subsequent brain illustration. Also, in its presentation of the medulla and cranial nerves it helped promote a new way of imagining the interactions of brain and body that became increasingly influential in the eighteenth and nineteenth centuries. I am referring to Willis's promotion of the method of dissecting the skull by approaching it from below, severing the membranous attachments of the contents from the skull, and removing the (whole) brain. Once this was done, then "it will easily appear" that the cerebral cortices were not "united" to the cerebellum and medulla, but instead that the "Brain" was "altogether free and independent of them."[29]

This method of dissection, which was presented by Christopher Wren as the first illustration in *Cerebri anatome*, has provided a standard method of presentation of the gross anatomy of the brain since its presentation in 1664. Indeed, the Wren engraving with only slight modifications, is one of the images used as a visual aid in medical schools today as well as in the current edition of *Gray's Anatomy*. Later in this chapter I will discuss contemporary Anglican theological and philosophical beliefs about the primacy of the will and rational thought current among Willis's religious acquaintance. Given Willis's promotion of the "free" cerebrum as the primary location of the Rational Soul, I would suggest that his method of brain dissection helped reinforce or "naturalize" his moral cosmology. In this sense I would argue that Willis consistently "read" the body in a dual way. The new vista of the medulla and spinal nerves that this method afforded may also have contributed to the increasing attention these areas received in the work of influential eighteenth-century physiologists, such as Albrecht von Haller (1708-1777).[30]

Willis did not pioneer this anatomical approach, but he popularized it. Originally developed in the sixteenth century by the Paduan professor Costanzo Varolio (1543-1575), the Varolian approach was known in Europe but not used

by Willis's contemporaries.[31] Willis, who did not acknowledge Varolio, probably learned of the method from the influential English anatomical text, the *Mikrokosmo Graphia*, written by the surgeon Helkiah Crooke and first published in 1618. In recommending this method, Crooke did not emphasize its ability to establish the brain as free and independent. Instead, he found it appealing because "it doth better exhibit the true original of the spinal marrow and the nerves proceeding there from as also the structure of the ventricles for our better satisfaction in the *causes* of the diseases of the head."[32]

In contrast, Willis's contemporaries and influential antecedents employed a variety of other methods. The Galenic method, which was adopted by Vesalius, was considered outdated in the seventeenth century. It involved making transverse slices while the brain was in the skull.[33] In the seventeenth century Caspar Bartholin (1585-1629) and Sylvius (1614-1672) exposed the (whole) brain from the top and then dissected the hemispheres separately. Nicholas Stensen (1638-1686), who, as we shall later see, emerged as one of Willis's main continental critics, removed the cerebral cortices and dissected downward into the medulla.[34] In contrast to Willis's technique, which modified Varolio's in freeing the cerebrum *completely*, none of the other methods produced a "free and independent" cerebrum. Furthermore, in the Varolian approach as modified by Willis and his colleagues, the "oblong Marrow" or medulla oblongata, to which they assigned the principal tasks of "machine" direction, was the only structure that was united to the "brain."

The Varolian-Willis approach also had iconographic and social implications of which Willis seems to have been fully cognizant. He noted that the freeing-up of the (whole) brain from the skull made its "Contents..as much as may be..all made plain or open to the Spectators." While I will discuss the social aspects of dissection in a subsequent chapter, I do want to point out here that

Willis was ever conscious of the importance of witnessing, whether of the actual dissection or of its results as conveyed in images. A principal epistemological factor in this desire was his belief, shared by people like the botanist (and religious dissenter) John Ray as well as the physiologists who worked in the Harveian tradition, that structure conveyed function. Thus, if credible witnesses could see anatomical facts or "ocular demonstrations," they would learn, in the case of Willisian neuroanatomy, the "secret ways of working of the Sensitive Soul itself."[35] Dissections and tables and images of their findings would show the "uses and actions" of the "Particles of the Brain and of its Appendix" for "the exercise of every faculty."[36]

Juices

The crucial physiologic link between these various components of the Sensitive Soul and the overall body was the circulation of the "nervous Juyce" through the head's substance as well as the peripheral nerves. This "very subtil and spirituous" liquor was made in the brain. It was derived form the blood , and could be affected by "taints" in the blood, but it was not just blood. I t is noteworthy that Willis first proposed a nervous liquid distinct from the blood but related to it in his 1659 text, "On fermentation." As he indicated there, what he later termed the "nervous juyce" was made by a process akin to distillation:

> "the blood being restrained within by the Skull, and its menynges, as by an Alembic, are drunk up by the spungy substance of the Brain, and there being made more noble or excellent, are derived into the Nerves, as so many snouts hanging to it. In the mean time the more crass or thick Particles of the blood, being hindred from entering, are carried back by Circulation."[37]

The relation between the nervous juice and the blood was complicated. Both juices were nutritive, but the nourishment of the nervous juice was special and limited. In the first place, not all parts of the body were nourished by the nervous juice. Such a task would impose on the Sensitive Soul and the (whole) brain an obligation which was not suitable for their "dignity." The demands of the body were both too great and too coarse. Considering the "immoderate sweat..by continual labour and exercise, which Country-men and Labourers daily use, it is not possible that such losses should be repaired only by the nourishment supplied or sent through the small passages of the Nerves."[38]

While the arterial blood should be commended for nourishing the whole body and providing its "stuff" and replenishment, it lacked "a certain directing faculty" which only the nervous juice possessed. Existing as a "subtil and spirituous Liquor", the nervous juice was able to meet "everywhere" with the arterial blood, which was "duller and thicker," and "actuate and inspire" it. This actuation had a gendered aspect. The nervous juice was "like the male seed" and impregnated the thicker arterial blood "with Animal Spirit." Since the animal spirits, like good gentlemen, were mostly "at leisure from the work of nutrition" they were "ready for the offices of sense and motion." Indeed, they would flow into the nervous fibers "as into proper dwelling-houses."[39]

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The stuff of nerves

A final link in the circulatory passage of the animal spirits and nervous juice between body and brain was the nerves. These were not hollow large-capacitance vessels like the arteries and veins, but instead made of fibers arranged with "pores and 'passages" that resembled a "honeycomb." Fibers, a basic building-block of the body to Willis--as they were to Descartes, Gassendi, and van Helmont--received "constantly" from the nerves, which were also made

of fibers, the "forces and supplements of the animal Spirits, and also the Instincts of the Motions to be performed by them."[40]

When there was a problem of visceral origin, it could reach the brain in one of two ways. The slower pathway involved the "preternatural Juyces" of an ill spleen, womb or other "bowel" emitting "vaporous little bodies" which would "infect" the blood, which then circulated to the head. Or, they could affect the cerebrum "more immediately" by their effect on the nerves, which would carry the message quickly and "strike (the brain) with an heavy ill." The evidence proffered was pharmacological: in a healthy person pills of opium, although "scarcely dissolved in the Stomach" could cause 'Torpor".[41]

A new approach to the ventricles

The (whole) brain's ventricles, which had been of major importance in Greek and Galenic physiology, were also crucial in the Cartesian model. Willis and his colleagues, however, considered them to be of only minor importance in normal function, and a large portion of the eleventh chapter of *Cerebral Anatomy* was devoted to re-defining their role. After discussing the relative freedom of the cerebrum, Willis noted that upon lifting it, the "three Ventricles commonly so called" went into "one empty space or mere vacuity."[42] Their existence was only a "complication of the brains infoldings" or "circuit..over or above the oblong marrow."[43] Before delving further into Willis' views on the ventricles, however, it may be worthwhile to outline their role(s) in traditional and Cartesian physiologies.

Classical views of the ventricles

Even those writer(s) of ancient texts that most emphasized the role of the brain, such as the Hippocratic text on epilepsy, *The Sacred Disease* (430-450 B.C.),

described it primarily in terms of its status as a container and transit point for breath from outside the body to the muscles and viscera. Nonetheless the brain was key: "Men ought to know that from the brain, and from the brain only, arise our pleasure, joys, laughter and jests, as well as our sorrows, pains, briefs and tears."[44] Intelligence, by which the author(s) seems to indicate cognitive and emotive operations, however, came from the air:

> "I hold that the brain is the most powerful organ of the human, body, for when it is healthy it is an interpreter to us of the phenomena caused by the air, as it is the air that give it intelligence."[45]

In this scheme the substance of the brain was not discussed. Instead, it seems that the brain's important function was as a reservoir which communicated breath and humors to and from the body either in some unspecified direct manner (breath) or through "veins," which "lead up to it from all the body":[46]

> "For when a man takes in breath by the mouth or nostrils, it first goes to the brain, then most of it goes to the belly, though some goes to the lungs and some to the veins...the air that goes into the lungs and the veins is of use when it enters the cavities and the brain, thus causing intelligence and movement of the limbs."[47]

Plato (429-347 B.C.) also placed his Rational Soul in the head. Emphasizing the similarity between the "round shape of the universe" and the head, he found the brain "the divinest part of us and lord over all the rest" because it served as a "vessel" for "Seed."[48] As with the Hippocratic text, it was the brain's ventricles, the head as a vessel, that was given imaginative importance, not its gray and white matter and cranial nerves. Indeed, Plato wrote that the fleshy parts of the body, including those of the head, were inferior.[49]

When he discussed the brain, Galen's (129-199 A.D.) central purpose seems to have been to undermine the Aristotelian proposition that the heart was the center not only of the body's nourishment, but of its intelligence. Thus, much of his experimental work on the brain and nerves was devoted to an explication of the cranial nerves and peripheral nerves based on dissections of the Barbary ape. When Galen talked abut the brain itself, he was preoccupied with its heating and cooling properties as compared to those of the heart as well as its proximity to the senses (and cranial nerves). As a consequence of these concerns, Galen's analysis of the brain's structures was skewed toward establishing the brain as an efficient refrigerator of the heart's heat and as the body's center for sense and movement. The following excerpt from his *Use of the Parts* gives a sense of his interest in the internal structures:

> "Does not each of the eyes receive a soft (sensory) and a hard (motor) nerve... Do not four of them go to the tongue..Shall I announce the other parts that enter into the structure of the brain? Shall I say what use is provided by the meninges, the reticular plexus, the pineal gland, the pituitary body...the multiplicity of the ventricles, the openings by which they communicate with one another and the variety of configurations...the roots of the nerves..The brain is the source of all the nerves."[50]

Galen imagined the ventricles as the storage tanks of animal spirits, which were manufactured in the brain and distributed through the (hollow) nerves. His emphasis, however, was not on their storage but on the role of the nerves, both cranial and peripheral.

When one looks at extant images from medieval and Renaissance anatomical texts, however, one can see that the image of the brain as a series of three hollow cells (ventricles) became dominant. An image from the 1503 encyclopedia of Gregor Reisch (?-1525) is typical.[51] The brain tissue is shown as

an undifferentiated mass on the borders of three empty spaces with curved sides. In the most anterior of the cells occurs "phantasy" and "imagination." In the middle, which communicates with the anterior by a narrow passage (the choroid plexus), occurs thought and judgment; in the posterior, which communicates with the middle by another narrow passage, occurs memory.

Willis and Descartes on the ventricles

With Descartes, who borrowed considerably from Galenic physiology and anatomy, a similar concern with to and fro nerve transmission was described with a markedly different verbal imagery than Galen's. Written in a metaphorical style in the early 1630's but published posthumously in Holland in 1662, Descartes' *De homine* contains his most sustained thought on bodily organization. In contrast to Willis, for Descartes the whole brain, like the body that physically supported it, consisted of pieces of a hydraulic machine akin to a waterworks in "the royal gardens":

> "Indeed, one may compare the nerves of the machine I am describing with he pipes in the works of these fountains, its muscles and tendons with the various devices and springs which serves to set them in motion its animal spirits with the water which drives them, the heart with the sources of the water, and the cavities of the brain with the storage tanks."[52]

It was this brain-as-cavity, brain-as-ventricle thinking that Willis wished to overturn. Instead, he and his colleagues sought to establish the solid tissues of the brain and the cranial circulatory system as of primary importance. Antecedents for their desire to establish the primacy of tissue and circulation can be seen in the parallel work undertaken by Willis, Lower, Bathurst and their fellow physiologists in the 1650's (and by Lower in the 1660's) on the heart and vasculature which was discussed in the previous chapter. Stripped of its

philosophic and theological glosses, the work of Willis and his colleagues on the brain and nervous system had much in common with the Oxford approach to the blood and heart. Just as Lower explicated the heart as an active muscle in the *Tractatus de corde* (published in 1669 but written earlier in the decade) to counter Cartesian characterization of it as a physically passive vessel, so, too, Willis and his group approached the structures of the solid parts of the head as chemically and physiologically active.

Given that the ventricles "are only a vacuity resulting from the folding up of (the brain's) exterior border," Willis saw "no reason we have to discourse much of their office." [53] Furthermore, the concept of large fluid reservoirs did not make physiological sense. The "animal spirits" were "very Subtil", and, as such, were apt to "fly away." As a consequence, they did not need a "large and open space" for storage. Instead, they required the "more narrow passages and little pores" of the "substance of the Brain." Furthermore, as the "various Faculties of the Soul" were "composed" differently, they "ought" to move within *particular* "orbs and tracts" of the solid brain.[54] When Willis later developed his pathological and therapeutic ideas, this notion of particular pathways was useful.

A broad variety of evidence was put forward in support of this position. Post-mortem examinations of "dropsical" patients, as well as "conjecture" based on comparative anatomies of large mammals and ventricular injection experiments with colored inks indicated that the ventricles were merely an overflow drainage system for the cerebrum and cerebellum. When blocked they could cause problems, as the in history of a "Gentlewoman"--possibly Anne Conway (1631-1679)--with recurrent headaches.[55]

The result of this explication of the origin and disposition of the animal spirits was that the ventricles, previously characterized by Willis as secondary and accidental in structure, were no longer in the center of brain action.[56] Hence,

they were no longer centrally involved in the operations of the mind or body. Such a characterization had major implications for Cartesian physiology. Indeed, by so setting-up the ventricles, Willis also set-up his assault on the role of the pineal gland, which Descartes had considered the seat of the Rational Soul in man.[57]

Central structures: the pineal versus the striated bodies

Descartes, who believed that the pineal gland was unique to humans, characterized it as the "fountain-keeper who must be stationed at the tanks to which the fountain's pipes return if he wants to produce, or prevent, or change their movements in some way."[58] Its undulating motion in the ventricles was "like the fingers of the organist, which press certain keys and cause the air to pass...into certain pipes."[59] If the heart and arteries were like an organ's "bellows," the location of the pineal, "suspended" as it was over the passage between the "anterior" and "posterior" ventricles, occupied a crucial position in the direction of the animal spirits, and, hence, nerve transmission:

> "the slightest movement on its part can do a great deal to alter the course of these spirits, and, reciprocally, that the slightest change in the course of the spirits can do a great deal to alter the movements of this gland."[60]

Moreover, there was no other structure in the brain that could do its work, for the pineal was one of the few mid-line brain structures, and its only mid-line gland. Preoccupied with his optics, perhaps, Descartes was concerned that sense impressions, of which he mentioned most prominently the visual, came from two organs usually. Therefore they needed a place to "unite" so that they would not present the brain with two images. There was simply "no other place in the body where they could unite before doing so in this gland."[61]

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Just as they did not accept the Cartesian heart, Willis and his collaborators were having none of this. In the first place, Willis pointed out--as had Helkiah Crooke in 1618--that the pineal was not unique to humans. Comparative anatomies had shown that is was found in birds and fishes as well as humans. Hence, although it was a "necessary" organ, one

> "can scarce believe this to be the seat of the Soul, or its chief Faculties to arise from it because Animals, which seem to be almost quite destitute of Imagination, Memory and other superior Powers of the Soul have the Glandula or Kernal large and fair enough."[62]

Pathological anatomy and clinical correlation provided additional support for this view. Given that the structure of the pineal resembled an "infolding" of tissue to Willis, he noted that in certain diseases which filled the ventricles with "water," the infolding disappeared. Nonetheless, the "sick" from this condition had been during life "indifferently strong in the exercise of the animal Faculties."[63]

Evidence of a continuing tension between Cartesian and Willisian views of the pineal is provided in a report published in the *Philosophical Transactions* in 1686 on a "petrified" pineal gland recovered from a human brain on post-mortem examination. Edmund King (1629-1709), Willis's surgical collaborator in London, wrote a four-page note on the clinical history and post-mortem findings on Robert Bacon, a "Pious Learned Man" who was an Oxford graduate and minister "above 75 years of Age." Apparently during the last twelve years of his life, Bacon had developed progressively severe symptoms including a persistent falling to the right, urinary and fecal incontinence as well as disparate oddities of behavior and speech that suggested his "rational Faculties seemed to be quite lost."

Hearing of this while Bacon was alive, King wrote that the "desired" to examine Bacon's "Brain" when he died. With Bacon's relations as "eyewitnesses" of the process, King was granted his wish. Although the contents of the chest and abdominal cavities were more or less normal, Kind noted many abnormalities in the contents of the skull. What was most odd, however, (and what provide the headline of the report), was the finding of a "Stone in a film, or rather a petrified Gland in a film" in the pineal, which otherwise was "firm and fair." Keeping the stone as a "great Rarite," King noted that he also talked to a "gentleman" present about Cartesian views of the pineal as the "seat of the Rational Soul." King, however, declined to speculate on the meaning of his finding, citing lack of time. He did note, however, that he had dissected more than an hundred" brains and not seen "such a one."[64]

The central structure that *was* of major interest to Willis was the white and gray matter that bridged the two cerebral hemispheres at their base. What caught Willis's attention about this area was that its fibers connected anatomically to many parts in the cerebrum. Known today as the corpus callosum in reference to its white matter only, for the Willisians the area included "striated bodies" (today the corpus striatum) as well as a "transverse medullar process, like a great nerve," which is now known as the anterior commisure.

Proportionately larger in "man and the more perfect four-footed beasts" and particularly small in birds and fishes, Willis viewed them as "the Mart or Exchange of the (animal) Spirits" rather than as a production center of spirit. In such a "free and open place" to meet, the spirits had the "leisure" to become "refined more and more" before they served the "Imagination" or the nerves by way of the medulla.[65] Pathological anatomies provided evidence of their importance. People who had exhibited abnormal motions and sensory derangements had "striated bodes" that were "less firm than others...(and which

were) discolored like filth or dirt."[66] Edmund King's post-mortem on Mr. Bacon noted that his corpus callosum was "very Flaccid more than ordinary," but Bacon's brain had several other abnormalities as well as the odd pineal, and King did not assign Bacon's behavior to defect in any particular structure.

Controlling the automatic body

According to Willis and his colleagues, if one wanted to learn about the body's automatic motions, one should look not at the pineal, but at the cerebellum instead. But in classical thought the cerebellum had been the seat of memory, a function Willis reassigned to the "cortical spires of the Brain." This left the cerebellum, which Willis argued was "wholly distinct from the Brain," to nonetheless play a vital function. It was a "peculiar Fountain of animal spirits designed for some works." These spirits directed in a "constant manner unknown to us" the body's "involuntary actions such as the beating of the Heart, easie Respiration, concoction of the Aliment...and many others." Moreover it did its work "unperceivedly and silently...without our knowledge or care." Cerebellar anatomy was cited as the basis of these assertions. Whereas the structure of the cerebrum was typified by "crankling turnings and windings" of tissue, that of the cerebellum was "orderly disposed," as in an "artificial Machine or Clock" that was subject to "Rule and Method."[67]

Controlling the emotions: the role of the cranial nerves

One of Willis's key supports in his argument for the primacy of the brain and nerves in controlling emotions was his explication of what he termed the "intercostal" nerve, which today is known as the sympathetic chain of ganglion. Elaborating Gassendi's idea that it was an important link between the brain and the heart, Willis asserted that it had a dual origin in the fifth and sixth cranial

nerves of the cerebellum. In addition to the vagus, it provided a "quick commerce" between the brain and the "intercostal's" main terminations in the heart, viscera, and face. Moreover, at the time he wrote the following statement, Willis believed the "intercostal's" innervation of the heart and abdomen was limited to only man and "most four-footed beasts." He also believed that its innervation of the diaphragm was unique to humans This finding, which was later retracted upon his finding "intercostal" innervation of the diaphragm in monkeys, indicated man's special place in the chain of beings. It also was "certainly the cause why risibility is the proper affection of man." As Willis summarized the matter:

> "For as much as this nerve reaching forth into the praecordia (heart) and viscera of the whole Abdomen is continued by its superior ramification also into the Eyes, as also into the parts of the Mouth and Face: certainly from hence a true and genuine reason may be given wherefore in every passion the Eyes, Face, and Mouth do so correspond with the affections of the Praecordia, often unknown to us or against our minds, that often times we are compelled to betray the most intimate sense of the heart by the countenance and aspect."[68]

Willis also materialized other mental functions, such as memory, in terms of the gross anatomical characteristics of the cranial nerves. Noting that the seventh cranial nerve had its origins in the cerebellum and innervated the ear and mouth, he argued that it helped explain humans' differential capacities to remember melody: "Some men learn Musick without any trouble (while others), "though very ingenious men and of excellent memory are very Fools at Musick." The reason was that some men had "a harder frame of Cerebel." As a consequence, they produced no regular "tracts" of melodies and so humans so

configured had no "natural memory" of them and could not remember songs or perform them.[69]

Human and animal emotional capacities

In terms of the place of emotions in humans as compared to other animals, the structures Willis termed the "orbicular Prominences" and the "annular Protuberance" on the anterior and posterior aspects respectively of the cerebellum were of central importance. Acknowledge that he was "propos(ing) our Opinion, though with an hesitating and doubtful mind," Willis used comparative anatomies on humans, dogs, cats, calves, hares, "and other milder Animals" to establish a relation between the proportionate size of these structures and the creature's emotional capacity and "wit." He claimed that when the "annular Protuberance" was smaller, the "orbicular Prominence" was larger, and *vice versa*. This became important, because he also claimed that the "orbicular Prominences" carried the "forces of the Passions" from the cerebrum to the cerebellum, where they would travel via the "intercostals to the heart. The "annular Protuberance," on the other hand, received the "forces of the Passions...second-hand from the deputiship of the Cerebel" only, and from thence "immediately" to the heart.[70]

Given his assumption that the animal spirits that conveyed emotions must, of necessity, be stored in the "annular Protuberance" before being transmitted in the nerves, he argued that the structure "is far greater in Man than in any other Animal." Next the dog had the greatest emotion and "annular Protuberance," then the cat, and so on. In contrast, the orbicular "prominences" were largest in those animals with an "indocil or dull Brain", such as the sheep, hog, and calf. In man and the more emotive animals, however, the "prominences" were small. All of this was by way of establishing a distinction

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between "wit" and "instinct," and, hence, a gradation between man and beast. The "orbicular Prominences" were "another or supplementary Brain, and the chief Organs of the natural instincts."[71] It was no wonder that they were large in "dull working beasts" and small in more clever and emotive animals.[72]

Theological connections

In addition to citing Pierre Gassendi, Willis also cited the Anglican theologian Henry Hammond (1605-1660) as a major authority on his explication of the soul. When the general subject of the influence of religious thought on seventeenth-century English science has been explored, sociologists and historians working on the period, such as Robert Merton, Christopher Hill, and Charles Webster, have emphasized "Puritan" influences. While a number of historians, including Barbara Shapiro, Michael Hunter, the Mulligans, and the Jacobs, have questioned some of their interpretations regarding the demographics of active investigators and the place of animistic thought, the subject of Anglican influence on physiological constructions of mind and body scarcely has been considered.[73]

In approaching Hammond, then, I want to approach not just Hammond, the individual, but the tradition of which he was a prominent spokesperson. One unifying aspect of that tradition was an effort on the part of its adherents to ameliorate that strand of Calvinist thought which characterized God's behavior as arbitrary and wholly beyond the operations of reason. Moreover, Hammond had been the intellectual leader of a group of Anglicans which included Willis's close friends Richard Allestree and John Fell and principal patron, Gilbert Sheldon, a politically influential Anglican leader from the period of the Civil War through his elevation to Archbishop of Canterbury in the early Restoration.

In discussing Hammond, then, I am attempting to lay out not only a cluster of contemporary theological ideas about reason and the soul, but also establish the religious context of the High Church world in which Willis, Wren, Bathurst, and King (but not Lower) and many of their patients moved. In doing so, I do not want to suggest that these ideas only appealed to High Church Anglicans. Indeed, Hammond's theological writings, as opposed to his consistent support for episcopacy, were respected by Presbyterian leaders such as Richard Baxter (1615-1691) who had little use for his opinions on church governance.

In writing on the efforts of certain seventeenth-century Anglicans to move their church away from Calvinistic thought, Isabel Rivers has asserted that the thought of Hammond, Allestree, and Jeremy Taylor was central:

> "Their central texts, Hammond's *Practical Catechisme*, Taylor's *Holy Living*, and *The Whole Duty of Man* (whose "likely" author was Richard Allestree), represents a very important shift in doctrine, argument, emphasis, and vocabulary, and the production of such texts was a deliberate attempt on the part of this group of Anglicans to undermine the assumptions of Puritanism and transform popular religious opinion."[74]

Of direct use for Willis was Hammond's characterization of the human soul in *Practical Catechisme*--a text that went through twelve editions from 1644 to 1683--as possessing a dual nature. It was both immortal and immaterial as a Rational Soul and "subtle" and "finely material" as a corporeal soul.[75] Like Gassendi, with whose thought he may or may not have been familiar, Hammond's characterization of the soul was part of a larger effort to persuade readers that the purpose of Christ's life, death, and resurrection was to increase man's righteousness, "in effect, the reformation of lives, and heightening of

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Christian practice to the most elevated pitch being the one only design of all our Christianity."[76]

In contrast to the Calvinists, who stressed the arbitrary nature of God's predestination of souls for salvation, Hammond emphasized the conditionality of God's offer of salvation. Salvation depended on living well. Living well, in turn, depended on repentance, obedience, duty, and performance. Given these assumptions regarding the conditions of access, God's offer was open to all. It was an approach that undercut sectarian impulses to find assurance in displays of religious enthusiasm, such as speaking in tongues. Hammond's writings in this vein also anticipated the emphasis that the influential Anglican authors Jeremy Taylor and Richard Allestree, in particular, were to lay on conduct and performance in the Restoration.

By embracing Christ, the individual sinner might take advantage of God's general providence and be reborn at the Resurrection. According to Allestree, who purportedly authored the popular conduct books *The Gentlemans Calling* and *The Ladys Calling*,[77] physic for the mortally ill was helpful not to prolong bodily life, which was suffering the torment of terminal disease anyway, but to preserve the sinner's *mind* so he or she might convert while still rational. After all, Christ's promise of eternal life was a dispensation offered to humans, who, alone among God's creatures, were both rational and redeemable. Conversion might be achieved by the operations of God's providence alone, of course, and by the reading of the proper spiritual guides; it was aided, however, by active consideration of issues of conscience by the afflicted and his or her minister.[78]

Willis would have known of these strains of religious thought not only through his readings, about which no extant evidence remains, but also through his frequent company with Allestree, John Fell (1625-1686), who was Hammond's biographer , and Sheldon, whom he knew in Oxford. It is not known for certain

whether Willis met Hammond in Interregnum Oxford. However, as his lodgings were the site of clandestine but well-known Anglican services in the 1650's, it is plausible that visiting Anglican divines met him through services of worship. Also noteworthy in this regard was Willis's (first) marriage to Mary Fell, sister of his friend John, who became Bishop of Oxford. Richard Allestree conducted the marriage services. Moreover, the "practical" approach of Hammond and his followers seems consonant with contemporary account of Willis's personality and behavior. Pious in demeanor, Willis tithed as well as hired a curate to read prayers twice daily when he could not attend.[79]

Also present in the thought of Hammond and his followers as well as that of the Latitudinarians, such as Wilkins, was a belief in the importance of reason.[80] One can trace the importance of reason in Anglican at least as far back as the late sixteenth century thought of Richard Hooker, who argued, following Thomas Aquinas, that natural law was the law of reason: "The natural law, "meaning thereby the law which human nature knoweth itself in reason universally bound unto...comprehendeth all those things which men by the light of their natural understanding evidently know."[81]

This is not to say that scriptural authority and church tradition were not also standard assays of theological knowledge, for they were. However, one does find in early modern Anglican thought a role for reason that was not so present in either Calvinism or Catholicism as they were understood in England. Moreover, the tendency to value reason as an independent authority in matters theological increased with the development of the "new" philosophy in mid-century. Edward Stillingfleet (1634-1699), a prominent Anglican of Latitudinarian persuasion, wanted a prose style like that favored by the Royal Society. The aim of "the style and way of writing" should be "to join clearness of expression with evidence of reason."[82]

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In contrast, for Calvin and his intellectual descendants both in the sects as well as the Church of England, the ineluctable fact about the human condition was man's Fall. Humans existed with no assurance of redemption. Man was permanently alienated from God, who was unknowable. He might be saved, but only God had so predestined his soul. General providence, a trait of God's behavior which appealed strongly to Anglican as a whole, had little place in Calvinistic thought. One could only hope for special providence, or salvation.

The role of curiosity, or reasoned inquiry, was severely constrained in this cosmology. One should "not..indulge curiosity." It was a sin "when miserable man endeavors to force his way into the secret recesses of Divine wisdom...that he may discover what is determined concerning him at the tribunal of God."[83] Epistemologically, scripture, not the tradition of scripture, tradition, and reason, had full authority. The universality of the Fall and the general wretchedness of man's condition also argued for congregational election and equality among ministers and against a hierarchy of bishops.[84]

Although stated less harshly than by Calvin, belief in the subsidiary nature of reason was shared by the other main influence on mid-century non-conformism: Christian mysticism. The inheritors of the theological assumptions that lay behind the matter-theory of Paracelsus and van Helmont likewise discounted the value of reason by itself. The Rosicrucians, Familists, Quakers and other "enthusiasts" who occupied one chamber of what might be termed an "Anglican nightmare" tended to value reason only so far as it amplified an "inner light" experienced in unmediated access to God and/or Christ.[85] Believing deeply in free-will, they tended to see the human soul as possessing "perfect liberty of choice and full independence from any external influence and form any pre-determined inherent condition."[86]

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Conclusion

Unlike previous theories of interaction between the brain, nerves, and visceral organs, Willisian neuroanatomy of the emotions minimized unmediated access by the lower body to the (whole) brain. Furthermore, in the Willisian model the brain contained a series of pathways by which emotions always remained under the (potential) control of the cerebrum, and, hence, the Rational Soul or mind. In other words, the physiological distance between mind, now firmly located in the brain, and body had increased. Even fluid containing diseased material from the lower organs was presented to the brain by medication of the nerves. Its message was then processed by the brain, which then sent its signals back to the body via the nerves. Transmission, which I have not discussed in detail, had characteristics of both particle flow and wave propagation.

By these and other theories, Willis and his associates created a matrix of explanations that permitted them to posit a neurological origin for a large number of normal and abnormal cognitive, emotional and bodily situations from the autonomic to the volitional. Much earlier Platonic thought had located reason in the head. A distinction, which I believe constituted a major difference between previous physiologies of reason and that of the Willisians had to do with the role of the solid tissue of the brain. Whereas classical thinkers as well as Descartes ascribed to them minimal roles, the Willisians made them, together with the nerves, supreme in the body. Furthermore, existing "free and independent" in the apices of those tissues, the cortex of the cerebrum, was a physiologically sophisticated notion of reason.

In assessing the impetus for the rapid emergence of this "neurocentric" model from a group so recently devoted to circulation physiology, two factors have been emphasized. The first has to do with model-competition. Harvey had

put large problems out for consideration in the 1640's and the 1650's, but they were problems confined to what was known traditionally as the vital soul. In contrast, influential Continental thinkers including Descartes, van Helmont, and Gassendi had written comprehensively regarding nature and the body. If Willis and his colleagues came to terms with these challenges in their physiology of the vital soul, or blood, in the 1650's, the result was neither satisfying nor comprehensive in the Restoration.

Unsatisfying, I would argue, because, for one thing, dispute about the result divided the learned medical community and its supporters. Moreover, as evidenced by the struggle between (al)chemical physicians and those in the College noted in the previous chapter, this dispute survived the Restoration. Also, as everyone involved knew, it was not just a struggle about the place of the blood and particular therapies but also a struggle about the whole apparatus and control of learning, including university medicine, and the medical profession. Additionally, physiological conceptions of humans as either wholly machines (Descartes) or wholly independent spirits (van Helmont) were at odds with the outcome of the Civil War and Interregnum. English people had more or less tried out the civil body as both machine and free spirit and fond them wanting, or at least not sustainable.

A limitation of physiological inquiry to the vital soul also did not square with the new expansiveness of roles that the Restoration provided to loyal Anglicans and Royalists. Oxford explication of the blood in the Civil War and Interregnum was brilliant, but it left the rest of the body and its souls, as it were, in limbo. This position may have reflected the political situation in the late 1640's and 1650's, when, in the consciousness of many Anglicans and conservative Puritans, the king and Church--the animal and rational souls if you will--had been beaten into ruin. The vital soul was all that was left, and Willis and his

associates were in no position to assert otherwise. But monarch and church had been restored! More was possible! If skeptical of the possibilities of human goodness, Willis was nothing if not optimistic regarding the abilities of medical investigations to discover the "secrets'" of his countrymen's minds and souls. Furthermore, his "neurocentric" model established a uniquely English body that was as comprehensive in its scope as anything the Continent had produced.

Additionally, I have argued that Willis was writing not only physiologically but also theologically. Indeed, I maintain that it is difficult to comprehend Willisian neurophysiology without also absorbing the theological views current among its developers. If Willis's "findings" in these matters pushed the bounds of the plausible, let alone the known, in physiology, they were consistent with contemporary Anglican ideology (as well as the Christianized Epicureanism of Gassendi) regarding reason, emotion, and authority. I would suggest that this ideological consistency is one reason the Willisian "neurocentric" model emerged in comprehensive form in such a comparatively short time. In many ways the contours of physiological terrain to be explored already had been mapped. In this sense Edward Stillingfleet's words from a sermon preached before the king in 1667 possessed both theological and physiological meaning: "The difference...between good and bad men is between those who maintain an Empire of reason, assisted by the motives of Religion, over the inferior faculties." [87]

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[1] As was noted in the previous chapter, Anglicans, under the *de facto* leadership of Gilbert Sheldon, who was then Warden of All Souls at Oxford as well as Bishop of London, undertook a housecleaning of their Puritan rivals in the universities and parishes. Approximately 2,000 non-conforming academics and ministers were ejected in the early Restoration. Sheldon recommendedWillis to Charles II, who approved the appointment. Within a few weeks of that Oxford granted Willis his M.D.

[2] William Laud (1573-1645) was made Archbishop of Canterbury in 1633, at which time he sought to enforce Aristotelianism in the university curricula. Laud led the movement in the Church against Calvinist influences, which had been in the ascendant since the later sixteenth century. By the time of the Restoration, however, Laud, who was executed in the Civil War, was regarded as having been the main promoter of "High Church" Anglicanism by "latitudinarians" such as Wilkins. See John Spurr, *The Restoration Church of England,* (New Haven: Yale U.P., 1991), pp. 313-16.

[3] Seth Ward, *Vindiciae academiarum,* (Oxford, 1654), pp. 29-30. See also Robert Frank, *Harvey and the Oxford Physiologists,* (Berkeley: U.C. Press, 1980), pp. 48-9.

[4] Willis, *Anatomy of the Brain*, 1664, "Preface to the Reader." The text is also known commonly in translation as *Cerebral Anatomy*.

[5] Ibid, "Epistle Dedicatory to his Grace Gilbert, Archbishop of Canterbury"

[6] For the most recent approach of this kind, see J. Trevor Hughes, *Thomas Willis 1621-1675,* (London: Royal Society of Medicine, 1991); also Richard Y. Meier, "Sympathy in the neurophysiology of Thomas Willis," *Clio Medica*, 17, nos. 2/3, pp. 95-111; Alfred Meyer and Raymond Hierons, "On Thomas Willis's Concpts of Neurophysiology," part 1, *Medical History 9* (1965), pp. 1-15; idem, part 2, in ibid 10, pp. 142-155; Hansreudi Isler, "Thomas Willis's Two Chapters on Headache of 1672: a first attemtto apply the "New Science" to this topic," *Headache* 26: 95-98; idem, *Thomas Willis*, (New York: Hafner, 1968); G.W. Bruyn, "The Seat of the Soul," in F. Clifford Rose and W.F. Bynum, *Historical Aspects of the Neurosciences,* (New York: Raven Press, 1982). For a more contextualized view of Willis, see Robert G. Frank, "Thomas Willis and his Circle: Brain and Mind in Seventeenth-Century Medicine," in G.S. Rousseau, ed., *The Languages of Psyche*, (Berkeley: U.C. Press, 1991); also, W.F. Bynum, "The Anatomical Method, Natural Theology, and the Functions of the Brain," *Isis,* 1973, 64, 224,:445-468. For an assessment of the impact of Willisian neurophysiology on eighteenth century English learned culture, see G.S. Rousseau, "Nerves, Spirits, and Fibres: Toward Defining the Origins of Sensibility," Brissenden and Eade, eds., *Studies in the Eighteenth Century,* v. 3 (Canberra: Australian National U.P., 1976), pp. 137-157).

[7] Willis, *Two Discourses*, (1672), "Epistle Dedicatory," sig. A3.

[8] Ibid., "Preface to the Reader," n.p.

[9] Ibid, pp. 29-30.

[10] Ibid., "Preface to the Reader," n.p.

[11] Ibid.

[12] Willis, *Cerebral Anatomy*, 1664, p. 91.

[13] Ibid., p. 91.

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[14] Willis, *Two Discourses*, p. 41.

[15] Ibid, p. 39. See also Diane Puklin, "Medical Psychology in the Seventeenth Century: The Idea of a Neurological Emotion in the Thought of Thomas Willis," unpublished Ph.D. dissertation, University of Chicago, 1980, ch. IV.

[16] *Two Discourses*, p. 34.

[17] Ibid., pp. 52, 45-6.

[18] Ibid., "Preface to the Reader," n.p.

[19] Ibid., p. 40.

[20] Ibid., p. 41.

[21] Ibid., p. 52.

[22] Ibid., pp. 46, 52.

[23] Willis, *Two Discourses*, "Epistle Dedicatory," n.p.

[24] Ibid.

[25] Ibid., pp. 40-1.

[26] Margaret J. Osler, "Baptizing Epicurean atomism: Pierre Gassendi on the immortality of the soul," in ed. M.J. Osler and P.L Farber, *Religion, science, and worldview*, (Cambridge, U.K.: Cambridge U.P.), pp. 163-183., p. 168.

[27] Pierre Gassendi, *Opera omnia*, II, 446; quoted by M.J. Osler, op. cit.

[28] Pierre Gassendi, *Syntagma philosophicum*, in *Opera omina*. 6 vols. (Florence, 1727), vols. I and II. Book X, ch. 1, 473a. Cited by Puklin, op. cit., p. 84.

[29] Willis, *Cerebral Anatomy*, p. 60.

[30] Von Haller commonly dissected the brain from below. He also maintained that the "seat of the mind" was in the "crura of the medulla" because of that area's abundance of nerve origins. Von Haller even seemed to think that the medulla was the primary seat of intelligence, for he noted that whereas it was normally a "very soft pulp", it was "harder in insects and idiots." See von Haller, *First Lines of Physiology*, trans. from 3rd Latin ed., (Edinburgh, 1801), pp. 176-179.

[31] On Varolio's method, see an excerpt from his *De nervis opticis nonnullisqeu aliis, praeter communem opionem in humano capite observatis, epistolae*, (Padua, 1573) in Edwin Clarke and C.D. O'Malley, T*he Human Brain and spinal Cord*, (Berkeley: U.C. Press, 1968), pp. 820-3.

[32] Helkiah Crooke, *Mikrokosmo Graphia*, (London, 1618), pp. 493-502.

[33] See figures on brain and head in Andreas Vesalius, *De corpore humani fabrica*, (Basel, 1543).

[34] On Stensen, more commonly known as Steno, see his *Lecture on the Anatomy of the Brain*, (1669), intro. by Gustav Scherz, (Copenhagen: Nyt Nordisk, 1965)

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[35] Willis, *Cerebral Anatomy*, p. 56. For recent historiography on seventeenth-century witnessing in natural philosophy, see Steven Shapin, 'The House of Experiment in Seventeenth-Century England," *Isis*, 1988, 86:373-404.

[36] Willis, *Cerebral Anatomy*, p. 56.

[37] Willis, *Diatribe duae*, "On fermentation," pp. 14-5.

[38] Willis, *Cerebral Anatomy*, p. 134.

[39] Ibid., pp. 135-6.

[40] Ibid., pp. 127-8.

[41] Ibid, p. 132.

[42] Ibid, p. 56

[43] Ibid., p. 91.

[44] "The Sacred Disease," in *Hippocrates*, trans. W.H.S. Jones, (Cambridge: Harvard U.P., 1923) fours vols., 2:175.

[45] Ibid., p. 179.

[46] Ibid., p. 153.

[47] Ibid, pp. 159-161.

[48] For Plato's description of the supremacy of the head as a vessel for the soul, see T*he Timaeus,* trans. Benjamin Jowett, in *Plato: the collected dialogues,* ed. by Edith Hamilton and Huntington Cairns, (Princeton: Princeton U.P., 1961), pp. 1195-6, 73 b-d.

[49] For Plato's view on the inferiority of the head's flesh, see ibid., p. 1198, 75e-76a; for his general belief that the fleshy parts of the body are inferior, see pp. 1194-8, 70d-77.

[50] Galen, "The Use of Parts, " in *Oeuvres anatomiques, physiologiques ety medicales,* trans. to French by C. Daremberg, (Paris, 1854-6), 2 vols., 1:532-35, trans. from the French by Clarke and O'Malley, op. cit., 1968, 1:18-19.

[51] Gregor Reisch, *Margarita philosophica*, (Freiburg, 1503).

[52] Descartes, *The Philosophical Writings,* trans. by John Cottingham, Robert Stoothoff, Dugald Murdock, (Cambridge, U.K.: Cambridge U.P.), 1:100.

[53] Willis, *Cerebral Anatomy*, p. 96.

[54] Ibid.

[55] Ibid., pp. 97-100. On Conway's headaches and Willis, see letter of Anne Conway to her sister, Huntington Library, ms. HM 14330; also Anne Conway to Henry More, 24 May, 1664 in *The Conway Letters,* ed. Marjorie H. Nicholson, rev. ed, Sarah Hutton, (Oxford: Clarendon Press, 1992), p. 224; also Gilbert Owen, "The Famous Case of Lady Anne Conway," *Annals of Med., Hist.*, 1937, 4:567-41-47.

[56] Willis, *Cerebral Anatomy,* p. 97.

[57] Descartes, op. cit., 1662, pp. 106-7.

[58] Ibid., p. 101.

[59] Ibid.

[60] Ibid., pp. 123-4.

[61] Descartes, "Passions of the Soul," (1649), article 32, in *Essential Works of Descartes*, trans Lowell Blair, (New York: Bantam, 1966), p. 124.

[62] Willis, *Cerebral Anatomy*, p. 106.

[63] Ibid.

[64] *Philosophical Transactions*, 1685, 15:228-231.

[65] Willis, *Cerebral Anatomy*, p. 93. For a discussionof the place of Willis's description in comparison to contemporary findings, see Meyer and Hierons, op. cit., 1965, p. 9.

[66] Ibid., p. 102.

[67] Ibid., p. 111.

[68] Ibid., p. 117.

[69] Ibid., p. 119.

[70] Ibid., pp. 121-2.

[71] Ibid., p. 122.

[72] Ibid., p. 85.

[73] For an account of "Calvinist" influences, see Robert K. Merton, "Science, technology, and society in seventeenth-century England, " *Osiris*, 1938, 4:360-632; Dorothy Stimson, "Puritanism and the new philosophy in seventeenth-century England, " *Bull. His. Med.*, 1935, 3:321-34; Richard S. Westfall, *Science and Religion in Seventeenth-Century England*, (New Haven: Yale U.P., 1958); Christopher Hill, "Puritanism, capitalism, and the scientific revolution," *Past & Pres.*, 1964, 29:88-97;; Charles R. Webster, *The Great Instauration: Science, Medicine, and Reform, 1626-1660* (London: Duckworth, 1975); for a brief reveiw of the religion-science issue, see David C. Lindberg and Ronald L. Numbers, eds., *God and Nature: HIstorical Essays on the Encounter between Christianity and Science* (Berkeley: U.C. Press, 1986), pp. 1-18; Lotte Mulligan and Glenn Mulligan, "Reconstructing Restoration Science: Styles of Leadership and Social Composition of the Early Royal Society," *Soc. Stud. of Sci.*, 1981, 11:327-64; Michael Hunter, *Science and Society in Restoration England*, (Cambridge, U.K.: Cambridge U.P., 1981); Barbara Shapiro, "History and Natural History in Sixteenth- and Seventeenth- Century England: an essay on the relationship between humanism and science," (U.C.L.A.: Clark Library, 1979); Steven Shapin, "'A Scholar and a Gentleman': the problematic identity of the scientific practitioner in early modern England," *Hist. Sci.*, xxix (1991), pp. 279-327.; Michael MacDonald, "Religion, Social Change, and

Psychological Healing i n England, 1600-1800," in ed. W.J. Shields, *The Church and Healing,* (Cambidge, U.K: Cambridge U.P., 1982), pp. 101-125.

[74] Isabel Rivers, *Reason, Grace and Sentiment,* vol. 1, (Cambridge, U.K.: Cambridge U.P., 1991), p. 18.

[75] Henry Hammond, *Practical Catechisme,* (1649 ed.), pp. 300-2.

[76] Ibid., "Epistle to the Reader," sig. A2, A3.

[77] John Fell has also been considered as the author or collaborator.

[78] See John Spurr, "Virtue, Religion, and Government: The Anglican Uses of Providence," in *The Politics of Religion in Restoration England,* ed. Tim Harris, Paul Seaward, and Mark Goldie (Oxford: Blackwell, 1990). Also, Scott Mandelbrote, "Prodigal Children: Repentance, Death, and Resurrection in Early Modern England," p. 5. Mr Mandelbrote is a junior research fellow at All Souls, Oxford; also Andrew Wear, "Puritan Perceptions of Illness in Seventeenth-Century England," in *Patients and Practitioners: Lay Perceptions of Medicine in Pre-Industrial Society,* ed. Roy Porter, (Cambridge, U.K.: Cambridge U.P., 1985), pp. 55-100.

[79] Anthony A. Wood, *Athenae oxoniensis,* (London, 1817), p. 1053.

[80] On the continuity of Anglican thought in the seventeenth century and the importance of arguments based on reason, see Henry R. McAdoo, *The Spirit of Anglicanism*, (New York: Scribners, 1965), esp. pp. 1-24; 240-316.

[81] Richard Hooker, *Of the laws of Ecclesiastical Polity,* (1592?), Ib. I. VIII.9, cited by McAdoo, op. cit., 1965, p. 7, n.8.

[82] Edward Stillingfleet, *A Rational Account* (London, 1681 ed.), preface; cited by McAdoo, op. cit., p. 388.

[83] John Calvin, *The Institutes of the Christian Religion,* I xiv, 4, from translation of John Allen (Philadelphia, 1921), cited by Michael Walzer, *The Revolution of the Saints,* (Cambridge: Harvard U.P., 1965), p. 24, n.4.

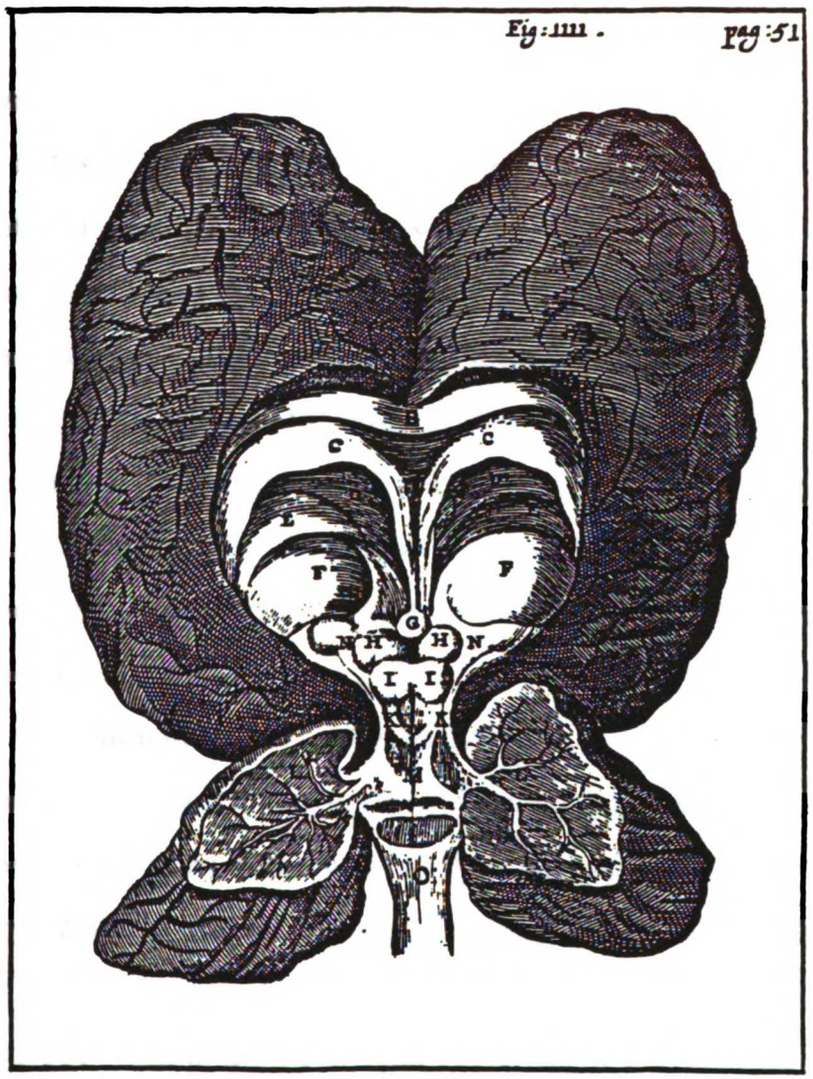
[84] McAdoo, op. cit., p. 4; Walzer, op. cit., pp. 26-8

[85] For a reveiw of Anglican reactions to religious enthusiasm, see Michae Heyd, "The Reaction to Enthusiasm in the Seventeenth Century: Towards an Integrative Approach," *Journal of Mod. Hist.* 53 (June 1981):258-280. For a seventeent century "amateur" meditation on reason and inner light, see Anne Conway, *The Principles of the Most Ancient and Modern Philosophy,* (Amsterdam, 1692), ed. by Peter Loptson, (The Hague: Martinus Nijhoff, 1982).

[86] Margaret Baily, *Milton and Boehme,* (New York: Oxford U.P., 1914), p. 28.

[87] Edward Stillilngfleet, sermon preached before the King at Westminster, (London, 1667), Library of Lambeth Palace.

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Cerebri anatome, 1664

Engraving of the brain of a "congenital idiot"

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Chapter Three:

Unreason

Introduction

The remarkable achievements of Willis and his colleagues in their investigations of the circulatory system, blood, and nervous system provided an important intellectual resource in this effort by the orthodox to naturalize behavioral phenomena. But that was not all. Ideas regarding unreason implied a corresponding ideology of human reason and its limits. Mainline seventeenth-century natural philosophers and theologians also concerned themselves with the place of humans in the natural world, particularly our status in what was perceived as the hierarchy of the the animal kingdom.

Moreoever, these two concerns--that for finding a "natural" basis of behavior, both normal and unusual, and the distinctiveness of the *human* as opposed to the non-human animal--were often joined. After all, it was difficult to characterize human reason in physiological terms without also characterizing what set it apart from human unreason as well as the "wit" of a brute, and *vice versa*. The purpose of this chapter is to consider Willisian thought regarding unreason and the bounds of the human in their intellectual context.

The efforts of Willis and his colleagues in this regard reflected a central concern by learned Englishman in the seventeenth century, particularly those with religious and medical vocations, with the nature and content of "abnormal" human behavior. Insanity, suicide, epilepsy, hysteria, and congenital idiocy--conditions that today would receive the attention of well-formed medical specialties--were the subjects of increasing general interest from the late sixteenth century forward.[1] Traditional medical psychology, astrology, demonology and natural magic were all used as resources by literate and illiterate people to

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explain what was perceived as an increase of behavior that reflected "despearate inhumanity", to quote one commentator from the 1630's.[2] Moreover, as late as the 1630's learned people, if not able to agree, were "still able to reconcile all of the main types of causal explanations" for unusual behavior, passions, and thoughts.[3]

By the time of the English Revolution, however, there was little consensus among preachers, physicians (and politicians) about the causes and meanings of abnormal behavior. While contemporary commentators looked to the same sources for explanations, their interpretations became increasingly incompatible as the century progressed. If, as Michael MacDonald has argued, religous dissenters tended to favor diabolical causations and spiritual healing, the "orthodox elite seized the healer's gown in which the radicals clothed themselves and turnd it inside out, calling religious enthusiasm madness..."[4] This tendency on the part of the governing classes became particularly apparent after the Restoration, when "enthusiasm" became a trope of denigration by the orthodox for speculations of diverse kinds and private English madhouses first began to appear.[5]

Even as Ralph Bathurst was reviewing (and presumably editing)[6] Willis's manuscript on the physiology of reason, the *Anatomy of the Brain and Nervous Stock* in the winter of 1663/4, its author had almost completed what Richard Lower termed Willis's "book of the Diseases of the Head."[7] Thus, like the *Anatomy*, Willis's thoughts on neurological abnormality were a product of his Restoration position as a physician *cum* natural philospher. Close links between physiology and pathology were especially important to Willis, who characterized the *Anatomy* of 1664 not as a definitive work, but rather as a "firm and stable basis" for what he had "long thought upon, the *Pathologie of the Brain and nervous stock.*"[8] Willis's prinicpal thoughts on the subject of unreason were published in

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two texts, the Pathologyy *of the Brain and Nervous Stock in which Convulsive Diseases Are Treated Of* (1667) and *The Soul of Brutes* (1672).

If the goal of the *Anatomy* had been to "unlock the secret places of Mans Mind," the purpose of the later texts was to explicate the abnormal anatomy and physiology of those who possessed an "infirm Brain" or souls at "Civil War." When such work was linked to "rational therapeutics," the subject of Willis's posthumously published book of 1675, the potential benefit would be both individual and social. In this sense Willis always imagined abnormal behavior as both an individual and family problem and as a disturbance of the social fabric: sufferers had been driven not only "from the Communion of Saints," but from the "Society of men." Once "growing well," they would leave "both at once their Diseases and Errors, but also should have become wise."[9]

The upshot of these efforts was to reclassify a number of human conditions as "nervous diseases" and/or brain abnormalities which might lead to a loss of the "habit of reason."[10] In the Willisian *schema*, this ambitious approach to diagnosis and treatment was coupled with an equally ambitious nosology regarding the range of nervous disease. In this chapter I will be discussing three kinds of unreason which received intense attention from Willis: epilepsy, idiocy, and hysteria. However, my concerns are not with the history of hysteria, epilepsy or idiocy as such. (Indeed, I think that such an approach, which has been that taken by Ilza Veith in regard to the history of hysteria, runs considerable risk of recapitulating the wise-after-the-event thinking that presentist historys of medicine have often adopted.[11]) Rather, I want to explore how Willis and his colleagues re-fashioned these concepts from their traditional form into neurological ontologies, or neurological things-in-themselves. Then I want to show how use these concepts, now physiologically glossed and

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hardened, were used by Willis and his one-time student John Locke to draw new boundaries around the concept of "human."

Epilepsy

As one might expect, Willis regarded epilepsy as a "convulsive disease" of the nerves, but so, too, did he consider seemingly less likely candidates such as scurvy, asthma, and hysteria. This was not the case with either his antecedents or his critics. Nathaniael Highmore, a contemporary physician and fellow Harveian whose criticism of the "neurocentric" model will be considered in chapter five, regarded them as manifestations of the physical interaction of a disordered blood with particular end organs.

Willis supported his neurological etiology with a mix of anatomical and clinical arguments. Such a mix was necessary because neither the "ocular demonstrations" of pathological anatomy nor the "case observations" of his clinical life achieved *on their own* the epistemological threshold that Willis wanted. After all, his goal was to make medicine "grow to a true Science and be practiced with a certainty not inferior to the Mathematicks."[12] As a consequence, his general level of epistemological confidence regarding epileptic disease was expressed in terms of probability. "I think it is very likely so" and "we may suppose with very great probability" represent typical examples.

The anatomical limitation was that in epilepsy itself, "no marks at all of the Morbific matter appear, or are so very obscure, that we may have deservedly suspected it to be an inspiration of an evil spirit."[13] As a consequence, Willis admitted that its cause was "the most difficult to be unfolded." Furthermore, because it symptioms could be so "stupendous", the "prognostification of the Desease...is of very difficult cure."[14] Nonetheless the search for cause was necessary on both medical and socio-religious grounds: the dissease frequently

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ended in death or caused permanent injury, and a more exact knowledge would be particularly useful to counter older characterizations of persons with epilepsy as being "possessed by the Devil."[15] It also tended to occur in family clusters, a cultural truth that motivated both physicians and families to accept aggresive treatments and intense investigatory efforts.

Classical physiology had provided a two-fold explanation for epilepsy. It was the cause either of an excess of fullness or emptiness in the animal spirits, and/or it was a consequence of that fullness or emptiness causing the meninges (the covering layers of the brain) to move spasmodically. In disproving these Willis relied on clinical and anatomical grounds. In order to knock down the humoral argument, he noted his experience of patients in wasting or edematous states: no convulsive motions were seen. Furthermore, in those whose disease was sufficiently mild so that they retained consciousness during an attack, no perception of the membranes being contracted occurred. Secondly, when Willis had opened a patient's meningeal abcess, "stinking matter" was expressed, but no epileptic fits ensued. Vivisectional experiments on puppies as well as in "almost every man" had shown that punctures of the nerves and tendons excited muscular spasms.[16]

As we shall see with hysteria and stupidity, Willis was more confident regarding the anatomical evidence, and he let "occular demonstrations" establish the reality of those conditions. But with epilepsy, given its anatomical murkiness, pathological anatomy on its own would not work. As a consequence, theory and practice so penetrated each other in his presentation that the inference underlying the entire construction known as epilepsy became circular: "A fair maid, sprung from Parents indifferently healthful" developed epileptic symptoms at the onset of puberty. She had seen many physicians, as well as "every Empirick and outlandish Mountebank" before her parents brought her to

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Willis. He noted that her illness began with vertigo and progressed to convulsions after the onset of menstruation. It happened that a "cautery (the literal or chemical application of heat) being accidentally and by chance administered," freed her from the fits. Thus, "it may be inferred that fontanells (drains) "may be profitably administerd, "for wheresoever an emissary is opened...there morbifick particles flow out with it that therefore the brain might remain free."[17]

Willis's justification for his construction of epilepsy at times reads like a recitation of cases, with sheer numbers of examples seeming to count when the anatomical argument was particularly weak. A sixty-seven year old "honest woman" complained of vertigo, naursea, and vomiting. Willis diagnosed a convulsive problem and directed a "blistering plaster" to be applied behind her ears. Next, a "noted man" of thirty-three complained of a "thick spitting", night sweats, and vertigo. These progressed to convulsions of the mouth and face. This meant to Willis that the "morbific matter" had descended from the head into the "pipes of the Nerves" and caused spasms. A "tall and handsome maid, sprung from sound parents" develped "heaviness in her head" after exhausting herself in caring for a sick master. After a year the heaviness degenerated into convulsive fits, which in another year degenerated into a "madeness sometimes furious and sometimes plainly stupid and foolish." The progression in this case suggested a contagion or convulsive infection." Finally the accumulation of "convulsive matter being daily increased in the brain" caused it to be "debilitated and broken." This illustrated for Willis how the combination of a "great sadness" and debility could cause nervous disease.[18]

Epileptic children provided a "difficult" challenge, but successful treatment was particularly gratifying not only for the child and the family involved but also as a poignant endorsement of the *post ergo propter* logic which

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Willis was wont to employ regarding epilepsy. If such reasoning was not satisfying to his critics, when presented with the evidence of a "cured" child it must have seemed powerful incitement to patients to accept the doctor's theory. John Locke, who attended Willis's Sedleian lectures in 1663/4 recorded this example:

> There was a woman in this town who had lost three or four foetuses fro epileptic attcks immediately after birth. We dissected the fourth, and found no leasion in its brain except that in the fourth ventricle there was a litle clot of extravasated blood perhaps brought on by the violent contraction of the brain and was, therefore, the result rather than the cause, of the epilepsy. (For we often find similar clots in the brains of those who have died of apoplexy, which lead doctors falsely to accuse the extravasated blood as the cause of apoplexy, as will appear later.) It is also clear that those foetuses died from a taint in the blood transmitted to the brain, as in dealing with her next three children, immediately at birth, we had a fontanelle (drain) inserted in the neck and leeches applied behind the ears in order to drain off the impurities from the brain: the result was that they escaped epilepsy and still do to this day. This is clear proof that this condition had stemmed, not from the (brains's) ventricles, but from impurities in the blood."[19]

I should note that shortly after this lecture Willis modified his views to indicate that epilepsy was caused either by a defect in brain tissue itself or the effect of tainted blood on the nerves. At the time of the Sedleian lecture cited above, his particular concern was to de-emphasize the role of the ventricles and humoral theory as they had been characterized in classical physiology.

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Stupidity

In addition to wanting to correct propensity of the unlearned to misinterpret the pressured speech of an epileptic as divinely (or diabolically) orchestrated, Willis was concerned that poorly treated epilepsy frequently led to permanent stupidity, a condition which he and his colleagues regarded as a disease. Indeed, much of Willis's later work involved extending the rubric of disease to include not only stupidity, but also foolishness as pathological. By extending the concept of disease, I mean that he not only *named* these conditions as diseases--a first in the instance of idiocy--but also provided an explanatory framework that sought to establish them as ontologies, or things-in-themselves. Most of this was carried out in chapter thirteen of *The Animal Soul* of 1672, which was titled "Of Stupidity, or Foolishness."

The most graphic evidence of the Willisians in these matters occurred much earlier, however, in the *Anatomy* of 1664. Although the *quarto* was nominally about *normal* neuroanatomy and function, it contained an engraving by Wren of a brain described in the notes as "effigies of an humane Brain of a certain Youth that was foolish from his birth, and of that sort which are commonly termed Changelings."[20] Other than describing a general wasting of the cerebral cortices, however, Willis did not elaborate. Clearly, though, correlation of structural changes or abnormalities in the brain with behavior was much on his mind in the earlier work. For example, in discussing the function of the internal capsule, he supported his claim with a post-mortem finding on a patient with long-standing hemiplegia of "bodies...discoloured, like the dregs of oil."[21]

The key to this kind of argument was the physiological linkage between the Rational Soul and the Corporeal Soul. Whereas Willis followed the classical practice of considering the Rational Soul as immortal and immaterial, he also

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argued that the Rational Soul was seated in the cerebrum. *That* structure was very much corporeal and subject to defects of structure as well as faults of the Animal Spirits. For these reasons, Willis argued that "Stupidity...or Foolishness, although it most chiefly belongs to the Rational Soul...is not improperly reckoned among the Diseases of the Head or Brain."[22]

In common with his explication of convulsive diseases (as well as of fevers), the causes of stupidity and foolishness included a variety of structural, physiological, hereditary, and environmental factors. Regarding "stupidity", Willis made a distinction between acquired and hereditary forms. Furthermore, acquired stupidity could be permanent or transient. The prognosis depended largely on the initial cause. Drunkenness and frequent opiate use, for instance, could so dull the animal spirits that a person would become stupid, but chances of recovery were excellent if the person stopped partaking those substances. So, too, "terror or vehement sadness" could "dissipate the spirits."[23]

The two most common causes of permanent stupidity were congenital idiocy and epilepsy. In describing congenital stupidity, Willis distinguished between hereditary situations that carried an increased risk factor of producing diseased offspring and the "accidental" situation of the stupid child "like a changeling" which might be born to a "wise and highly ingenious" man."[24] Risk factors included some of the traditional bugbears of good health: intemperance, luxury, and evil manners. Parents should be of the right age and conformation. In the birth sweepstakes, the best chance--the value of which was "far beyond a large patrimony"--was to have parents possessed "of a sound mind in a sound body."[25]

Finding that epileptics on post-mortem often had problems in their "streaked bodies...in the Callous (corpus callosum)," Willis was not surprised that epilepsy, if not successfully treated, often led to both stupidity and the "Palsie."[26]

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The likelihood of a poor outcome increased with age. Partly this was a consequence of Willis's conception of the physiology of mentation in children and the aged. In common with Aristotle and Plato, Willis (and Locke) imagined that children and the elderly *might* have poor memories or wits merely as a consequence of the formation of the spirits or parts at their respective life-stages.[27] Because of this, it was particularly important to treat childhood epilepsy, for children's already weak spirits, like those of the aged, could be irremediably damaged easily.

Mostly, however, the mental and neuromuscular deficits that attended prolonged seizures or brain fevers were incurable. Whereas traditional medicine (and traditional physicians) would have had little more to say to a patient once the diagnosis had been made, (just as they did not when situations were terminal), Willis continued to recommend treatment. Albeit it was treatment of a particular kind: "it must be the work both of a *Physician* and a *Teacher*." The goal was to bring the afflicted, whether their stupidity was innate or acquired, "the use of reason in a little measure." If they could achieve that, they "may be accounted out of the number of Brutes." Such an approach would not do, however, for the extremes of "Madness or Stolidity, uncapable of all learning."[28]

Much was packed into those statements. For one thing, the recommendation of special education for the mentally handicapped was novel. The mention of madness also hints at Willis's concern with that subject, which he also treated at length in *The Animal Soul* and in the *Pathology*. Instead of pursuing either of those themes, however, I think it would be more useful to pursue the handling of that borderline condition, the mentally handicapped at the margins of the human and the brute, in the work of Willis's one-time student Locke. It is there, I think, that the contemporary implications of this emerging nosology of mental handicap were most formally realized.

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Given his sensate psychology--"Perception then being the first step and degree towards knowledge, and the inlet of all materials (i.e. simple ideas) of it"[29] --Locke argued that conditions that hindered perception could reduce a human to animal status. In old age, for instance, when the sense impressions made "are scarcely perceived, or not at all retained", Locke left it to the reader to consider whether there was any difference between such a person and the "lowest degree of animals" such as an "oyster."[30] Moreover, the description would hold if a man had "passed sixty years in such a state." Without perceptions one could not abstract, which for Locke, as it was for Willis, the *sine qua non* of humanity. Thus the inability to "distinguish, compare and abstract" which was the defect in "naturals", by which Locke meant natural fools or congenital idiots, placed them on the dividing line between man and the "species of brutes."[31] As had Willis, Locke made a distinction between these people and those who were insane.

The boundary-drawing of Willis and Locke also reflects the interest seventeenth-century English thinkers expressed in establishing humans' place in the great chain of being. As noted earlier, Willis, in common with many seventeenth-century investigators in England and Europe, examined the structures of invertebrates and vertebrates both to better understand animal physiology as well as to define the distinctiveness of the human. Humans occupied a link on a chain between tiny creatures and angels. What were the discontinuities that provided individual links with their identity?

Comparative anatomy, a particularly forceful epistemological argument to Harvey (and Vesalius), had been a mainstay of the Oxford physiologists, such as Willis, who worked in his shadow. Harvey, in turn, had been inspired by the place of comparative arguments in Aristotlelian biology. The irony was that even those who were dismissive of scholastic Aristotelianism--excepting Harvey, a number which included a majority of the influential English investigators--

nonetheless sought to establish their claims based on the comparative studies Aristotle had first championed.

When this effort to differentiate the distinctly human from the brute was applied in reference to the "neurocentric" model by Willis and his colleagues, my argument has been that a new discontintuity was introduced in physiological thought between the stupid and the rest of humanity. It seems incumbent upon me, therefore, to provid some context of older Western physiological thought regarding what has come to be known as mental deficiency. In this I want to be brief, for, as mentioned earlier, the larger goal in this chapter has been an attempt to develop neither a history of idiocy or epilepsy, but rather to explore some contours of unreason in the "neurocentric" body with an end to suggesting that "neurocentric" unreason, like "neurocentric" reason, was about establishing new medical criteria regarding what it meant to be *human*.

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Classical Physiologies of Idiocy

What may be most surprising to ourselves as inheritors of "neurocentric" thought is the thinness of Greek physiological literature regarding what nowadays is considered mental disability. Dull-wittedness was recognized, but it did not seem to occupy either a large medical or social space. It was a condition, and not a disease. The Hippocratic corpus, for instance, which discussed the condition of a club foot in five places, made only one reference to congenital stupidity.[32] Moreover, when Aristotle or Plato did make reference to congenital conditions or life-stages that might result in loss of intellectual function, their organ of reference was the heart. For example, Aristotle, who thought that "slow" people had a good memory while the "quick-witted" were better at "recollecting," considered that dwarfs and children had "abnormally weak memory" because of the "abnormally large" size of their heads in relation to

their trunks.[33] The problem for dwarfs was that the weight of their comparatively large heads compressed their "organ of perception," the heart.[34]

In his dialogue on knowledge, the *Theatetus*, Plato recorded Socrates as describing those men who were "quick to learn" and possessed of "good memories" as having minds analogous to a "good thick slab of wax" which could take "imprints" which were "clear" and "deep enough to last a long time."[35] The next reference, however, was to the wax tablets as "tables of the heart." When persons were "slow" and could not "quickly...imprint" their "tablets," Socrates used the image of the "shaggy heart", which he attributed to Homer.[36] Being "stupid" was defined as being "so slow" and tending to "sort things into the wrong places."[37] Similar fast and slow thinking informed the approach of Galen to intellectual function.

Regardless of the bodily location of "quickness" and "slowness"--and it is useful in this regard to remember that Aristotle and his intellectual descendants among the Schoolmen maintained a cardiocentric physiology--classical Greek thinkers did not by definition put intellectually dull people on humanity's margin. According to Plato, that space was reserved for "the most expert of calculators" who "hates, not loves, what his judgment pronounces to be noble or good."[38] In other words, as Christopher Goodey has pointed out, Plato considered "unvirtuous knowledge nonsensical."[39] Furthermore, for Plato human existence was defined by one's relation to one's community. Calculating but unvirtuous people represented a grave social threat. Thus, the unwise clever were the biggest fools. It was they who needed to be removed for remedial training to be "styled wise."[40]

The transformation of Eve

If the "psycheology"[41] of Willis and Locke tended to *exclude* the slow-witted from the human family on the basis of their supposedly defective Rational Souls and brains, Willis's treatment of hysteria, a condition which was felt to be both common and a "woman's problem" reflects his effort, also pioneering, to *include* women among the reasonable. Moreover his thinking on the subject seems to have shifted in the 1650's or early 1660's.

In February, 1650 a woman "of very good family" complained to him of "several months of pain." The pain began in her stomach and radiated to her back. It was worse when she lay down, so much so that she spent "whole nights sleepless." "Liable to headaches for several years," she suffered pain in her loins and upon urination. The doctor noted her condition "is doubtless hysterical, having its origin from a foul vapour ascending from the uterus into the praecordia"[42] Such thinking was in line with the Galenic view of hysteria held by learned physicians in mid-century. Willis's interpretation of 1650 was very much like that of his generation's mentor, Harvey, who, *pace* Galen, described hysteria in 1651 as a "furur uterinus" which would benefit by "hymeneal exercises."[43]

Seventeen years later the doctor, by then Europe's most influential neuroanatomist and England's leading physician, had changed his mind. Concerned that "any time a sickness happens in a Woman's Body...we accuse the evil influence of the Womb (which for the most part is innocent),"[44] Willis's anatomical studies and medical experiences had convinced him that hysteria was "chiefly and primarily Convulsive, and chiefly depends on the brain and the nervous stock being affected."[45]

The claim that women's bodies were governed by their brains and not their wombs and "foul vapours" emanating from them represented a novel

departure in English thought regarding women's physiology.[46] According to Ilza Veith, Carolinus Piso (1563-1633) was the first European physician to argue unequivocally for a brain etiology of hysteria. Unlike Willis, however, Piso did not publish a comprehensive theory of the body.

Traditional Economies of Female Moisture

Before proceeding further, it might be useful to provide some background on the traditional physiological context of women. If a central issue in traditional theories of human reproduction was heat,[47] the central issue in traditional physiologies of women when they were of child-bearing years but not pregnant or infertile was thought to be moisture.[48] The uterus was not only a cold organ, it was also the transit area and vessel for vast quantities of fluid. Unlike men, women regularly produced so much fluid, both menstrual blood as well as ejaculate during orgasm. My premise is that these differences in kind and quality of fluid were perceived to constitute the (non-childbearing or nursing) female body as fundamentally different from the male.

Whereas men had less fluid, traditional theories accorded them more means of fluid elimination. Men could get rid of excess moisture either by sweating, ejaculation, or extrude it to the skin's surface through their larger pores.[49] There it would turn into hair on contact with the air: women after all, did not have beards. Women's coolness, however, made such coctions, or transformations, unlikely. Men's situation was akin to other animals, who extruded their excess fluids through their pores, where the residue became fur, horns, or claws, or burned them up through intense physical activity.[50] Human females, however, were thought to be the only female animals who menstruated.[51] In addition, in both classical and medieval times it was felt that the normally flowing menstrual blood, being 'waste', was foul or worse. As

recorded in the French medieval *Secrets des Dames*: "And whosoever were to take a hair from the pubis of a woman and mix it with menses and then put it in a dung-heap, would at the end of the year find wicked venomous beasts."[52] Widespread at the end of the thirteenth century, stories of the Venomous Virgin represented a synthesis of mysogynistic thought on female fluids.[53]

Much of this kind of thinking, if not its overt misogyny, carried over into seventeenth century thought regarding the etiology of hysteria. The anonymous author of *The Compleat Doctoress* (1656) divided female disease into four classes: 1. those common to all; 2. those affecting widows and virgins; 3. those affecting the barren and fruitful; and 4. women with child. Hysteria, the author argued, was the chief medical problem for women in categories one and two. "Stoppage of courses is the cause: ill vapours travel from matrix to brain."[54] Nicholas Fontanus argued much the same in his *The Woman's Doctour* of 1652: "by reason of the moisture wherewith those parts abound, the matrix is loosened, and exceedingly stretched: and this is the truth of the whole matter."[55]

The equivalent of the medieval "Venomous Virgin", however, was not necessarily extinct. At least early in the century, attribution of a "natural" cause of "hysteric" behavior in women was still problematic. Writing in 1603 in response to the trial of a woman accused of bewitching a fourteen-year girl into "hysteria", Edward Jorden argued that the causes of hysteria were completely "natural" and included blocked menstrual flow, sexual abstinence, and emotional problems.[56]

Although he argued for a different physiological basis, Willis likewise noted a connection in the popular mind between suspect female behavior and witchcraft. Arguing for the benefit of pathological correleations that could be "seen," Willis noted that the "hidden" causes of diseases and their symptoms, in particular hysteria, "which otherwise seem most difficult and unexplicable" and

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were commonly "ascribed to the Incantations of Witches may be found out and clearly laid open" by the method of "ocular inspection."[57] Such a belief would have been particularly appealing to the conservatively religious of either the Anglican or dissenting persusasions who did not approve of the Jesuit and enthusiastic sectarian practices of casting out devils, and the folk magicians' provision of charms against bewitchment.[58]

If the cause of woman's distress was considered to be almost exclusively a disorder of genital fluids and/or flesh, so too was the focus of traditional therapy. Achievement of female orgasm was considered the best therapy in both learned texts, such as Harvey's aside in the *Generation of Animals*, and popular health guides. For treatment of "fits of the mother" in 1655, the prolific medical popularizer and herbalist Nicholas Culpeper advised prompt marriage "to a lusty young man." If that was not feasible, popular writers, but not the learned, suggested that masturbation might do. As Culpeper suggested in his *Practice of Physick:* " the genital Parts should be by a cunning Midwife be so handled and rubbed as to cause an evacuation of the over-abounding sperm. But that being a thing not so allowable, it may suffice whilst patient is in bath to rub her belly in the Region of the Womb."[59] According to its publisher, that advice went through eight printings totaling 15,000 copies.

Such mid-century characterizations of women's physiology were cited as a natural basis for a division of labor between men and women. According to *The Compleat Doctoress*: "Women were made to stay at home and look after household employments...accompanied without any vehement stirring of the body...therefore hath provident Nature assigned them their monthly courses, that by the benefit of these evacuations, the feculent and corrupt blood might be purified, which otherwise, being the purest part of blood, would turn to rank poyson."[60] Wives were more healthful than virgins and (chaste) widows because

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they were "refreshed with man's seed, and therefore ejaculate their own, which being excluded, the cause of evil is taken away."[61]

Women were also thought to be profoundly similar to men. Belief in the similarity and difference of female and male physiology and anatomy co-existed at least since the time of Hippocrates. Specifically, that strain of Platonic thought that emphasized continuities fostered the tendency to conflate the sexes.[62] In this *schema*, women physiologically were like men, but less "perfect" because possessed of less heat. Structurally, women and men were thought to be homologous: the female genitalia were but the male inverted.[63] Aristotelian thought, particularly the neo-Aristotelian thought of the later middle ages, was more comfortable with differences: Women and men did not have the same seed, for instance. Man's seed was active; woman's passive.[64]

One-Sex or Two-Sex?

Recently the idea has been put forward that simultaneous acceptance of profound similarity and difference between the sexes was not the historical norm. Based primarily on reading of sections on *reproductive* physiology from traditional texts, Thomas Laqueur and Londa Schiebinger have argued that, prior to the eighteenth century, Western culture operated on a "one-sex" model: "man is the measure of all things, and woman does not exist as an ontologically distinct category." It was in the eighteenth century, they have argued, that a two-sex model emerged, largely for political and culture reasons. It was then, Schiebinger has noted, that a female skeleton was first described.

In my view the "one-sex" thesis has several serious problems. Aside from containing what to me are serious distortions of Aristotelian thought,[65] it does not square with sixteenth and seventeenth century views of women in England. As Sara Mendelson has pointed out, all branches of Tudor and Stuart social

thought "postulated a sharp polarity between the two sexes: Men and women were perceived as so qualitatively different that their respective attributes were hardly even comparable....At times this view was carried to its logical extreme with the assertion that women did not belong to the human race."[66] This thinking may have been more prevalent in rural groups with little formal education than among the better-educated in larger towns. During his wanderings in 1647 the (eventual) Quaker leader George Fox noted that he had met "a sort of people that held women have no souls, adding, in a light manner, no more than a goose."[67]

Secondly, in my view it remains to be proven whether the sexological knowledge included in the ancient and medieval medical canon was reflective of deep cultural assumptions of the kind Laquer and Schiebinger assert. They may just reflect the complicated problematics of representing bodies and processes of which the male authors may not have had much direct knowledge. Although the textsts were almost uniformly authored by men, knowledge of women's physiology was often based on women's reports on themselves or other women. Specifically, in the Hippocratic texts, internal examinations were sometimes undertaken by the patient herself or a female attendant.[68] These reports were then fashioned by male authors into physiological accounts of women. Long continuance of such a practice might contribute to significant distortions of female physiology. Women might emerge in these portrayals as both strange and quite similar to men. The most recent studies on the authorship of the influential twelfth and thirteenth century gynecological texts attributed to a female physician, Trotula, for example, suggest that such a person existed. According to John Benton, however, she did not author the treatises attributed to her.[69]

Furthermore, classical anatomical knowledge of female sexual parts was not often based on direct examination of humans. For example, Galen's description of the human uterus, which formed the interpretative standard for all Western descriptions until the seventeenth century, was based on that of a cow. It was not that subsequent anatomists, particularly those in the Renaissance, did not have occasion to examine the human uterus. It was rather that they "saw" it through the authoritative lens of Galen. If endurance of such a view seems counter-intuitive to us, it may be useful to remember that Galen himself believed that the human uterus had seven-chambers, like that of the cow. More to the point, perhaps, is Nancy Siraisi's recent observation that "a (medical) theory that was satisfactory for philosophical, astrological or numerological reasons was unlikely to be displaced, however difficult it might be to demonstrate it visually in dissection."[70]

In this connection, it is worthwhile to note that Willis's assault on the Galenic physiology of women proceeded parallel to a general European effort in the seventeenth century to obtain direct understanding of animal bodies including those of human females. In particular the Dutch physician and anatomist, Reinier de Graaf (1640-1673), performed anatomical investigations of women that were published within a few years of Willis's work on hysteria. Galenic anatomy was also found wanting. Indeed, in the forward to his *De mulierum organis generationi inservientibus* of 1672, de Graaf scoffed that "Galen...never examined a human uterus, not even in his dreams."[71]

Both Laqueur and Schiebinger have made much of pre-Enlightenment anatomical texts that illustrated a structural isomorphism between female and male genitalia. Even when Renaissance anatomists, such as Vesalius, vigorously pursued anatomical investigation of both sexes, they have argued, they were so culturally enmeshed in a one-sex model that they saw the vagina, for instance, as

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an inverted penis. Challenge, to paraphrase Laqueur, waited until the eighteenth and nineteenth centuries. It was then, when there was the "consolidation of a science-based profession" in the medical establishment, that the search for sex-based differences became intense. Michel Foucault, whose influence Lacquer cited explicitly, has made similar arguments.[72]

One of the problems with that argument, however, is its linkage of medical science to the nineteenth century. That assumption, which was first made by George Canguilhem, ties the emergence of a "scientific" medical epistemology to the French and Austrian hospital reforms that followed the French Revolution.[73] Accepted by Foucault in his influential *Birth of the Clinic*, Canguilhem's assumption also have informed descriptions of the English situation by the sociologist Nicholas Jewson. Unfortunately, however, neither Foucault nor Jewson studied pre-hospital evidence of scientific medical approaches, including those of Harvey and the Oxford physiologists.

Even when Laqueur and Schiebinger are taken on their own strictest terms, which is to say the structural isomorphism of male and female genitalia represented in Vesalius' *De humani corporis fabrica* (1543), I have problems accepting the hegemony of the one-sex model in pre-Enlightenment Western thought. When one compares illustrations of the male and female genitalia in this text, which both Laqueur and Schiebinger do, one cannot help noticing that the female genitalia depicted on the right-hand side of figure 24 resembles in shape the male genitalia depicted in two images on the lower half of figure 22. Does this mean that they are the "same"? Yes, if one limits the observation to the shape of the depicted organs.

In terms of the *gestalt* of the respective pages, however, I would argue that quite a different comparison is also plausible. Whereas the page depicting the male devoted its top half to a truncal image of the opened male body, the page

depicting the female used only its top left one-quarter to show the opened female. Furthermore, when one compares the respective portions devoted to depictions of the genitalia themselves, the page carrying the male showed two images of the genito-urinary system on its lower left and center and nine smaller images of the testes and epididymi on its right-hand and bottom margins. In contrast, the page presentation of the female was quite different. Most notably for this discussion, the right-hand image of the female genitalia is the largest image on the page, approximately 1.75 times the length of the image of the female trunk which purportedly contains it. In contrast, the penises depicted on the preceding plate are only one-third the length of the corresponding truncal image of the male.

Whatever else may be going on in terms of illustrative or publishing strategies in the *De corporis,* what I want to suggest through this exercise of image comparison is that is is quite plausible to read the respective images of male and female in Vesalius, and by extension in many other Renaissance texts, as representing male and female as both similar and different, as both one-sex and two-sex. The main theoretical cleavage point, as I have attempted to establish earlier, was the difference between male and female economies of fluid. Vesalius may have made the female genitalia so much larger than the corresponding male both in respect to each other and in respect to the bodies that putatively contained them because he and his audience assumed the womb and its fluids were much more important in women as compared to the penis and its fluids in men.

In my view, the consensus between high and low cultures on the nature of women's physiology was reflected in the lack of substantial difference between learned and popular medical texts on women's health issues. When he asked rhetorically, "How many incurable diseases are brought about by unhealthy

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menstrual discharges?," an elderly William Harvey did not sound very different from the popular authors cited above.[74] Common sense, empirical and folk treatments, and attention to astrological conditions characterized the content of texts on women's health. By and large women were taken care of by women, or by women or men who read women's health guides authored by men who pretended to be women.[75] The knowledge of midwives was on the same plane as the knowledge of university educated (and, hence, male) physicians. Both the model and the consensus, however, were about to change.

Willis and Women's Bodies

As noted earlier, when Willis took up the question of hysteria in earnest in the middle 1660's, he had already finished his canonical text on the normal (un-sexed) brain and nervous system, *The Anatomy of the Brain,* three years previously. Expensively produced in *quarto* size with numerous engravings by Christopher Wren (1632-1723), it was a major assault on both the Galenic and Aristotelian bodily paradigms that had emphasized the bodily primacy of either the triumvirate of liver, heart, and brain (Galen) or heart (Aristotle.) Instead, as discussed in the previous chapter, for Willis the brain was the "chief mover in the animal machine."[76] Through complex interactions mediated by the nerves and various fluids, it was the prime minister of a body composed of important but inferior organs.[77]

Unlike previous theories of interaction between the brain, nerves, and visceral organs, Willisian neuroanatomy of the emotions minimized unmediated access by the lower body to the brain. Even fluid containing diseased material from the lower organs was presented to the brain by mediation of the nerves. Its message was then processed by the brain, which then sent its signals back to the body *via* the nerves. In this regard, it was not so much that Willis did away with

the potential for the visceral organs, including the womb, to turn "evil."[78] Instead, he proposed anatomical and clinical findings to suggest that the action was elsewhere.

Willis rejected the notion of the ascending womb on anatomical grounds: the womb was "of small bulk in widows and virgins," and is "so strictly tied by the neighbouring parts round about, that it cannot of itself be moved."[79] Rebuttal of the "foul vapour" etiology of hysteria was more complex and depended on clinical experience. Noting the his contemporary Nathaniel Highmore had advanced the view that hysteria was a consequence of the blood "most impetuously rushing on the Lungs" from the spastic uterus, Willis countered with case anecdotes that showed normal lung structures in some hysteric women. Furthermore, the first signs of an hysterical fit were not in the lungs, but in the head.[80] Additionally, dissections of hysteric patients who had died of other causes frequently revealed abnormalities in the brain.[81]

Although notions of a "wandering uterus" may seen nonsensical to us, seventeenth-century evidence suggests that Willis's anatomical argument was something more than a rhetorical device. Writing at the end of the century, John Purcell argued for a non-uterine origin for hysteria based on the finding that "dissection...of women who were afflicted" with hysteria failed to reveal "corruption or Ulcer" in the reproductive tract.[82] Furthermore, in her review of seventeenth-century medical casebooks, Katherine Williams has pointed out that physicians often referred to hysteria by terms, such as "hysteric suffocat virgi" that implied their belief, or at least equivocation, regarding a uterine origin.[83]

As a theoretical construct, woman's new "nervous body" was expanded well beyond its uterine core. Directed by the brain and nerves, it was presented, like man's body, as a complicated "machine" subject to interplay between its end organs, chemical processes, and the ebb and flow of its many fluids. The

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physiological ground had been laid, in other words, for women to be viewed no longer primarily as expressions of their wombs. Indeed, as noted earlier, Willis explicitly opposed the traditional tendency to conflate women's distresses with the womb.

At least in its healthy state, then, one could say that the "neurocentric" body of the seventeenth century was relatively unsexed. Indeed, Willis noted that hysteria could be experienced by men. Differential capacity existed, but it was of insufficient magnitude to constitute a difference in kind. According to John Locke, Willis said that women were more susceptible to hysteria than men: their brains were smaller, their nerves more "delicate"," and the nervous connections to the womb numerous.[84] Such sentiments were in accord with Locke's own ideas on sexual capacity for reason as well as those of Sydenham.[85]

Conclusion

One might argue that Willis, the physician *cum* philosopher, and Locke, the philosopher and incidental physician, really only clothed classical ideas of mental disability in up-to-date physiological dress. Whereas classical thinkers identified the ability to reason as a defining characteristic of humanity, however, they did not elaborate a physiological profile for the Rational Soul. According to Aristotle, for instance, the "incapacity of old age (which he had just argued could lead to the loss of perception) is due to an affection of the soul but of its vehicle."[86] Not only was the Rational Soul nominally immortal and immaterial in classical thought, it was not unambiguously linked to the cerebrum and its special fluid. Thus, the functional operations of sensation and perception could be deranged without a person's status as a human being called into question.

Although Willis paid lip service to this version of the Rational Soul, the basic supposition that supported his pathologies of reason (and unreason)--the

adherence of mind to brain--assumed that its very ontological status might be at stake in abnormal brain and nerve conditions. In the hands of Locke, who pushed the implications of this "psycheology" to their limit (while side-stepping his intellectual debts to Willis and the physiological principles that underwrote them), the upshot was that tight boundaries were drawn around the human species.[87] If Willis thought these should be inclusive in new ways for women, whose capacity to reason heretofore had been considered to be under the suzerainty of their bodies, the combination of Willisian neuropathology and Lockean epistemology also tended to exclude those such as congenital idiots, who were too much the victims of the (illustrated) defects of their Rational Souls.

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[1] Michael MacDonald, *Mystical Bedlam*, (Cambridge, U.K.: Cambridge U.P., 1981), pp. 2-5.

[2] William Gouge, a Puritan divine, in John Sym, *Lifes Preservative against self-killing*, (London, 1637), Sig. A4. Edited and intro. by Michael MacDonald, (London: Routledge, 1988).

[3] Michael MacDonald, op. cit., p. 177.

[4] Michael MacDonald, op. cit., p. 9. See also pp. 170-2, 223-6.

[5] See MacDonald, op. cit. pp. 1-12. Also Michael Heyd, The reaction to enthusiasm in the seventeenth century: towards an integrative approach," *J. Mod. His.*, 1981, 53: 258-280, esp. pp. 272-3.; Roy Porter, "Cultures of Madness," in *Mind-Forg'd Manacles*, (Cambridge: Harvard U.P., 1987), pp. 33-109. For a work influential on the current historiography of abnormal behavior, see Michael Foucault, *Madness and Civilization*, trans. Richard Howard, (N.Y.: 1965).

[6] Ralph Bathurst, letter of 10 February, 1663/4 in T. Warton, *The Life and Literary Remains of Ralph Bathurst*, etc. (1761), cited by Kenneth Dewhurst, "Thomas Willis and British Neurology," in Clifford Rose and W.F. Bynum, *Historical Aspects of the Neurosciences*, (New York: Raven, 1982), p. 342, n. 79.

[7] Lower's letter to Robert Boyle of 24 June, 1664, in T. Birch, editor, *The Works of the Hon. Robert Boyle* (1772, New Ed.), vol. 6, p. 474, cited by Dewhurst, op. cit., 1982, p. 343, n. 87.

[8] Willis, *Anatomy of the Brain*, 1664, "Epistle Dedicatory," n.p.

[9] Willis, *Soul of Brutes*, 1672, "Epistle Dedicatory," n.p.

[10] Willis, *Soul of Brutes*, 1672, p. 40.

[11] Ilza Veith, *Hysteria: the history of a disease*, (Chicago: U. of Chicago Press, 1965).

[12] Willis, *Rational Therapeutics*, 1675, "Preface to the Reader," n.p.

[13] Willis, *Pathology*, 1667, p. 11.

[14] Ibid., p. 17.

[15] Ibid, p. 11.

[16] Ibid., pp. 3, 11-14.

[17] Ibid., pp. 18-19.

[18] Ibid., p.p. 30-34.

[19] Bodleian Library, MS. Locke, f. 19, pp. 48-50. Quoted in Kenneth Dewhurst, *Willis's Oxford Lectures*, (Oxford: Sandford, 1980), p. 86.

[20] Willis, *Anatomy*, 1664, op. cit., p. 70.

[21] Willis, *Anatomy* 1664, p. 63; the same phrase is used in *The Animal Soul*, 1672, p. 84; see also Alfred Meyer and Raymond Hierons, "On Thomas Willis's Concepts of Neurophysiology, part 1," *Medical History*, 9 (1965), p. 9.

[22] The whole of Pordage's 1683 translation of chapter XIII is readily available in Paul F. Cranefield, "A Seventeenth Century View of Mental Deficiency and Schizophrenia: Thomas Willis on 'Stupidity or Foolishness'", *Bull. Hist. Med.*, 35 (1961), pp. 291-316. My references to Willis in this section will be from this source. In note 3, p. 291 Cranefield notes that this chapter was printed *in toto* in an influential medical compendium at the end of the seventeenth century, J.J. Manget's *Bibliotheca medico-practica*, Geneva: Chouet, vol. 4, 1698, pp. 581-586.

[23] Ibid, p. 299.

[24] Ibid, p. 297.

[25] Ibid, p. 298.

[26] Ibid, p. 95.

[27] On Willis, see Ibid, p. 95. For Aristotle, see "Memory and Reminiscence", 450b:7-14 in *Basic Works of Aristotle*, ed. and with an intro by Richard McKeon, (N.Y.: Random House, 1941), p. 609.

[28] Willis, *The Animal Soul*, in Cranefield, op. cit., p. 302.

[29] John Locke, *An Essay Concerning Human Understanding*, 1690, 2 vol., (reprinted New York: Dover,1959), Book II, chap. IX, "Faculty of Perception", section 15.

[30] Ibid, section 14.

[31] Ibid, "Of abstraction," Book II, chap. XI, 11-12.

[32] Club foot is described extensively in "On Joints." See ibid in *Hippocrates*, trans. W.H.S. Jones, (Cambridge: Harvard U.P., 1923), III: 320, 346, 348, 428-30. Christopher Goodey has asserted that there is one reference to a condition of congenital stupidity, but he has not cited the passage, and I cannot find it in the above translation. I am indebted to him for sending me an early draft of his essay, ""Mental Handicap": the early history of some intellectual difficulties," unpublished ms., 1992, p. 4.

[33] Aristotle, "On Memory and Reminiscence," 449b:3-4; 453b: 1-10 in *Parva naturalia*, trans. J.I Beare in *Aristotle*, op. cit., pp. 607, 617.

[34] Ibid, 453b.

[35] Plato, *Theatetus*, 194c,d, trans. F.M. Cornford, in *The Collected Dialogues*, ed. Edith Hamilton and Benjamin Cairns, (Princeton: Princeton U.P., 1969).

[36] Ibid.

[37] Ibid., 195a-b.

[38] Plato, *Laws* III, 689a-d. in *Dialogues*, op. cit.; see also Goodey, "Mental Disabilities," op. cit., 1992, pp. 37-8.

[39] Goodey, "Mental Disabilities," op. cit, 1992, p. 36.

[40] Plato, *Laws* III, 689c-e.

[41] Willis's seventeenth-century translator, Samuel Pordage, used the term "psycheology" on page 18 of *The Soul of Brutes.* Paul Cranefield points out that "this may be the first use of the word psychology in the English language. It antedates by ten years the earliest English usage given in the *Oxford English Dictionary.*" Paul Cranefield, "A seventeenth Century View of Mental Deficiency and Schizophrenia: Thomas Willis on 'Stupidity or Foolishness,'" *Bull. Hist. Med.*, 35, 1961, 4:291-316, p. 292, n. 7.

[42] Thomas Willis, *Oxford Casebook*,, ed., Dewhurst (Oxford: Sandford, 1981), pp. 92-94.

[43] William Harvey, *Exercitationes de generatione animalium*, (London, 1653), p.

[44] Thomas Willis, *An Essay of the Pathology of the Brain and Nervous Stock in which Convulsive Diseases Are Treat Of*, (London, 1667). Originally published in Latin as *Pathologiae cerebri et nervosi generis specimen*, in *Dr. Willis's Practice of Physick* , trans. S. Pordage, London, (1684), p. 69

[45] Ibid, p. 70.

[46] Ilza Veith, *Hysteria: the history of a disease*, (Chicago: University of Chicago , 1965), pp. 128-129.

[47] See Everett Mendelsohn, *Heat and Life*, (Cambridge, Mass: Harvard 1964). For concepts of heat in reproduction, see Laqueur, 1990, op. cit., pp. 27-29, 34-36, 44-50, 101-102.

[48] Danielle Jacquart and Claude Thomasset (translated by Matthew Adamson), *Sexuality and Medicine in the Middle Ages*, (Princeton: Princeton 1988), pp. 48-78.

[49] Jacquart and Thomasset, op. cit., p. 73.

[50] Ibid, p. 73, n. 76, 77.

[51] Ibid., p. 72

[52] *Les Secrets des dames*, ed. E. Rauneyre (Paris, 1880), pp. 65-6. Cited in ibid., p. 76, n. 89.

[53] Jacquart and Thomasset, op. cit., p.75, n. 85.

[54] Anonymous, *The Compleat Doctoress or, a choice treatise of all disease incident to women*, (London, 1656), Huntington Library 478273., p. 4.

[55] Nicholas Fontanus, *The Woman's Doctour, or an exact and distinct explanation of all such Diseases as are peculiar to that Sex with Choice & Experimentall Remedies against the same.* (London, 1652), p. 51. Wellcome Library 22842/A.

[56] Edward Jordan, *A Brief Discourse of a Disease Called the Suffocation of the Mother*, (London, 1603).

[57] Willis, *Pathology*, 1667, p. 71.

[58] Michael MacDonald, 1981, op. cit., pp. 172-176.

[59] Nicholas Culpeper, *Practice of Physick*, (London, 1655), p. 419, Wellcome Library 44145/C.

[60] *Compleat Doctoress*, op. cit., p. 1.

[61] Ibid, p. 4.

[62] Plato, *Republic*, , in *The Collected Dialogues*, ed. Hamilton and Cairns (Princeton: Princeton 1963), p. 454c, p.693

[illegible]

[63] Laqueur, *Making Sex*, (Cambridge: Harvard U. P., 1990), pp. 63-96; Thomas Laqueur and Catherine Gallagher, eds., *The Making of the Modern Body: sexuality and society in the Nineteenth Century*, (Berkeley: U.C. Press, 1987), pp. 5-14; and *idem*, "Orgasm, Generation, and the Politics of Reproductive Biology," in Laqueur and Gallagher, op. cit., 1987; Londa Schiebinger, "Skeletons in the Closet: the first illustrations of the female skeleton in eighteenth-century anatomy," in Laqueur and Gallagher, op. cit., 1987.

[64] Aristotle's most extensive sexological discussion occurs in book I, chapters 18-20 of "Generation of Animals"; see Arthur Platt's translation in *Basic Works of Aristotle*, ed. Richard McKeon, (New York: Random House, 1941), pp. 668-679.

[65] For a contrast to Laqueur's views on Aristotle, see Maryanne Cline Horowitz, "Aristotle and Women," *Journal of the History of Biology*, 9, 2 (1976), pp. 183-213.

[66] Sara H. Mendelson, "Women in Seventeenth-Century England: Three Studies," (Ph.D. dissertation, 1981, unpublished, University of Oxford), p. 5.

[67] George Fox, *The Journal*, rev. ed. John L. Nickalls (Cambridge, U.K.: Cambridge U.P.), p. 7.

[68] See Geoffrey R. Lloyd, 'The Female Sex: Medical Treatment and Biological Theories in the Fifth and Fourth Centuries B.C.," in idem, *Science Folklore and Ideology*, (Cambridge: Cambridge U.P., 1983), pp. 70-4.

[69] John F. Benton, "Trotula, Women's Problems, and the Profesionalization of Medicine in the Middle Ages," *Bull. Hist. Med.*, 1985, 59:30-53, p. 52.

[70] Nancy Siaraisi, *Medieval and Early Renaissance Medicine*, (Chicago: University of Chicago Press, 1990), p. 91.

[71] Reinier de Graaf, *De mulierum organis generationi insevientibus*, (Amsterdam, 1672), "Preface," n.p. in facsimile edition, (Nieuwkoop: Dutch classics in the history of science, 1965).

[72] Michael Foucault, introduction to *Herculine Barbin*, (N.Y.: Pantheon, 1980), pp. vii-viii. Cited in Laqueur, 1990, op. cit., p. 124, n. 20.

[73] George's Canguilhem, *On the Normal and the Pathological*, trans. Carolyn R. Fawcett, with an introduction by Michel Foucault, (Dordrecht, Holland: D. Reidel, 1978); Michel Foucault, *Birth of the Clinic*, trans. A.M. Sheridan Smith (New York: Vintage Books, 1975); Nicholas D. Jewson, "Medical knowledge and the patronage system in eighteenth-century England," *Sociology*, 1974, 8:370-85; and idem, "The disappearance of the sick-man from medical cosmology, 1770-1870," ibid, 1976, 10:225-44.

[74] William Harvey, *Exercitationes de generatione animalium* (1651) (London: Sydenham Society) cited in Porter, op. cit., p. 37, n. 77.

[75] John F. Benton, op. cit., "Conclusion."

[76] Thomas Willis, "Preface," *Animal Soul* (1672), in idem (1684).

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[77] Robert G. Frank, Jr., "Thomas Willis and His Circle: Brain and Mind in Seventeenth-Century Medicine," in George S. Rousseau, ed., *The Languages of Psyche*, (Berkeley: University of California, 1990), pp. 107-46; Diane Puklin, "Medical Psychology in the Seventeenth Century: The idea of a neurological emotion in the thought of Thomas Willis," (doctoral dissertation, unpublished, University of Chicago, 1980).

[78] Willis, *Pathology*, 1667, op. cit., p. 69.

[79] Willis, *Anatomy*,1664, op. cit., p. 87

[80] Willis, *Pathology*, 1667, op. cit., p. 69-70.

[81] Ibid, p.p. 75-8.

[82] John Purcell, *A treatise of Vapours of Hysteric Fitts* (London, 1702), p. 15; cited by Katherine E. Williams, "Hysteria in Seventeenth-Century Case Records," *History of Psychiatry*, 1, (1990), pp. 383-401, p.p. 386, n. 11.

[83] Katherine E. Williams, op. cit, 1990, p. 389.

[84] Thomas Willis, *Oxford Lectures*, translated and edited by Kenneth Dewhurst, (Oxford: Sandford, 1980), p. 87.

[85] Although Locke viewed "the female sex" as "softer", he advocated raising girls in a manner similar to boys. See his letter to Mrs. Clarke of February, 1685 in, *The Educational Writings of John Locke*, ed. James L. Axtell, (Cambridge, U.K.: Cambridge U.P., 1968), pp. 344-6.

[86] Aristotle, "On the Soul", Bk. I, ch. 4, 18-30, in *Basic Works*, op. cit., p. 548.

[87] See also Goodey, ms., op. cit, 1992, p. 11.

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Chapter Four:

Death into Life

Introduction

In 1667 Willis reported post mortem[1] findings on a child of "a nobleman", a "noblewoman", and a "very noble woman". References also were made to other patient/subjects, including a hydrocephalic and several who died of convulsions, scurvy, whooping cough, and complications of spontaneous abortions. Most of these investigations would have been performed in Oxford, for the text in which they appeared, the *Pathology of the Brain and Nervous Stock*, was substantially completed by the fall of 1663, when Willis was resident there. Also, most of them probably took place at The Angel, an Oxford coaching inn leased by Willis and two partners for use as a combination of consulting rooms, patient lodgings, and anatomy and chemistry chambers.[2] The findings from these studies, as well as those on the "whole Hecatombs of Animals" which Willis had "slaughtered" in preparation for the *Anatomy of the Brain* of 1664, were the "ocular demonstrations" and "anatomical observations" which supported not only a "more certain Physiologie" but also a "Pathologie of the Brain."[3] As Willis put in it 1664: "For either by this way, viz. by Wounds and Death, by Anatomy, and a Caesarean Birth, Truth will be brought to Light, or for ever lye hid."[4]

If Willis's tendency to philosophize on his findings was not shared by his colleagues and assistants, a belief that the anatomical method--by which I mean the linking of normal and pathological findings from post mortem examination of healthy and sick bodies--was shared by most, but not all of the Oxford physiologists as well as their Continental counterparts. Excepting Robert Boyle, whose ambivalence regarding anatomy will be discussed in the next chapter, Richard Lower, Ralph Bathurst, Christopher Wren, William Petty, and Willis's

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London collaborator, Edmund King, all anatomized regularly. Indeed, as noted earlier, in 1685 King could compare the pineal of the late Reverend Bacon with those of "over one hundred brains" which he had dissected.

But Willis did philosophize: the brain was both the "Chapel of the Deity" and the "chief mover" in the "engine" of the human body.[5] At the time of his greatest anatomical activities he was, after all, Oxford's one endowed professor of natural philosophy. Moreover he was a natural philosopher who moved among and treated Royalists and High Church Anglicans as did his collaborators. As such, they were the beneficiaries of significant patronage dispensed by Gilbert Sheldon, who was Archbishop of Canterbury from 1663 to 1675. If anyone was concerned that brain dissection might be disrespectful of God's handiwork, the human body, Willis wanted to reassure him that "Whoever professes Philosophy..I do judge him not only to have shaken hands with Religion, but also with Reason."[6]

Nothing like this was going on elsewhere in Europe. Anatomical investigation was performed to be sure, especially in mid-century Holland. But the combination of private anatomies performed not on bodies harvested from a charity clinic but affluent private patients and philosophically-couched theories based in part on those findings was unique. The purpose of this chapter is three-fold. In the first place, I want to demonstrate the uniqueness of Willis's approach. How and why did English practice differ from contemporary practice on the Continent? Secondly, what were the implications of the Willisian approach for formation and reception of his neurological theory? Finally, I want to use the history of Willisian anatomy to address some historiographic concerns of mine regarding typical accounts of the formation of scientific medicine. Let me begin with a brief summary of developments in European anatomy prior to the Oxford physiologists.

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Definitions

Existence of a long-standing and effective cultural prohibition regarding the performance of post-mortem manipulation of human bodies--a prohibition that stretched from the third century B.C. to the later twelfth century--is well-known. In discussing the medical handling of dead bodies, it may be helpful at the outset to resurrect several terms relating to anatomical investigation which have since become conflated or otherwise experienced a significant change in meaning. Nowadays the terms "autopsy," "anatomy," and "dissection" are used more or less as synonyms. However, in the Renaissance and early modern periods their meanings were shaded and conveyed different approaches to dead bodies.

While it is true that "anatomy" was entering the general cultural circulation in an increasing way from the late sixteenth century forward, it may be useful to note that in its medical context in the period 1550-1640 "anatomy" was often used synonymously with the word "skeleton, at least in England."[7] The implication was that "anatomy" was about the demonstration of normal human structures beginning with the skin and proceeding inward to the bones.

Furthermore, "public anatomies" of the kind performed both in surgeons' guild halls as well as the civic anatomy theaters of continental Europe referred not to the performance of deconstructing a corpse in a more or less public space but to the status of the body itself: a "public" body was that of a malefactor.[8] In contrast, "private" anatomies referred both to the status of the body in question as being non-criminal and the performance of the procedure as requiring an invitation.[9] "Private" anatomies, however, were not necessarily performed on (deceased) patients; the identity of the (former) person might not be known to the anatomist.

Aside from the pathological "private" anatomies of the Oxford physiologists and scattered investigative physicians, most English (and Continental) "private" anatomies were sessions conducted by anatomical teachers for the instruction of students, who paid an admission fee.[10] This became a dominant method of teaching anatomy in the eighteenth century in London, but it may have been practiced there much earlier. The evidence, however, is indirect and scanty. The *Annals* of the London Barber Surgeons do note that they were tired of having their private anatomies performed in the "upper kitchen" of their guildhall, disposal of the entrails being a particular problem. As a consequence, the Masters in 1631 authorized the provision of a separate room for "private dissections."[11]

"Autopsy"--literally "to see with one's own eyes"--was an older term that conveyed a more limited and restricted investigation. The corpse was generally not deconstructed wholesale; instead, selected organs were investigated for specific reasons. Indeed, when human corpses again began to be opened in Bologna in northern Italy in the later twelfth century, the stimulus came not from physicians or surgeons seeking to perform anatomies, but rather from civic and legal authorities wanting autopsies for an answer to the much more limited (if pressing) question of cause of death. The first autopsies in Bologna in the 1170's and 1180's, for instance, were performed as part of a process of gathering evidence to determine if the decedent(s) had been poisoned.[12]

"Dissection," on the other hand, seems to have maintained its meaning as indicative of a *complete* deconstruction of the body, including skeletal dis-articulation, throughout the period. Both in England and on the Continent, it conveyed a relatively violent approach to the body. Executed criminals, who formed the mainstay of anatomical subjects in Continental Europe (but not in

England, at least not among the Oxford physiologists), were almost always dissected.

Public versus Private

In the gradual and incremental growth of practice that characterized anatomical investigation in Europe in the fifteenth, sixteenth, and seventeenth centuries, several important differences developed between Continental practices and the English custom. The most important of these, in my opinion, was the differential level of public audience for anatomy in England compared to Italy, Holland, and France. Most importantly for our study, I think, was the comparative failure of the English to develop a civic culture of anatomy on anything like the scale it achieved in Italy, France, and particularly in the seventeenth century, the cities of the Dutch republic. Whereas by the late sixteenth century and early seventeenth century Bologna (1638), Padua, Leiden (1597), Delft (1614), Amsterdam (1619) and several other cities in Holland alone had communally financed anatomy theaters, in England only the professional corporations and guilds, the College of Physicians in London and the Barber-Surgeons had dedicated spaces for the seasonal performance for dissection of an executed criminal.

But although these were "public," in the sense of the legal status of the body under consideration, they were not public in the double sense that they were in Italy, the Netherlands, and Paris. Not only was the audience largely limited to physicians and surgeons, but even among them attendance was scanty. The annals of both the Barber Surgeons as well as the College of Physicians for the first half of the seventeenth century both note low attendance and occasional cancellation of the "public" lectures, which occurred at their greatest frequency a maximum of six times a year. In 1645, for instance, the Barber Surgeons secured

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an endowment of two hundred fifty pounds to generate income for the provision of one body and six lectures (initially by a physician!) a year. But the *Annals* indicate that despite regulations obliging attendance of "free" surgeons, absenteeism was rampant and considered a problem.

In terms of the public culture of anatomy, recent historical work by Jan Rupp on the civic culture of anatomy in early modern Holland and Giovanna Ferrari on that of Bologna indicates marked differences from the English approach. Let me emphasize several distinguishing features: In the first place, in both Bologna and the cities of the Dutch republic, anatomy was highly regulated from the fifteenth century forwards. Both the "kinds" of bodies used and the settings of their deconstruction were specified. For example, in both Holland and Bologna the corpses for the student dissections and the later public dissections of the civic anatomical theaters were required to be "foreign" to the community in question. In Bologna this took the form of a requirement dating from 1442 which specified that bodies for student dissections had to come from at least thirty miles away.[13] From an examination of the context of similar regulations for Amsterdam, Rupp has concluded that the "foreign" restriction was to "prevent a sense of outrage on the part of the relative and neighbours of the executed criminal" (or deceased hospital patient).[14] Furthermore, it was not until the 1660's in Leiden, Amsterdam and Delft that physicians were allowed to perform "private" dissections in their homes or other places.[15]

In contrast, English regulations from 1540 which granted the Barber Surgeons the rights to four executed criminals per year made no such stipulation.[16] When Willis and William Day removed the (presumably) dead body of a local servant woman, Anne Greene, from an Oxford scaffold in 1651 in order to take her to Day's rooms for dissection, they were joined by a number of curious bystanders.[17] The extant records on post mortems performed by Harvey,

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Willis, King and others in their circle from the 1640's to the 1680's indicate that deceased patients were often anatomized in the presence of their friends and relations. The *Annals* of the Barber Surgeons indicate that a surgeon was disciplined in 1638 for performing a "private" anatomy, but the infraction was a consequence of the business occurring in his home as opposed to the guildhall, not because the body was locally "known."[18] Indeed, England did not develop a regulatory code for reconciling the interests of anatomists and the public until Parliament passed the Anatomy Act of 1832.

Secondly, in contrast to the Continent, where civic anatomy theaters were popular cultural centers, England did not develop a significant public culture of anatomy until the eighteenth century.[19] Whereas the anatomy theaters of Leiden and Delft were popular meeting places for artists and scientists as well as curious citizens and visitors, the spaces for anatomy in sixteenth, seventeenth, and eighteenth century England were both comparatively private and restricted in their use. Presumably almost any man who was reasonably well-connected could have obtained an invitation to the anatomy demonstrations that took place at either the professional spaces of the medical and surgical groups or that of the Royal Society in the 1660's. But admission did require a personal invitation, not a fungible ticket; also, organizations were financed by subscription. In short, "public" anatomical spaces in England functioned as clubs, not civic amenities.

What is interesting about the Dutch situation--as well as being helpful regarding my thesis about the English--is the different nature of anatomical "styles" which developed around the theaters in Amsterdam, Leiden and Delft. According to Rupp, in Amsterdam the dead body was "seen as a source of knowledge of the geography of the human body." Delft anatomists were more interested in animal vivisections and self-experiments. Leiden, as the center of

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medical education in Holland, tended to favor pursuit of the newest discoveries.[20]

What this interpretation suggests--and I think Rupp needs to provide more extensive evidence to be wholly convincing--is the influence of local factors. According to Rupp, salient features in the case of the Dutch cities mentioned included the styles of art (Delft and Amsterdam) and status as an educational center (Leiden). Before analyzing the local factors which I think played a role in mid-century English anatomy, I would first like to provide a brief background on some themes in Continental anatomy prior to the mid-seventeenth century.

Continental Background

Whether performed publicly during Lent in a civic anatomy theater, or in a medical school anatomy room, or in a private house for paying students, most of the intellectual focus of anatomical investigation in the fifteenth, sixteenth, and seventeenth centuries was on delineating the structure and function of the *normal* human body. Correlations between the clinical condition and course of a patient and the appearance of his or her organs on post mortem were seldom done. Leading sixteenth century anatomists practicing in Italy--Andreas Vesalius (1514-1564), Fallopius (1523-1562), Realdo Colombo (1516-1559), and Eustachius (1524-1574)--described pathological organs on occasion.[21] However, they made few systematic efforts to link pathological abnormalities with disease processes or patient histories. Colombo's *De re anatomica* (1559), for example, devoted a section to pathological findings, but its emphasis was on "rare and abnormal things," including "monsters of nature."[22] Antonio Benivieni's *The Hidden Cause of Disease* (1507) represents an exception. Obtaining permission from patients' relatives in twenty-two instances, Benivieni sought to correlate their clinical

histories with post-mortem findings. However, the organs were not carefully dissected, and, thus, the correlations weak.[23]

One of the factors inhibiting a more systematic approach was the persistence of humoral theory as an explanatory framework of the body in both health and disease. Based as it was on fluids and their motions, adherents of Galenic humoralism could and did argue that vivisections and supposed pathological anatomies did not reflect what their promoters said they did, but instead the rapid readjustments of the fluids to bodily insult.[24] Such thinking was particularly resistant to both the circulation theories of Harvey and his antecedents, but it also tended to diminish the importance of the solid organs. As a consequence, it is not surprising that both circulation theory, for which the crucial proofs were physiological experiments, and the tendency to argue from pathological findings only began to take form as Galenic approaches were under a broad-based challenge. In this sense, I suggest that it may be useful to think of Galenism in the later sixteenth and early seventeenth centuries as a paradigmatic theory at the stage of Kuhnian "crisis."[25]

In sixteenth century France and Germany, however, several texts were produced which used organic anatomical pathology to describe and classify diseases. Written by physicians for other learned physicians, they confined themselves to explications of new findings and recitation of conventional knowledge. In contrast to Willis, Descartes, or van Helmont, their authors did not attempt to write philosophically or cosmologically. And, although there are exceptions, they did not tend to write as physiologically as did the less speculative members of the Oxford group, such as Lower.

Jean Fernel's *Medicina* (1554) was an influential example of this. Like the work of J.S. von Grafenberg (1530-1598), who produced a massive *Observationum medicarum, rarum novarum* (1584-1597), it contained pathological findings gleaned

rom his private practice as well as others based on hospital patients and those urreptitiously disinterred.[26] Notable as well were the seventeenth century roductions of Johann J. Wepfer (1620-1695), a city physician in Shaffenhausen whose particular interest was cerebral circulation and apoplexy, and Nicolas ulp (1593-1674), who focused on tumors, polyps, and cancer, and Frederick uysch (1638-1731).[27] Surgeons including Ambroise Pare (1510-1590) and W.F. on Hilden (1560-1634) contributed to this literature, some of which was llustrated.

The efforts of Wepfer deserve special mention. Historians emphasizing he priority of discovery have noted that Wepfer "discovered" the collateral rterial circulation of the brain prior to Willis, whose eponymous "circle" has aused the latter's name to endure instead. Wepfer, whose work has received ittle modern notice, was the only seventeenth century physician aside from Willis to provide extremely detailed descriptions of the cerebral circulation based n large numbers of post-mortems. However, he did not illustrate his work. urthermore, unlike Willis, he did not concern himself with the links between tructure and function. Nor did he attempt the philosophical glossing haracteristic of Willis's mature work.

nglish Developments

Both medical and non-medical interest in manipulating dead bodies seems o have developed significantly later in Britain than in continental Europe. mong the medieval nobility, division of the corpse was not as prominent there s it was in Continental Europe, especially France.[28] Also developing in the ixteenth century in England, but not earlier, was the practice of the heraldic uneral, a medieval Continental custom which was invigorated by the Tudors, articularly Elizabeth I. Both Tudor and Stuart monarchs attempted to regulate

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the funerals of persons with the rank of baronet or bishop and above. Although the practice fell away in the middle of the seventeenth century, under Elizabeth especially, funeral licensing by the Crown and regulation by the College of Arms involved close management of funeral processions and burial rites. The presence of agents from the central authority was common, and significant delays between death and burial became the norm. For example, if one of the kingdom's twelve dukes died, the funeral was postponed until the remaining eleven arrived.[29]

As a consequence, embalming became common among the aristocracy. The procedure was usually carried out by surgeons, though doctors might be present. At the embalming of Sir Nicholas Bacon in 1578, three doctors were present, but two surgeons did the actual work.[30] Resistance to embalming and heraldic funerals was present from early on. James Montague, Bishop of Winchester in the late sixteenth century, for example, directed in his will that his body should undergo "no cutting or mangling," but it was to no avail. He was, in fact, embalmed twice, the first effort failing to delay putrefaction sufficiently.[31]

By the third decade of the seventeenth century, church burial records suggest that families nominally required to obtain a license frequently chose an *unlicensed* nocturnal funeral.[32] Since night funerals took little time to organize, post-mortem manipulation of the corpse was not necessary. The choice of a quick nocturnal funeral was an obvious one for those who did not want to be embalmed or autopsied Night burials seemed most popular with aristocratic women and their children. Frances, Duchess of Richmond, directed in her will (proved in 1639) "that I may be speedily buried and not opened for so my sweet Lord out of his tender love commanded me that I should not be opened." [33] In the Jacobean era both the College of Arms and Anglican leaders objected to nocturnal burials, but the practice seems to have grown nonetheless.

In the early decades of the seventeenth century, however, two royal deaths occasioned autopsies, which gave the practice an enhanced public profile. The death and post-mortem of the young son and heir of James I, Henry, Prince of Wales, received considerable attention in 1612. The autopsy, which was ordered by the Privy Council in response to rumors of poisoning, was performed by surgeons and witnessed by the royal physicians and numerous courtiers. The report, which indicated death from natural causes, circulated rapidly in manuscript form both within England and abroad.[34] Similarly, the autopsy report on James I, whose death in 1626 was also rumored to be secondary to poison, received wide notice.[35]

A systematic medical approach to dead bodies, however, does not seem to have existed in England prior to the training of several men in William Harvey's generation in Padua, which in 1600 was the center of advanced European medical thought. Typical of sixteenth century English work was the anatomy of the first master of the Barber-Surgeons Company, Thomas Vicary (1490?-1562). First published in 1548, *The Anatomie of the Bodie of Man* seems quite primitive in comparison to Vesalius's work of five years previous. For example, although Vicary stated that the "Brain is the governor or Treasury of the 5 Wits," he described its physiological effects mostly as a consequence of lunar influences on its motion within the skull.[36] The surgeon Helkiah Crooke's *Mikrokosmo Graphia* , an influential synthesis of recent European work of 1618 represented a significant advance. Crooke had absorbed post-Vesalian innovations in brain anatomy, for example, and in some ways his physiological ideas, though minimally developed, anticipate the work of Willis and the Oxford physiologists. In evaluating the body's "noble parts," for instance, he took issue with the architectonics of Galen and Aristotle and placed the brain first in "dignity," but

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not in "instant necessity."[37] But it is worth noting that until Harvey, English anatomical and medical thought exerted minimal influence internationally.

The comparative backwardness of English anatomy prior to Harvey may also be a reflection (as well as a consequence) of the comparatively backward nature of university medical education prior to the endowments and great expansions of the 1620's and 1630's.[38] Furthermore, not only did England not have the civic and university anatomy forums present in Italy, Holland, and France, neither did she have the large hospitals, royal patronage, and effective central professional bodies that characterized French medicine and surgery under Louis XIV.[39] Additionally, English medical instructors had not integrated a surgical approach into medicine as effectively as had their peers in either Italy, France or Holland. Some physicians, such as Richard Andrews, performed anatomy with the London barbers and surgeons in their guildhall in the 1630's,[40] but the practice was unusual. The desire of Vesalius to have physicians think like surgeons and work with their hands did not find its echo in sixteenth and early seventeenth century English medicine.[41]

Although he did not anatomize, Bacon's remarks on anatomy seem to recognize this comparative lag in the English approach. Wanting to extend the range of investigations of all kinds, the cosmopolitan Bacon encouraged anatomists to expand their vision:

> "for the humours are commonly passed over in anatomy as loathsome and excrementious things; whereas it is highly useful and necessary to note their nature...the marks and impressions of diseases, and the changes and devastations they bring upon the internal parts, are to be diligently observed in different dissections"[42]

Harvey began providing just that vision in the 'teens in his Lumleian Lectures on anatomy to the members of the College of Physicians. Based on

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Harvey's emendations on Aristotelian and contemporary approaches, the lectures provided an up-to-date anatomical program along the lines of the Paduan model Harvey experienced while resident there in the 1590's.[43] Structure almost invariably implied function, and for Harvey the function was resolutely physiological, not astrological. As was common in the latest European anatomies, dead patients and their ailments occasionally were named.[44]

In terms of understanding the continuum between health *and* disease, the lessons of sick patients were almost more useful than those of the healthy. As Harvey later put the matter in a letter to his friend, the Parisian anatomist Jean Riolan in 1649:

> I also intend putting to press my Medical Anatomy, or Anatomy in its Application to Medicine. Not with the purpose, like Riolanus, of indicating the seats of diseases from the bodies of healthy subjects, and discussing the several diseases that make their appearance there, according to the views which others have entertained of them, but that I may relate from the many dissections I have made of the bodies of persons diseased, worn out by serious and strange affections, how and in what way the internal organs were changed in their situation, size, structure, figure, consistency; and other sensible qualities, from their natural forms and appearances...From pathology the use and art of healing, as well as occasions for the discovery of many new remedies, are perceived."[45]

During the Civil War, however, Harvey was "plundered" of his "anatomical histories of his patient sick bodies," a loss that, as he recounted to a friend, was "the greatest crucifying to him that ever he had in all his life."[46] Whereas Harvey made modest use of pathological findings and clinical correlations in his published works, such findings and correlations were central to Willis and the Oxford physiologists who followed him.

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In saying that I do not mean to suggest that the main actors in this dissertation were the only physicians who anatomized in mid-century England. In June 1654, for instance, the deceased Anglican divine Jeremy Whitaker was dissected by a surgeon under the direction of three English physicians who had studied at Padua.[47] Also, scattered records indicate that some post mortems were performed on soldiers who died in military hospitals in the Civil War. However, prior to the 1640's--the period in which Harvey's theories and approach became famous--the anatomical method had minimal impact in England. This changed markedly in the 1650's, 1660's and 1660's, primarily because of the success of Harveian models in stimulating additional investigation. So much so that, as noted earlier, Edmund King could record as an aside in 1685 that he had dissected over a hundred brains.[48]

For Willis and his medical supporters, pathological brain anatomies provided an interpretive framework for assessing the living sick. When Willis consulted on Lady Anne Conway (1631-1678) in the 1660's for instance, he assumed the headaches to be a consequence of meningeal scarring from a childhood infection. Indeed, he described her meninges, which he never saw, in a manner consistent with his post mortem findings on another woman whom he had treated earlier for recurrent sever headaches. Opening *her* skull in the early 1660's, he had found a tumor "three fingers broad" in her "third sinus" which "grew to the membranes (meninges) including the pia mater." Describing the earlier findings in the Pathology, Willis concluded "from these observations the invincible and at length mortal cause of that Disease may plainly appear."[49] Thus, though he had not seen Conway's meninges, he talked as though he had: her mininges had "contracted an habitual and indelible vice." But Conway had not yet died, and so although her miningeal disruption, like the other woman's, was an "invincible and permanent" cause, it was also "not yet deadly."[50]

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Patients as Subjects and Objects

Most of those one hundred brains would have once occupied the skulls of the gentry, Anglican clergy, relatives of investigative physicians of the sensibilities we have been considering, or academics. Whereas in Europe the bodies of (charity and military) hospital patients and executed criminals formed the majority of early modern anatomical subjects, in England the bodies of patients who had enjoyed relatively high status provided the substrate of anatomical research. Why did they and what were the implications of their participation?

This was not because English people in general looked favorably on manipulation of the corpse. In other words, "private" anatomy did not progress primarily on the affluent because the less prosperous could not afford it. All extant evidence indicates that ordinary people did not want their bodies manipulated when dead, primarily because of their belief that the corpse retained sentient qualities.[51] Indeed, contemporary practices, still in use in country districts in the late seventeenth century, acknowledged the popular belief that fresh corpses might have qualities implying sentience. Coroners' courts, for example, often took place in the presence of the body: the corpse should bleed if touched by the killer. The body of a suicide occasionally was buried outside of a village, under the highway, with its heart staked so as to prevent wandering of the decedent's spirit.[52] Moreover, the rising proportion of unlicensed funerals among the gentry and upper clergy suggests that reluctance to undergo dissection and/or embalming was not confined to the relatively powerless.

But a number of English people also said "yes." Several factors accounted for this. Perhaps the most important non-medical contributor to willing participation in anatomy by members of powerful families was their family

experience of post mortem manipulation. In a sense the older practices of division of the corpse and embalming both rested on a notion of the bodies of the aristocracy and upper clergy as possessing a semi-public nature. In a curious way their bodies, like the truly "public" bodies of executed criminals, were in one way on the same plane: both were regarded as a *secular resource* for the living. The pre-existence of these practices among the group that eventually participated in investigative anatomy also meant that in a practical way people were used to their friends and relatives being opened and cut after death.

More immediate (and probably more influential) in influence was the increasing prestige that the "new" natural philosophy of the body enjoyed among the wealthy and powerful. Charles II, whose scientific interests were much more in the direction of chemistry than anatomy and medicine--and who proved to be no special friend to the College of Physicians--nonetheless attended one of George Ent's anatomy lectures there in 1665 (and knighted Ent at its conclusion).[53] Thomas Sprat, the man John Wilkins selected to write the authorized *History of the Royal Society* (1667), was delighted at this new fashionability of natural philosophy. According to Sprat, the "new" philosophy itself was partly about wealth and power, and it was not a moment too soon: "For now Philosophy, being admitted into our Exchanges, our Church, our Palaces, and our Court, has begun to keep the best company...and to become the Employment of the Rich, and the Great...whereas it was of old for the most part the study of the Sullen and the poor."[54] (The link between wealth creation and the new circulation physiology--in this case Harveian circulation theory--became explicit in the eighteenth century in the economic theory of the influential French royal physician and physiocrat Quesnay (1694-1774).[55])

Echoing Willis's distinction between blood and "nervous juyce" and the latter's lack of capacity to nourish the "immoderate sweat" of "Countrymen and

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Labourers,"[56] Margaret Cavendish, Duchess of Newcastle, argued in 1664 that the prosperous needed learned medicine precisely because of their prosperity. Noting that "Country-people and Labourers take little or not Physick (medicine)" yet lived longer than "Great and rich Persons," Cavendish attributed their longevity to their "laborious exercises and spare diet." In contrast, the elite were "most commonly lazie and Luxurious," conditions and habits that bred "superfluities of humours, and these again breed many distempers." As a consequence, the nobility needed learned medicine. Its "lenitive" medicines and greater understanding would "mediate" the disease burden of their "luxurious" lives. After all, "physicians with good and proper medicines, have, and do as yet rescue more people from death, than the Laws do from ruine."[57]

This is not to say that Renaissance literate culture did not assign specific constitutional frailties to certain "types." Scholars, for instance, had been considered subject to nervous ailments by the humanists for at least two hundred years previously. Indeed, Galenic humoralism would assign certain tendencies to anyone whose habit or occupation caused their fluids to become unbalanced. Moderation, the basis of Renaissance conduct and all classical medicine, was grounded in humoral physiology. But it was also perfectly compatible with the physiologic need of the "neurocentric" body for balance.

Willis's advice--"*mens sane in corpore sano*"--was nothing new.[58] What distinguished the new attitude from older humanist ideas was a new emphasis on material connections between blood, brain and mind at the level of the individual patient and his or her family. Parents might let an epileptic dead infant be anatomized by Willis or Lower in order that the knowledge gained would help save another child. It was not just that one wanted a sound mind in a sound body, but that one wanted to pass on healthy tendencies and correct,

when possible, the effects of harmful ones. As Willis put it: "To be born of Parents who *have a sound mind in a sound body,* is far beyond a large patrimony."[59]

In this regard, it is important to realize just how savvy the primary audiences for the new physiology were. Not only were the newly enlarged student bodies from the Oxbridge of the 1630's and 1640's now in middle age, prime years for medical advice and service, the "new" philosophy first given (extra-curricular) voice there and at Gresham College had entered mainstream life as well. Familiarity if not facility with microscopes and telescopes as well as the argot of the "new" philosophy of the Royal Society was becoming part of the cultural furniture of both investigative medicine--Willis was the first European to regularly use the microscope in human anatomy[60]--and gentlemanly accomplishment.

If interest very quickly merged into fashion, and the figure of the gentleman microscopist likewise into a staple of Restoration satire, I would argue that the theme of curiosity regarding natural phenomena was also expressed through permission for postmortem and/or attendance at the dissection of one's friend or relation. Samuel Pepys did not leave word of attendance at a human anatomy, but he indicated that he spent an enjoyable half-day dissecting "pretty" things like cow's eyes with Lower and two other medical people.[61] In his dissection of Robert Bacon, Edmund King concluded his recitation of "matter(s) of fact" with the note that they had been "attested by (the decedent's) own Relations (who were Eye Witnesses of it.)"[62] Writing in 1662 on the death of the Anglican scholar Henry Hammond, his biographer John Fell, Bishop of Oxford and Willis's brother-in-law, included two pages of autopsy details on the grounds that "the Reader cannot want the curiosity to desire to know everything that concerned this great person."[63]

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When a "very Noble Lady" who had been a patient of Willis's died after consultations of "many other Physitians," he returned to anatomize her, citing as pretext the desire of "her Friends that her dead Carcase, kept long opened for the Funeral, should be diligently inspected, and so the genuine causes of the Disease and her Death, might be investigated."[64] Echoing this sentiment, the Duchess of Newcastle did not want to see learned physicians criticized because they could not "restore every Patient to his former health...(when) they have only outward signs of inward distempers." The problem was that "all (people) are not dissected after they are dead, to inform Physicians of the true cause of their death."[65]

Newcastle's matter-of-fact tone, which was echoed by others, merits some explanation, particularly since dissections (but not embalming) had been relatively uncommon in this group prior to the "new" physiology. What the matter-of-factness suggests to me is another factor in post-Revolutionary English life: the cosmopolitan experiences of some influential Royalists and High Church Anglicans as a consequence of the Civil War. Charles II as well as his courtiers (including the Newcastles) and Anglican advisors had spent all or part of the Interregnum in Paris. When they returned to power they brought with them Continental customs, among which were the long-established practices of autopsy and dissection. As David Harley has pointed out, the first European royal autopsy whose findings were widely disseminated was performed on Henri IV in Paris in 1610.[66] Thus, both the Oxford physiologists, via the approach and example of Harvey, and an important strata of their (eventual) patients gained a different perspective on death and knowledge through their different exposure to foreign influences.

Another factor contributing to support by the wealthy of post mortem investigation was their general tendency to support the projects of the learned

professional order. The Duchess of Newcastle, well known in Restoration court circles for her disparagement of microscopy ("deluding glasses"), nonetheless supported elite medicine in it competition with popular medicine. To do otherwise, she believed, would be to support "Hereticks."[67] This attitude, echoed in the rhetoric of the controversy between the Helmontians and Collegiate physicians, reflected the Restoration establishment's increasing tendency to be for the knowledge claims of loyal and orthodox thinkers and wary of any claims to knowledge, including those of popular medicine, that had been given radical interpretations by religious sectarians and medical popularizers.[68] After all, when the world turned upside down in the Revolution, many Anglicans and Royalists had been on the bottom; they were not eager to embrace systems that eschewed hierarchy.

In this connection, I think the fact that Willis's published anatomies gave prominent place to the noble, or at least well-placed, had important ramifications for the reception of his theories as well as his success in practice. Willis was doing in an extended way what had not been done before: establishing the normal nervous structure, and then linking their degradation in disease processes to particular pathological findings on post mortem. Suppose that, instead of the noble, Willis had concentrated instead on the anatomical structures of "public" bodies and the odd charity case. How would one know whether his declarations regarding a body's clinical course and structural pathology reflected the ante-mortem disease, the bodily disruption of an execution in the case of the criminal, or the taint of the decedent's base social position. Furthermore, if one's findings were derived from the bodies of the undesirable, why would prospective prosperous patients and doctors be inclined to accept them?

For a young Robert Boyle--this passage was originally written when he was twenty-one or twenty-two-- anatomical investigations, like chemical ones, were part of a practical worship of God's presence in the world:

> "when, in a word, by the help of Anatomical Knives, and the light of Chymical Furnaces, I study the Book of Nature, and consult the Glosses of Aristotle, Paracelsus, Harvey, Helmont, and other learned Expositors of that instructive Volume, I find myself oftentimes reduc'd to exclaim with the Psalmists (Ps. 104.24) *How Manifold are thy works, O Lord in Wisdom hast thou made them all!*"[69]

But the appeal of mid-century anatomy penetrated more than just Royalist and Anglican circles. While I can find few examples of non-Anglican patients submitting to the private anatomies under consideration, there exists at least one prominent counter-example of an autopsy performed on a radical critic of the (then) establishment. But then, as the man had been notable, the death suspicious, and the corpse viewed by hundreds of people, one could argue that the autopsy reflected not an infatuation with pathological anatomy, but the circumstantial status of the decedent as a "public" body akin to those opened in Bologna at the behest of civic officials at end of the twelfth century. The recorded facts are these: when the Parliamentarian leader John Pym died in 1643, the Puritan preacher, Stephen Marshall, spoke at length on the findings of the autopsy. Granted, the manner of Pym's death had become the stuff of polemic: Royalists had rumored that their political foe had died of lice. In describing the autopsy, Marshall pointed out that at least eight physicians "of unsuspected integrity, and some of them *Stranger* to *him*, (if not of different Religion from him)" had been present. Also, as "neer a thousand people" had viewed the corpse. All of these could "testify" that his death had been the consequence of "an Imposthume in his Bowels."[70]

Matters of Fact

Given the intense interest in witnessing expressed by seventeenth-century English people of diverse kinds, (as well as its role in the history of science by modern-day scholars such as Simon Schaffer and Stephen Shapin[71]), it may be useful to consider a few aspects of the anatomical ritual as practiced by Willis and his colleagues. Clearly, it was much different than the official demonstrations of the anatomy theaters of the Continent or the lecture rooms of the medical organizations. The speaker was not behind a podium reading as the prosector demonstrated a semi-prepared cadaver. Rather, the lighting was dim, and the corpse personally known , quite likely emitting horrible spells, and displaying in its open form convoluted masses of indistinct and putrefying organs. Not only would an infectious process--the usual cause of death--contribute to this, but so, too, would the common delay of a day or more between death and post mortem. In this setting, it is difficult to imagine that the ten or thirty professional or lay "witnesses" saw much more than what the lead physician or surgeon said was present as he poked and cut about.

Quite certainly this was the case with the "ocular demonstrations" of structures of the brain that Willis and other neuroanatomists described and illustrated. Not only does the brain not exist independently of the skull and its meningeal (membranous) attachments, fresh brains when removed from the skull do not retain their shape. Instead, unless fixed with fluids that preserve and stiffen, they tend to sag over minutes into an amorphous mass with a half-spherical shape. Helkiah Crooke noted as much in 1618 when he cautioned would-be anatomists to "take the head of a man newly cut off" to avoid the "waterish" quality that otherwise set in.[72]

As we shall see in chapter five, this indeterminacy of neuroanatomical "facts" was not lost on contemporary critics. But it does not seem to have

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troubled medical and non-medical supporters. In the text *The Natural History of the Passions*, published in 1674), the author indicated in the preface that he was writing "not as Orator or Moral Philosopher, but only as a *Natural* one conversant in *Pathology*." [73] He then proceeded to describe humans' emotional life in terms that recapitulated Hammond, Gassendi, and Willis. Indeed, they and Bacon were praised lavishly while Cartesian neurophysiology was attacked at some length. The author made it clear that his efforts in explicating the interactions of brain and body were not for everyone. He specifically did not "recommend" his treatise to the "unlearned" and the "vulgar," citing as his reason their inability to distinguish truth from error and because such knowledge "can neither *please* nor *reform* them."[74] Authorship of the treatise is unclear. A penned note on the title page indicates Henry Carey, (1596-1661), the second Earl of Monmouth. However, as the printed text contains references to Willis's *De anima brutorum* (1672), that attribution seems impossible.

In *The Uncertain Art of Physick*, a work from 1684 which purported to be a translation of the a work by the Italian anatomist Lionardo di Capra, the translator/author, who identified himself as "J.L. Gent.," developed the thesis that learned medicine was progressing from a discipline of "art", which he equated with uncertainty and the practice of empirics, to one of "rational physick". Key in this transformation was the work of anatomists, the greatest of whom in "former ages" was Harvey. Now the honors should go to Willis, whose "new system of Rational Physick" was "advancing apace along the path of immortality and Glory." No doubt further progress by "modern anatomists" and the "new Natural Philosophy" would bring about additional improvements.[75] The treatise was dedicated to Robert Boyle.

Even when later writers questioned Willis's neurological theories, particularly those on animal spirits and nerve transmission, they tended to accept

(and reproduce) his team's images of the brain as "real". The religious dissenter and naturalist John Ray, who published an influential compendium which was a mix of biology and theology, the 1691 *Wisdom of God Manifested in the Works of Creation*, had little use for Willisian theory. But he borrowed directly from Willis's neuroanatomy, particularly his comparative work.[76] The author of *The Anatomy of Humane Bodies Epitomized*, who identified himself at the time only as a "Fellow of the College of Physicians, London," noted in 1682 that "learned" men did not agree about the nature of the animal spirits Willis discussed. Neither could he say what was true about the seventh cranial nerve: "but for Dr. Willis says, (I cannot tell how truly)."[77] Wren's illustrations of the brain, however, were acknowledged by the author to have come from Willis's *Anatomy*, and the latter received by far the most citations.[78] In the 1801 edition of this influential synthesis of seventeenth-century work, the author identified himself as Thomas Gibson.

Yet in what ways were the images and descriptions these near-contemporaries were seeing in Willis's neurological work "real" and "natural"? When considering the reality with which the "neurocentric" was received in the seventeenth century, worth noting are the efforts undertaken by Willis and his colleagues to "harden" their "ocular demonstrations" for printed presentation, to make the tissues of normal and abnormal brains and nerves less indeterminate and more "fact-like." Robert Boyle and Christopher Wren pioneered the technique of injecting spirits of wine into vessels in the 1650's, and Willis acknowledged using this method in his studies of cerebral vessels. However, he did not mention any special preservation and preparation methods for his other studies. Given the high ethanol content of such a distilled liquid and its consequent property as a preservative, it is highly likely that Willis and his team immersed the fresh brains of their subjects in this so as to preserve their

features.[79] A similar technique was used by F.M. van Helmont to preserve the corpse of Lady Anne Conway until her husband could return to England from Ireland to "see" her face.[80]

The purpose of recounting these details is not to analyze the history of fixative technique in anatomy, but rather to emphasize the elaborate lengths to which the Willisians and their clientele went to establish and witness the "real" in death and its links to the living. Moreover, these were presented as "natural" in the sense of being "just like" the undisturbed and living organism. What the engravings (and the fixative techniques which made them possible) suggest is the degree to which artifice and graphic manipulation were employed to achieve this perception. Given that many of these same conventions continue to be employed in present-day "naturalistic" anatomical illustration, particularly illustration of the brain, it may be particularly difficult to perceive these images as artificially constructed and historically contingent.

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Patronage

Willis did not have an M.D. when Gilbert Sheldon, then Bishop of London, Warden of All Souls, Oxford, and *de facto* the nation's most powerful prelate, arranged his appointment as Sedleian Professor at Oxford in 1660. When Willis relocated to London in 1667 at the urging of Sheldon, the latter encouraged his practice. Similarly, Edmund King was only a respected surgeon until Sheldon arranged for him to receive an M.D. and position as a royal physician.[81] Richard Lower's political and religious sympathies were always suspect in the eyes of the Royalists and High Churchmen, but nonetheless, he, too, enjoyed a large and lucrative practice in London as long as he stayed on the right side of Sheldon and his allies. The polymath Wren also benefited from significant patronage dispensed by Sheldon. Appointed at age nineteen as Savilian

Professor of Astronomy at Oxford in 1661, he also received his first architectural commission there from Sheldon, who asked him to design the latter's personal gift to the university, the Theater. After the great London fire in 1665, Wren received the bulk of the architectural commissions to rebuild London churches, although another polymath who was not a Royalist or High Church favorite, William Petty, also received several. When I speak of Anglican patronage, then, I am talking about a number of material benefits dispensed to a tightly drawn group that included Willis and his colleagues by Sheldon, and, to a lesser extent, his allies John Fell and Richard Allestree.

Sheldon's name *did* appear on the top of the petition of the nascent Society of Chemical Physicians, but my supposition is that his initial backing, which was not sustained, was induced by his political calculations at Court. Sheldon did author an undated *Principia,* which remains extant in manuscript form in the Lambeth Palace library (and indecipherable to me). In other words, he may have had some personal interest in natural philosophy. However, his only sustained scientific patronage involved the Willisians.

A staunch High Churchman, Sheldon did not represent the whole of Anglicanism, but he did function as its strategic mastermind in the Interregnum and Restoration until his death in 1677. Furthermore, at least until his partial falling-out with Charles II in the late 1660's, he and his allies were able to manipulate Crown positions on religion, particularly the key issue of treatment of dissenters, to suit their own ends. Sheldon, whom Pepys described as a man of "great business, among the most powerful in England," was less interested in theology than he was in recovering church wealth and controlling congregations.[82] A number of Anglicans, including Wilkins, were prepared, as was Charles II, to be trimmers in matters religious; Sheldon, however, was

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determined not to bend, particularly on the issues of comprehension of non-Anglicans and episcopal control.

As noted in chapter two, the associations between Willis, Allestree, Hammond, and Fell, and through Fell to Sheldon, were close. For one thing, Allestree, Fell, and Willis had prayed together regularly at Oxford during the Commonwealth. Fell's sister Mary was married to Willis--Allestree officiated--until she died in 1666. Sheldon and his principal allies--Hammond, Fell, John Sudbury, Seth Ward, and Robert South--were not interested in including Presbyterians in the Church of England even though that was the strong desire of Charles II.[83] Whereas the Presbyterians, a generally wealthy and otherwise conservative group, pressed for individual congregations to be involved in the choice of their ministers and texts, Sheldon and his allies wanted a Church of England controlled centrally through its bishops. In this context it is not difficult to imagine why Willis, Wren, King, Lower, and the other members of the team had such a particular appeal: as led by Willis, they were *safe*. Also they were known and vouched for by Sheldon's trusted friends.

In addition to these *personal* reasons, the relative importance of which remains difficult to assess, *ideological* factors may also have contributed to Willis's appeal not only to Sheldon, but to a broader group of Anglicans and conservative dissenters who valued reason, order, and hierarchy. In this regard, the mature Willis's theologically-glossed "neurocentric" model may have played a significant role.

Not only did Willis present his work as an examination of God's handiwork--the brain as the "Chapel of the Deity"--, he also presented an image of the investigative physician as Christ-like: 'There should be an Entrance into the Church thorow the Spittle; for that it appears, our Saviour to have used almost this method...that the health of the Soul, should take its beginning from

the restored health of the Body."[84] Moreover, wise use of the "spittle" might help ease social and religious discord: "the infirm brain(s)" of the "sick" would be restored to the Church and Society. Sprat, who also made use of the spittle image, made an even stronger link between medicine and religious discord:

> 'The medicines for Religious distempers must be changeable according to the Diseases: and in this we imitate Christ himself in his method of healing mens Bodies: some cures he performed by Voice, some by Prayer, touch of hands, and even by his Spittle mingled with Earth."[85]

Just as this group of men portrayed themselves as leaders of the "Empire of Reason," Willis and his colleagues portrayed the brain as the "chief mover" in the human body. In other words, for a time Willisian "facts" rang true to a collective imagination of nature and society preoccupied with hierarchical order.[86] To an elite that had lost and then regained its position after decades of political and religious strive, the new physiological approaches and the theories they produced suggested that the human body was capable of being known and ordered by reason. Furthermore, to the extent that it was properly formed, such reasonable knowledge would lead one to embrace Christ and, hence, conquer death.

Not only was reason essential for personal control, it was also increasingly emphasized as an important part of successful religious appeal. Preaching on the theme of "Wisdom and Pleasure" to the Court in 1665, Robert South, Chaplain to the Lord High Chancellor (Edward Hyde), declared that:

> "He that would persuade men to Religion, both with Art and efficacy, must found the persuasion of it upon this, that it interferes not with any rational pleasure, that it bids no body quite the enjoyment of any one thing that his reason can prove him."[87]

Among wise pleasures, natural philosophy was felt to be the greatest. The reason, according to the Anglican divine John Sudbury, was that "Philosophers above all other men spend their time and pains in observing and considering how God governs the world; and having his pattern so much in their eye, they must needs be so much the fitter to govern under Him."[88]

Of the philosophers, Christ was supreme, for His philosophy could conquer death. Moreover, His method was akin to that of natural philosophy. Preaching in 1670 at the funeral of George Monk, (Cromwell's *and* Charles II's leading military man), Seth Ward, one-time Savilian Professor of Astronomy and then Bishop of Salisbury entitled his sermon, 'The Christian Victory over Death." Christ, he preached, was not only the "Captain of our Salvation," but He had also "claimed the principal foundation of a Generous Contempt of Death." He had "assured the world of the truth of this theory...not by giving the world a *set* and *series* of *imaginary principles* of vain *Philosophy* and *Science* falsely so called, engendering strifes and everlasting disputations...but by *evidences plain and convincing*, by proofs *sensible* and *experimental*."[89]

Such behaviors also reflect a shift in focus on the part of Anglican divines, and perhaps others, regarding the soul. The specific efforts of Willis and his followers to preserve the "habit of reason," as well as to learn how to preserve it in the next patient when and if the present one died, aided ministers in one of the clerics' central tasks: the conversion of sinners before their bodily death. Casuistry, or that branch of ethics which seeks to resolve cases of conscience, was originally a Catholic custom adopted and popularized by the Anglican divines Jeremy Taylor and Robert Sanderson beginning in mid-century. Concerned over the decline of morality among the gentle and noble classes, the influential Taylor sought to devise practical methods for converting well-born sinners as an example to the vulgar. Richard Allestree spoke for many when he preached "that

[illegible]

Sin and Death are of so near, so complicated a relation, as that though they were Twins, the birth and Issue of one Womb and moment, yet they are also one anothers Off-spring, and beget each other."[90] For sinners, the death would be double. Not only would the sinner experience the first death of the body, but his soul and body would be in perpetual torment as of Judgment Day. Unlike the millenarian Puritan reformers of the 1640's and 1650's, Anglican millenarians in the Restoration did not intend the prospect of a final Judgment to hasten the reform of social injustices.[91] Their millenarianism was a quieter, largely private affair.

By embracing Christ, the individual sinner might take advantage of God's general providence and be reborn at the Resurrection. According to Allestree, physic for the mortally ill was helpful not to prolong bodily life, which was suffering the torment of terminal disease anyway, but to give the sinner time to convert while still rational. After all, Christ's promise of eternal life was a dispensation offered to humans, who, alone among God's creatures, were both rational and redeemable. Conversion might be achieved by the operations of God's providence alone, of course, and by the reading of the proper spiritual guides; it was aided, however, by active consideration of issues of conscience by the afflicted and his or her minister.[92]

This required the healthy functioning, if not of the vital soul, certainly the Rational Soul. Given the expressed devotion of the Willisians to this very programmatic in its medical aspects, it is not surprising that numbers of Anglicans volunteered as both the objects and subjects of physiological medical inquiry and care. Whereas such states as monstrous contortions and rantings "have usually by ignorant People been ascribed to Witch-craft and possessions of the Devil," now they could be seen in terms of "an Anatomical consideration of

the Brain and Nerves."[93] Medicine, in this sense, might help prevent a double death, the worse fate of all.

Conclusion

Willis's investigative enterprise depended on "ocular demonstrations" and "case observations" gleaned from the normal and the pathological. In order for it to proceed, the bodies of Willis' patients had to be available as scientific resources. Patients and their families participated for a variety of reasons. Nonetheless, he and his colleagues could not have proceeded with anatomizing deceased patients without the tacit approval of religious authorities. Willis' conflation of reason, philosophy and religion, and his apendment of autopsy to reason, promoted the practice as theologically *safe*. The endorsement of Archbishop Sheldon enhanced this Willisian claim to orthodoxy. Also, Willis's alignment of the role of the "rational" physician with Christ the healer emphasized his religious orthodoxy at the same time it suggested a beneficial effect of the new clinical knowledge.

With reference to both Western Europe generally and the English experience specifically, historians and sociologists have argued that the development of scientific medicine (particularly of pathological anatomy and clinical correlation) required the nineteenth-century institution of the urban charity hospital.[94] By focusing so much on the activities' institutional origins, they seem to have neglected their pre-hospital origins. Defined as a professional activity, medical science may be a nineteenth-century development. Nonetheless, the activities of Harvey, Willis, King, and others in England and on the Continent indicate that two of its central activities enjoyed epistemological prestige at least a century and a half earlier in a private-practice setting. What was required in Restoration England, I have argued, was not the institutional

authority of the hospital, but a cultural authority arising from a convergence of belief between a group of physicians, patients, and religious leaders regarding the meaning of reason, death, and order.

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[1] According to the *Oxford English Dictionary* (1933), "post mortem" first entered English usage in 1678.

[2] The Angel was leased by Willis, Dr. Peter Eliot and William Day, a surgeon, in 1662. See Kenneth Dewhurst, *Willis's Oxford Casebook*, (Oxford: Sandford, 1981), p. 2.

[3] Willis, *Anatomy of the Brain*, 1664, "Epistle Dedicatory" and "Preface to the Reader."

[4] Ibid, "Epistle Dedicatory."

[5] Ibid.

[6] Ibid., "Epistle Dedicatory."

[7] See, for instance, the entry of 3/23/1635 in the *Annals of the Barber Surgeons of London*, ed. Sidney Young, (London: Blades, East & Blades, 1890). The reference there and in several other places from the 1580's to the 1640's suggest that "anatomy" was used by the surgeons (and physicians) who participated in the Company's lecture program as equivalent to "skeleton." When the Barber Surgeons authorized the provision of a "private dissection room" on October 20, 1631, for example, it was because the "anatomies" and "skeletons" had messed up the kitchen.

[8] See *Annals of the Barber Surgeons*, op. cit., p. 362.

[9] Ibid.

[10] Giovanna Ferrari, "Public Anatomy Lessons and the Carnival in Bologna,", *Past & Present*, 117, Nov., 1987, pp. 50-106.

[11] *Annals of the Barber Surgeons*, op. cit., , p. 331.

[12] Arturo Castiglioni, *A History of Medicine*, 2nd ed. (New York: Knopf, 1958), p. 340.

[13] Ferrara, op. cit., 1986, p. 54.

[14] Jan C. Rupp, "Matters of Life and Death: the social and cultural conditions of the rise of anatomical theaters, with special reference to seventeenth century Holland," *Hist. Sci.*, xxviii (1990), 264-287, p. 268.; see also idem, "Michel Foucault, Body Politics and the Rise and Expansion of Modern Anatomy," *Journal of Historical Sociology*, vo. 5, no. 1, March 1992, pp. 31-59.

[15] Rupp, op. cit., 1990, p. 271.

[16] Ruth Richardson, *Death, Dissection and the Destitute*, (London: Penguin, 1988), p. 32.

[17] Anonymous, "News from the Dead, or a true and exact narration of the miraculous deliverance of Anne Greene," (Oxford, 1651) in *Phoenix Britannicus*, (London, 1732), vol. 1, pp. 233-240.

[18] *Annals of the Barber Surgeons*, 1890, op. cit., 7/3/1638.

[19] For eighteenth-century medical culture and anatomy, see Philip K. Wilson, "Acquiring Surgical Know-how: Occupational and Lay Instruction in Early Eighteenth-century London," in Roy Porter, ed., *The Popularization of Medicine, 1650-1850,* (London: Routledge, 1992), pp. 42-71.; also W.F. Bynum and Roy Porter, eds., *William Hunter and the Eighteenth-Century Medical World,* (Cambridge, U.K.: Cambridge U.P., 1985).

[20] Rupp, op. cit., 1990, pp. 279-280.

[21] I am indebted to Guenter Risse for sharing with me his unpublished manuscript (draft of 8/3/92), 'The Anatomical-Clinical Synthesis: From Morgagni to Laennec," p. 4.

[22] Robert J. Moes and C.D. O'Malley, "Realdo Colombo: 'On those things rarely found in anatomy': an annotated translation from the Dr. re anatomica (1559)," *Bull Hist. Med.*, 1960, 34: 520, 522.

[23] Risse, op. cit., 1992, p.p. 4-5.

[24] Circulation theory, especially, was doubted on these grounds. See Jerome J. Bylebyl, 'The Medical Side of Harvey's Discovery," in idem, *William Harvey and His Age,* (Baltimore: Johns Hopkins, 1979), esp. pp. 55-8.

[25] Thomas S. Kuhn, *The Structure of Scientific Revolutions,* 2nd ed. (Chicago: U. of Chicago Press: 1970), chapter 7.

[26] Guenter Risse, op. cit., 1992, pp. 5-6.

[27] Ibid., pp. 7-8.

[28] Henry I was the first English king to be so divided. His grandson, Richard the Lion-Hearted directed that his heart should be buried at Rouen, his brain, blood and entrails at Charroux, and his body at Fontevrault. See Elizabeth A.R. Brown, "Death and the Human Body in the Later Middle Ages" the legislation of Boniface VIII on the division of the corpse," *Viator* 12 (1981): 221-270, p. 228. She points out that although division of the corpse remained popular in France in the thirteenth, fourteenth and fifteenth centuries, the prace "declined radically" in England following the issuance of a prohibition on such procedures by Boniface VIII in 1299. See ibid, p. 253.

[29] Clare Gittings, *Death, Burial and the Individual in Early Modern England,* (London: Routledge, 1988), p. 166. For an extended discussion of Tudor and Stuart death practice among the gentry and aristocracy, see especially chapters 8-10. For an illustrated analysis of the visual culture of early modern English death, see Nigel Llewellyn, *The Art of Death,* (London: Reaktion Books, 1991).

[30] Gittings, op. cit., p. 167.

[31] Ibid

[32] Ibid, p. 189.

[33] Ibid, p. 190

[34] I am indebted to David Harley for sharing with me his unpublished manuscript (draft February, 1993), "Political Postmortems and Morbid Anatomy in Seventeenth-Century England," pp. 4-5.

[35] Ibid, p. 7

[36] Thomas Vicary, *The Anatomie of the Bodie of Man*, 1548, (reprint 1888 by Oxford University Press), pp. 32-3.

[37] Helkiah Crooke, *Mikrokosmo Graphia*, (London, 1618), p. 45.

[38] For a brief description of Oxford developments 1600-1640, see Robert G. Frank, Jr., *Harvey and the Oxford Physiologists*, (Berkeley: U.C. Press, 1980), p. 45-6.

[39] Toby Gelfand, "The "Paris Manner" of dissection: student anatomical dissection in early eighteenth-century Paris,' *Bull. Hist. Med.*, 46 (1972): pp. 99-130. See also idem, *Professionalizing Modern Medicine: Paris Surgeons and Medical Science and Institutions in the Eighteenth Century*, (Westport: Greenwood Press, 1980).

[40] *Annals of the Barber Surgeons*, 1890, p. 361.

[41] Andreas Vesalius, "preface" to *De corpore humani fabrica*, (Basel, 1543).

[42] Francis Bacon, *Works*, ed. James Spedding, R. Ellis and D. Heath, (Boston: Friedrich Formmann, 1860-4) vo. III, pp. 374-5. Cited by Audrey Davis, *Circulation Physiology in England, 1650-1690*, (Lawrence, Kansas: Coronado, 1973), p. 153.

[43] Harvey spent most of the period 1598-1602 as a student in Padua, where he received in M.D. in April, 1602.

[44] William Harvey, *Prelectiones anatomiae universalis*, an annotated translation by C.D. O'Malley, F.N.L. Poynter, and K.F. Russell (Berkeley: U.C. Press, 1961). In addition to his famous inclusion of postmortem findings on his father, Harvey also mentioned eight named patients, of whom three were baronets and one was a lady. The notes also frequently referred to anatomical findings on animals. In all cases, the mentions were a few lines at most. For more on the *Prelectiones*, see Luke Wilson, "The performance of the body in Renaissance anatomy," *Representations*, 1987, 17: 62-95.

[45] William Harvey to Jean Riolan, 1649, trans. Robert Willis (1848), in Esmond R. Long, *Selected Readings in Pathology* (Baltimore: Thomas, 1929), pp. 71-4.

[46] See Robert G. Frank,Jr., *Harvey and the Oxford Physiologists*, (Berkeley: U.C. Press) p. 32, quoting John Aubrey's seventeenth-century account of Harvey.

[47] David Harley, op. cit., 1993, p. 13.

[48] Edmund King, letter to *Philosophical Transactions*, XV, 1685, pp. 228-31.

[49] Willis, *Pathology*, 1667, op. cit., p. 283.

[50] Willis, *Two Discourses*, op. cit., p. 570.

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[51] See Ruth Richardson, op. cit., "The Corpse and Popular Culture," pp. 14-20.

[52] Michael MacDonald, "The secularization of suicide in England, 1600-1800," *Past & Present*, 1986, 111: 50-100.

[53] Annals of the College of Physicians, 4:87 b.

[54] Thomas Sprat, *History of the Royal Society*, ed. Jackson I. Cope and Harold Whitmore Jones, (London: Routledge & Kegan Paul, 1959), p. 403.

[55] Quesnay, who authored two articles on rural economy for the *Grande Encyclopedie* (1756), used an analogy of Harvey's circulation theory in constructing his influential *Tableau economique*. See Charles Gide and Charles Rist, *A History of Economic Doctrines*, trans. by R. Richards, 2nd ed. (Boston: D.C. Heath, 1909), chapter 1.

[56] Willis, *Cerebral Anatomy*, p. 134.

[57] Duchess of Newcastle, *Philosophical Letters; or, Modest Reflections upon Some Opinions in Natural Philosophy* (London, 1664), pp. 352-77.

[58] Willis, *De anima brutorum*, (1672), sect. M.

[59] Ibid.

[60] See the plates illustrating cross-sections of nerves in Willis's *Anatomy* (1664). For the assertion that Willis was the first European anatomist to employ the microscope regularly in dissection, see Hansreudi Isler, *Thomas Willis*, (N.Y.: Handford, 1968), p. 53

[61] Samuel Pepys, *Diary*, (London, 1825), October 3, 1666.

[62] Edmund King, *Philosophical Transactions*, op. cit., 1685, p. 231.

[63] John Fell, *The Life of the most learned reverend & pious Dr. H. Hammond* (1605-1662), (London, 1662), pp. 262-5.

[64] He found the meninges (the covering layers) of her brain "distended with Blood", a finding her interpreted as confirmatory of the neurological origin of her convulsions. Willis, *Pathology*, 1667, pp. 75-78.

[65] Duchess of Newcastle, *Philosophical Letters*, op. cit., p. 352.

[66] David Harley, op. cit., ms. 1993, p. 5.

[67] Duchess of Newcastle, op. cit., 1664, p. 377.

[68] See Michael Heyd, "The reaction to enthusiasm in the seventeenth century: towards an integrative approach," *J. Mod. Hist.*, 1981, 53: 258-80, esp. pp. 272-3.

[69] Written in 1648 but published in 1661, these sentiments are from a letter written by Boyle to his sister, the Countess of Warwick, and published as *Some Motives and Incentives to the Love of God*. (London, 1661, 2nd ed.), p. 56.

[70] Stephen Marshall, *Threnodia. The Churches Lamentation for the Good Man his loose* (London, 1644), pp. 30-1. Cited by David Harley, op. cit., ms. 1993, p. 10.

[71] See Stephen Shapin, "The House of Experiment in Seventeenth-Century England," *Isis*, 79, 1988: 373-404; Stephen Shapin and Simon Schaffer, *Leviathan and the Air-Pump*, (Princeton: Princeton U.P. 1985); Simon Schaffer, "Self Evidence," *Critical Inquiry* 18 (winter 1992): 327-362.

[72] Crooke, op. cit., p. 472.

[73] Henry Carey, *Natural History of the Passions*, (London, 1674), British Library 8403. ee.14

[74] Ibid., p. 165.

[75] J.L., Gent/Lionardo di Capra, *The Uncertain Art of Physick*, (London, 1684), pp. 89, 100-101.

[76] John Ray, *The Wisdom of God Manifested in the Works of Creation*, (London, 1691), pp. 36, 38, 208-209. On Ray and Willis, see W.F. Bynum, "The Anatomical Method, Natural Theology, and the Functions of the Brain," *Isis*, 64, 224: 445-468.

[77] Anonymous, *Anatomy of Humane Bodies Epitomized*, (London: M. Fleshier, 1682), British Library 1039., p.p. 324, 336.

[78] Ibid, Book III, "Of the Head."

[79] This is the opinion also of J. Trevor Hughes. See his, "Spinal Cord Arteries Described by Willis," in Rose and Bynum, ed., *Historical Aspects of the Neurosciences*, (New York: Raven, 1982), p. 199.

[80] *The Conway Letters*, Marjorie H. Nicholson and Sarah Hutton, eds., rev. ed., (Oxford: Clarendon Press, 1992), p. 451.

[81] King was given a Lambeth degree, which he incorporated at Cambridge in 1671. William Munk's *Roll of the College of Physicians* (London: Longman, Green, 1861), 1: 115-16.

[82] Samuel Pepys, *Diary* (1633-1703), (London, 1825), 1: 322.

[83] See M.A. Heyd, op. cit., 1981, pp. 258-80; Paul Seaward, "Gilbert Sheldon, the London Vestries, and the Defence of the Church," in *The Politics of Religion in Restoration England*, ed. Tim Harris et al. (Oxford: Blackwell, 1990), pp. 49-73; Victor D. Sutch, *Gilbert Sheldon, Architect of Anglican Survival*, 1640-75, (The Hague: Martinus Nijhoff, 1973).

[84] Willis, *Pathology*, 1667, "Epistle Dedicatory."

[85] Thomas Sprat, *History of the Royal Society* (1667), ed. Jackson I. Cope and Harold W. Jones, (London: Routledge, 1958), p. 376.

[86] For an influential discussion of the fit of scientific "facts" and culture, see Ludwig Fleck, *The Genesis and Development of a Scientific Fact* (Chicago: University of Chicago Press, 1979), esp. prologue and sec. 3.

[87] Robert South, "Wisdom and Pleasure," Library of Lambeth Palace, #5133.

[88] John Sudbury, from a sermon dedicated 28/10/1660 to Edward Hyde, then High Chancellor, upon the consecration of several bishops (Sheldon among them) in 1660. Dr. Williams Library, London, #12.55.12 (4), pp. 32-33.

[89] Seth Ward, "The Christian Victory over Death", Wellcome Institute, London. #34023/B/1. 30/04/1670, p. 17.

[90] Richard Allestree, "Why will ye dye?" in idem, *Forty Sermons*, 2 vols. (Oxford, 1684), 1:57-68, as cited in Scott Mandelbrote, "Prodigal Children: Repentance, Death, and Resurrection in Early Modern England," (ms., forthcoming in print), pp. 3-4. I am grateful to Mr. Mandelbrote, who is a junior research fellow at All Souls, Oxford, for suggesting the importance of casuistry in Restoration Anglican thought.

[91] On Interregnum millenarial thinking, see Charles Webster, ed. *The Intellectual Revolution of the Seventeenth Century*, (London: Routledge & Kegan Paul, 1974), pp. 19-27. The chronology and character of millenarian thinking has been a controversial topic in seventeenth century historiography. For views contrary to Webster's, see the essays by Bernard Capp ("The millennium and eschatology in England") and William Lamont ("Richard Baxter, the Apocalypse, and the Mad Major") in ibid., pp. 427-34 and 399-426, respectively. For the Restoration, see James R. Jacob and Margaret C. Jacob , 'The Anglican origins of modern science: the metaphysical foundations of the Whig constitution," *Isis*, 1980, 71: 251-67, esp. pp. 253-59.

[92] For additional background, see John Spurr, "'Virtue, Religion, and Government': The Anglican Uses of Providence," in *The Politics of Religion in Restoration England*, ed. Tim Harris, Paul Seaward, and Mark Goldie (Oxford: Blackwell, 1990); cited by Mandelbrote, op. cit, p. 5, n. 12. See also Andrew Wear, "Puritan Perceptions of Illness in Seventeenth Century England," in *Patients and Practitioners: Lay Perceptions of Medicine in Pre-Industrial Society*, ed. Roy Porter (Cambridge, U.K.: Cambridge U.P. , 1985), pp. 55-100.

[93] Willis, *Pathology*, op. cit., pp. 70, 90-1. See also David Harley, "Mental Illness, Magical Medicine, and the Devil," in Andrew Wear, and Roger French, eds., *The Medical Revolution of the Seventeenth Century*, (Cambridge, U.K.: Cambridge U.P., 1989).

[94] For an account of French developments, see Georges Canguilhem, *On the Normal and the Pathological*, trans . Carolyn R. Fawcett, with an intro. by Michel Foucault, (Dordrecht, Holland: D. Reidel, 1978). According to Canguilhem, "The reform of medicine as theory, itself rests on the reform of medicine as practice: in France as also in Austria it is closely tied to hospital reform." (p. 145). See also Michel Foucault, *Birth of the Clinic*, trans. A.M. Sheridan Smith (New York: Vintage, 1975). Both Cangulhem and Foucault ignore Harvey, Willis , and their followers. For pathological anatomy in eighteenth century France, see Toby Gelfand, *Professionalizing Modern Medicine: Paris surgeons and medical science and institutions in the eighteenth century*, (Westport, Conn.: Greenwood, 1980), pp. 131-148. For England, see "The Disappearance of the sick-man from medical cosmology, 1770-1870," *Sociology*, 1976, 10: 225-44, and idem, "Medical knowledge and the patronage system in eighteenth-century England," in ibid, 1974, 8: 370-385.

Chapter Five

Criticisms

Introduction

Mention has been made in previous chapters of contemporary criticisms of various kinds directed against the thought-products of Willis and his colleagues as well as the epistemological premises and investigational practices that supported them. Those critiques form the subject matter of this chapter. They include critiques from the 1650's by John Webster and Nicholas Culpepper on learned education and medicine, attacks on Willis by the learned physicians Edmund O'Meara and Nathaniel Highmore, and the fallacies of the anatomical and physiological methods of the Oxford physiologists as experienced by his contemporaries Sydenham, Locke, and Steno.

I have collected them and put them last in the dissertation for several reasons. First, it seemed wise to me to let Willis and his colleagues speak first. After all, this dissertation has been concerned with the formation of particular sets of ideas about proper appraches to human bodies, their operations, and their distinctiveness as well as the cultural success of that formation among particular audiences. To that end, I wanted to let their story emerge in full form. Including both their ideas and the ideas of the Cartesians, Paracelsians, and Helmontians which directly influenced them seemed to go together. One cannot understand Oxford notions of "ferment", for example, without knowing how those notions incorporated and avoided aspects of ferment in van Helmont and Descartes. In that sense, the latter were vital to the formation of English approaches. Willis and his colleagues used them *proactively.*

In contrast, with the exception of a discussion of the relation between Boyle, Sydenham, Locke and Willis regarding the place of anatomy in learned medicine, the material presented here represents responses to actions or ideas undertaken by Willis and his collaborators. In other words, they represent thought which was *reactive.* And because they do, they help to illustrate two general theses of this dissertaion: the contested nature of physiological explanation in early modern England and the ambiguities of early modern formations regarding the architectonics of the body.

Secondly, although the critiques span the forty year period of the Interregnum and Restoration--and the movement from blood to brain on the part of Willis and his colleagues--they share common themes, particularly in the recurrent debate about the place of investigational methods in medical practice. Yet despite some nominal similarlities, there were also some important shifts in emphasis. Collecting these critiques together facilitates comprehension of certain continuities and discontinuities. To that end, I think their presentation in this manner may help reinforce another argument of this thesis: the historically contingent nature of the Willisian enterprise as well as the learned empiricism which displaced parts of it.

I: Educational Challenge in the Interrugnum

In 1654 John Webster (1610-1682), who earned his living practicing medicine and surgery, published (in English) his *Academiarum examen, or the Examination of Academies.* Webster, who received training in religion and (al)chemistry, had served as a chaplain and surgeon in the Parliamentary army. As such, he his life represents a kind of flip-side biography to those Anglican Royalists, such as Willis and Bathurst, who had similar areas of interest and experience. Within a few months Wilkins, who wrote the

introduction, and Seth Ward (1617-1689), who wrote the text, published a defense, the *Vindiciae academiarum, containing some briefe animadversions upon Mr. Webster's book* (1654). As we know from previous chapters, Ward (1617-1689), who was then Savilian Professor of Astronomy and active in the experimental clubs, later became Bishop of Salisbury. A brief examination of the debate may help establish the context of incommesurability which characterized Restoration disputes about medical theory and professional order. To that end I want to concentrate on those aspects of the controversy which dealt with bodily investigation.

Although Webster wrote more critically than synthetically or programmatically, it is worthwhile to remember that a number of utopian tomes appeared in the Interregnum period.[1] In common with many of them, Webster voiced a desire to dispense with humanist and scholastic traditions which informed the curriculum of Oxford.[2] Describing himself first and foremost as a "free-born *Englishman*,"[3] Webster placed his effort in the context of Plato's *Republic*, More's *Utopia*, and Bacon's *New Atlantis*. Notable for his absence was Aristotle, whom he and many others dismissed as a "pagan." Yet Ward and Wilkins were for Bacon, too. If they were not vocal in their enthusiasm for Aristotle *per se*--Ward, after all, did not follow the mandate to lecture from Aristotle in his Savilian lectures[4]--they were not about to dispense with the scholastic tradition of which Aristotle had been a substantial part. It is important to note that support for a traditional curriculum ranged beyond Anglican circles. Despite their control of the government, neither Parliament nor Cromwell and his supporters sought a radical revision of the admission policies or the curriculum. And in setting up the early academic program at Harvard, its Puritan founders specified many of the same texts and approaches in use in English universities. In

large part this was because the purpose of the universities was to train ministers, a group who were expected to conserve and transmit traditional knowledge.

However, Webster's curricular proposals contained many of the same elements as those Wilkins and Ward encouraged in the extra-curricular clubs. According to Webster, students must "learn to inure their hands to labour" through chemical work.[5] They were to have "Laboratories as well as Libraries."[6] Not only should the authors mentioned above be studied, but also Gassendi, Descartes, and Plato. All of this, of course, was very much in accord with with the approaches, albeit informal ones, already in place. Websters recommendation for ocular inspection and hand work was not substatively different--at least on the surface--from Ward's for "observation and experiment."[7]

Yet these nominal similarities were superficial, as a look at the participants' respective ideas of anatomy will, I think, reveal. Whereas the "ocular demonstrations" of Interregnum Oxford club anatomy were about secular discription of living structures, Webster's anatomy was explicitly mystical. Sounding very much like George Thomson ten years later, Webster praised the contributions of "our never-sufficiently honoured Countryman Doctor *Harvey*." Nonetheless, the effort was largely beside the point, for Webster was convinced that the "wonderful secret" of the blood's circulation was of "small advantage" in curing diseases.[8] Harvey's kind of anatomy, while it could "bring great satisfaction to a speculative understanding," did little "to remove dolor, danger, or death."[9] The true anatomy was "Mystical Anatomy."[10] This process, which was left undefined, actually discovered the "true Schematism" of "that invisible *Archeus*" that was the true "opisex" of all "salutary and morbifick" bodily experiences.[11] The approved writers were

Paracelsus, J.B. van Helmont, and Robert Fludd. According to Webster, anatomy more properly belonged to "the most excellent art of *Chirurgery.*"

If Webster's attack on Oxford anatomy anticipated the efforts by Helmontian physicians to gain official status in the Restoration, the intellectual continuity belies substantial change in the political balance of power between radicals and conservatives in the intervening decade. Webster was only one of a number of Interregnum voices calling for dramatic changes in the academic and social order. The most prolific medical popularizer of the decade, Nicholas Culpeper, wanted to do away with hierarchies completely, considering "priests, physicians, lawyers, all of them monopolists." By the mid-1660's, however their ideological descendents were merely seeking to gain a place in the hierarchy. Moreover, (al)chemical physicians in the Restoration were no longer necessarily partisans of cheap medicines and the egalitarian life. Many, such as George Starkey, had successfully re-packaged themselves as physician/courtiers.[12]

Another tip-off that Webster's program of hands-on experiment was quite different from that of Wilkins and Ward was their differing use of the term "natural magic." After describing the virtues of "mystical anatomy", Webster then proceeded to recommend for curricular inclusion the "science of physiognomy," which he subdivided into categories of elementary, meteorogical mineralogical, botanical, and anthropological.[13] Such a recommendation was based on the Renaissance doctrine of signatures: external features revealed inner qualities. Behind that lay the tradition of reasoning by analogy with microcosm and macrocosm. The goal of the universities should be to train "true Natural *Magicians.*"[14]

But then what was true natural magic? As I pointed out in chapter one, the difference between the alchemical mystics and mainline natural

philosophers was not so much over the *existence* of supernatural and occult forces as it was over who was qualified to speak and how should the discourse be managed. In short, over discernment and control. In refuting Webster on his discussion of natural magic, for example, Ward did not argue that natural magic did not exist, but rather that Ward's approach was a false path toward learning the "true naturall Magick."[15]

According to Ward, this was discovered not by the "pretence of specificall vertues" in things, but by "applying agent and Materiall causes to produce effects."[16] Harvey's discovery of the circulation of the blood, as well as all the attendant discoveries it had inspired, had improved both the theory and practice of physick. Just consider, Ward wrote, a recent instance. Ward then mentioned the "recovering the Wench after she had been hanged at least half an hower."[17] This reference could only be to the hanging of Anne Green, a servant convicted of infanticide in Oxford in 1651. Willis, William Petty, and the surgeon William Day attended the execution with a plan to dissect Green's corpse subsequently. When they removed the body to Day's lodgings, however, they noticed a movement. Willis and Petty then thumped her chest and otherwise attempted to revive her. Green subsequently woke up. Granted clemency, she continued to live in Oxford. The three men received substantial credit for the "resurrection."[18] Presumably this was what Ward meant by "natural magick." He also cited the learning represented in the membership of the College of Physicians.

Ward also emphasized his differences with Webster regarding the goal of university education. Whereas Webster wanted an integrated curriculum directed toward producing Christian philosophers who were also "natural magicians," Ward pointed out that the social classes that Oxford cultivated, the sons of the "Nobility or Gentry," were not interested in natural

philosophy as a career.[19] Only a tiny number had a "designe...to be absolute in Natural Philosophy."[20] Their parents paid the fees not to have their sons be set to agriculture or mechanics, but to spend two or three years learning "lighter institutions and Exercises." Subsequently they would go to the Inns of Court, where they would learn how to handle property and business. Their university training, however, would allow them to become "rationall and Gracefull speakers" and adopt "an acceptable behaviour in their Countries."[21]

II: Physiological Challenges

A. The humours defended

If Willis's work in the 1650's on the blood, and by extension the work of Oxford physiologists of which it represented a synthesis, was not wholly new, it was "new" enough, in the sense Wilkins and Wallis used the term, to receive vigorous criticism from practitioners of a more traditional physick. The first major domestic attack on Oxford blood physiology came from Edmund O'Meara (1615?-1682), an Irish physician who spent most of his career practicing in Bristol. Published in 1665 as *Examen diatribae Thomae Willisii, Doctoris Medici et professoris Oxoniensis, cut accesserunt historiae aliquot medicae rariores,* O'Meara's criticism, though directed specifically at Willis, was an attack on medical investigation as it had developed at Oxford in the 1650's. O'Meara was determined to prevent "the lechery of the wanton mind and the mad itch for innovation" in medicine that he feared "will end in the ruin of the human race."[22] The attack of O'Meara is particularly worthy of mention, I think, because it received a published response from Richard Lower, in 1665. Titled the *Diatribae Thomae Willisii de febribus vindicatio adversus Edmundum de Meara,* Lower's work mixed *ad hominen*

attack of O'Meara with a general defense of the Oxford blood physiology of the 1640's and 1650's.

O'Meara, who received his M.D. from Rheims in 1636 (incorporated at Oxford in 1652), came from an established Irish family of physicians and landowners. Loyal to Charles I in the Civil War, O'Meara, active in Irish Catholic politics, left Ireland for England in 1652 after his family's lands were seized by the Cromwellians. Settling in Bristol in the 1650's, he developed a prosperous practice that included Lady Fairfax and John Locke's father.[23] Although a Catholic, O'Meara's social conservatism paralleled that of Willis in its Royalism and support of traditional social, religious, and professional order.

O'Meara was especially piqued that Willis had become a "professor" of "philosophy" at Oxford. His irritation in this regard recalls Thomson's conflation of Willis with the "Galenic" physicians of the College of Physicians. Willis, like O'Meara, joined the College of Physicians as an honorary fellow in 1664. Also, Willis was invited early to join the Royal Society, but did not actually do so until 1670, after he had lived in London for three years.[24] Though his publications were regularly (and favorably) reviewed by the *Philosophical Transactions* and accepted with commendations by the College, Willis was never active in either. He did not hold offices in either organization, nor did he attend more than a handful of meetings.[25] Nonetheless, for critics of both a traditional persuasion, such as O'Meara, as well as those such as Thomson, who favored a more vitalist physiology and use of more chemically potent remedies than those recommended by Willis, Willis the person seemed to stand in, if you will, for advanced learned medicine as it was being developed by practitioners of the "new" philosophy of the body.

Citing as his principal authorities Galen, Hippocrates, Aristotle and Plato, O'Meara criticized Oxford conceptions of the blood on several counts. Dismayed by their development of a heat model based on chemical ferments in a blood composed of particles, O'Meara criticized Oxford incorporation of a mechanical matter-theory, or the "barbarous and unintelligible appellations of Cartesian fire and Hooghelandic ferment."[26]

Furthermore, he judged impious Harvey's belief that the soul was situated in the blood.[27] The blood did not sanguify, or form itself, as Glisson had argued. Instead, new blood was made as needed as a consequence of its to and fro motion between the chambers of the heart. According to O'Meara, fever was not caused by a chemical disruption of the blood, as the Oxford thinkers had maintained, but by a "distemper of innate heat."[28]

Neither did the blood circulate as Harvey had supposed, but instead in a two-fold manner. Citing the work of the seventeenth century Aristotelian Fortunio Liceti of the University of Pisa, O'Meara recapitulated Liceti's idea that the blood had separate venous and arterial circulations. It mixed in the heart through the coronary veins.[29] Moreover, the four humors of classical Galenism *were* separate entities, and Willis, Glisson, and Harvey were wrong to ascribe to them insignificant roles. The Oxford physiologists had paid too much attention to the blood, and not enough to the solid parts of the body and their humors.

Much of O'Meara's criticism of Oxford physiology rested on his assertions of its methodological errors. In this regard, he criticized them in the area in which they were perceived by themselves and subsequent generations to be strongest, their experimental techniques. Boasting of his own anatomical knowledge gained through post-mortem examination of sick bodies, O'Meara criticized Willis for not examining more thoroughly the bodies of those dead

from intermittent fever. If he had, O'Meara argued, he would have noted their frequent and numerous abcesses in the pancreas, kidneys, intestines, and other organs.[30] Had Glisson diligently examined the testes, he could not have helped but notice its rich endowment of blood vessels.[31]

According to O'Meara, the practices of vivisection and animal experimentation, on which the Oxford group had depended for support of its theories, were not reliable. Echoing earlier criticisms by humoralists of Harvey's experimental work recorded in *De motu cordis*,[32] O'Meara found the evidence of animal experimentation unreliable. The "terrible tortures of vivisection" brought out a mixture of bodily humors and juices.[33] Thus, the very process of the experiment so distorted the body's response that its supposed evidence reflected only procedurally induced abnormalities, not underlying truths.

Willis's chemistry was particularly odious to O'Meara. In the first place, the terminology of this "new school" was sloppy. For example, chemists applied the term "spirits" to liquids distilled from either vegetable or mineral materials.[34] Furthermore, Willis's combination of the traditional elements of earth and water with chemical principles of salt, sulphur, and spirit made no sense. It only undercut both old medical theory and old medical chemistry. Willis might as well argue for an infinite number of elements. Chemists only came up with new terms for old ideas. Willis's natural philosophy was irrelevant to medical practice. Physicians should concentrate on the proximate, not the remote, causes of their patients' ills.[35]

When it came to therapeutics, an area of medicine Willis only took up in earnest in published form in the 1670's, O'Meara criticized Willis for recommending "empirical" remedies. Scattered throughout the *Examen*, O'Meara's recurrent contrasting of "empiric" and "orthodox" approaches to

therapeutics raises some difficulties of interpretation. If by "empiric" O'Meara meant "quack", as did most orthodox physicians in mid-century, O'Meara and Willis were quite close in their views. Although his exact sentiments on the matter were not published until shortly after his death in 1675, Willis's equation of empiricism as practiced by "quacking Jugglers and old Women" as akin to "people shooting at random"[36] was similar in vehemence to O'Meara's condemnation of empiricism. As O'Meara put it: the "civil sword could not be drawn with more justice against murderers and highwaymen than against the plague of empirics."[37]

At the time Willis wrote his *Diatribae* and O'Meara his *Examen*, both men were practicing in provincial cities. Nonetheless, Oxford and its surrounding towns as well as Bristol contained varieties of healers, most of whom were not university-trained.[38] Thus, in the vigorous medical marketplace that characterized London as well as provincial centers, it might be expected that learned physicians, especially ones who had ascended to the ranks of honorary fellows of the College of Physicians, should pay considerable attention to bolstering their professional place *vis a vis* the more casually trained. What is surprising is that O'Meara attacked Willis, who by the time of publication of the *Examen* had been Sedleian Professor for five years, on the grounds of practicing empiricism.

What O'Meara's criticism points up is that Willis and, by extension, other physicians skilled in the "new" philosophy, were able to define mid-century medical discourse not only physiologically but therapeutically in ways that their traditional colleagues perceived as a professional threat. Noting the rise of the physician virtuoso during the Restoration, Robert Frank has argued that "by the 1670's not only was research in anatomy and chemistry

considered laudable in its own terms, but it also contributed the establishment of a man's reputation as a clinician."[39]

O'Meara's remarks on empiricism suggest that the "new" philosophy of the blood created a rivalry not only between those inside and outside the medical elite, but within that elite as well. Moreover, that rivalry may have been experienced by the traditionalists at an earlier date than heretofore appreciated. Willis, after all, did not differentiate remedies only on the basis of their "experience" as evidenced by their presence in the Galenic and Hippocratic corpus.

Discrimination as to choice of medicines and maneuvers was beginning to depend on experimental and anatomical experience. Empiricism was acceptable, provided that it was controlled by a particular new kind of learning. For those trained abroad in a more traditional environment, such as O'Meara, epistemological authority had been more text-based. One of their main offerings to patients had been expert counsel on diet, travel, and other matters so as to keep the humours (and the patient) in balance. What the Oxford physician/physiologists attempted to establish was a new criterion for "experience" regarding therapeutics. Sophisticated anatomical and chemical explanations were amendments that were beginning to destabilize older forms of understanding.

Unlike the self-identified "Helmontian" physicians who came into increasing prominence in the Restoration, Willis never denigrated learned "experience" as a guide to therapeutics. But he did maintain that experiment, particularly chemical experiment, could provided its own experience, or justification. Though that argument was not made at length until his *Rational Therapeutics* of 1675, Willis (and Lower's) active promotion in the 1650's of steel salts in certain conditions was an early indication of his

sympathies in the matter. In criticizing this stance, O'Meara singled out one therapeutic, the emetic crocus metalloricum, for derision. Was it mild? he asked rhetorically. Were chemical remedies safe?[40] It seems plausible that O'Meara's choice of that drug was a reference to the injection experiments begun by Wren, Boyle, Willis, Lower, Petty in the late 1650's and 1660's and mentioned in chapter one. Not included in the *Diatribe*, they were widely known through correspondence in the late 1650's and the *Philosophical Transactions* in the early Restoration. When Wren injected that particular emetic into a vein of a dog in 1656, the animal vomited to death.[41] So much, O'Meara seemed to be saying, for the Oxford way with the blood.

When Richard Lower, then thirty-four years old and Willis's assistant for many years, prepared his *Vindicatio* in 1664/5, he wasted little effort on the niceties of learned controversy. The "utterance" of O'Meara, for instance, was "as of a little frog from the Irish bogs..."[42] What Lower's text contains besides invective, however, is a general defense of the Oxford work of the 1640's and 1650's. For our purposes here, however, it is only necessary to note that Lower did not apologize for what might be termed the "basic science" aspects of Oxford physiology. Going on the offensive, he knocked O'Meara for not understanding that Willis's work on blood and fever was not about improving therapy, but rather about improving knowledge and understanding. While Willisian "pyretology" had greatly increased understanding, Lower acknowledged that "the practice of medicine is altered little or nothing by (Willis's) doctrine."[43] Much the same might be of Oxford (and London) work on the blood in general in the 1640's and 1650's. It was only in the Restoration, when the experimental technique of injection became (for a brief time) the promising therapeutic technique of transfusion, that mid-century Oxford investigators identified their work as having a

practical benefit. Prior to that, they were content, as Lower put it, to attempt to see "that the causes of diseases are better understood..."[44] In this section Lower also made his first defense of Willis's use of empirical remedies, noting that "remedies approved by experience" were "nearly all empirical at first."[45]

Described by Henry Oldenburg in the *Philosophical Transactions* as "a very Ingenious and Learned Treatise,"[46] Lower's defense of Willis and Oxford may have hastened his award of Oxford degrees as bachelor and doctor of medicine.[47] However, it, too, received a number of critical responses. O'Meara's fellow Irishman and possible junior assistant, Conlan Cashin, published *Willisius Male Vinicatus sive medicus Oxoniensis mendacitatis et insitae detectus* in 1667. Repeating O'Meara's arguments for the most part, Cashin also criticized Willis and Lower's use of medical authorities. Angry that Willis had ignored Hippocrates, and Lower treated with contempt Hippocrates, Galen, and Avicenna, Cashin was most critical of their use of Paracelsus and van Helmont and medical chemistry in general.[48]

B. Blood versus brain

Perhaps the strongest contemporary learned challenge to the "neurocentric" woman --and an indication of its power to deflect received opinion--was provided by Nathaniel Highmore (1613-1685), an Oxford-trained physician who knew Willis from student days. As noted in previous chapters, Willis received considerable criticism in England for his studies on the blood. Also, as I will discuss in a subsequent section, his neurological assertions were criticized strongly in France by Niels Stensen. What distinguishes Highmore's attack from others is two-fold. In the first place, he came from the same professional circle as Willis. Secondly, in common with

George Thomson, but unlike most of Willis's critics, Highmore not only attacked Willis's ideas but also put forward his own pattern of bodily organization. Unlike Thomson, however, or, for that matter Willis's other major critics, Highmore was very much a part of the Oxford physiological community in its early days.

The son of an Anglican minister, Highmore was educated in medicine at Oxford in the 1630's and remained there until about 1650, after which he practiced in Dorsetshire.[49] Befriending Harvey in Oxford in 1646, Highmore collaborated with him on anatomical projects until the latter left in 1650. As a result of these efforts, Highmore published two books in 1651. The first, which was prepared in the mid-1640's, was an illustrated *folio* that sought to unite anatomy and physiology within a Harveian paradigm.[50] Emphasizing the violent motion of the blood in cardiac systole, Highmore also took pains to establish the particulate nature of the blood, a belief Harvey never held. The illustrations were based on Vesalius. Highmore's other early book, the *History of Generation,* pushed the concept of the particulate nature of the blood even farther. He also used a microscope to discover that, in contrast to Harvey's views, the heart of a chick embryo did appear as early as the blood.

My point in recounting these early works is not so much to begin a biographical sketch of Highmore as it is to point out that he was well-versed in the latest physiological knowledge and technique. Indeed, in the *Disquisitio* he makes reference to a human post-mortem in a manner that suggests he performed it with either Willis or Ralph Bathurst.[51] Also, although Highmore was loyal to Harvey and may be considered as one of his chief students, his early work indicates that the student was capable of establishing independent positions.

Highmore published twice on hysteria and hypochondriasis, first in 1660, and then in response to Willis in 1670. The former may have stimulated Willis to consider hysteria to the extent he did in the *Pathology*, for he makes several references to Highmore and his arguments. Highmore's 1670 defense and attack was promptly responded to by Willis, who published a rebuttal later in 1670. Highmore's fullest account is given in the publication of 1670, which ran to approximately 10,000 words in Latin. It is that document, which was titled *De passione hysterica et affectione hypochondriaca*, which will be considered here.[52]

One of the more ironic aspects of Highmore's effort, which was written in the form of a published letter to Willis, was his use of chemical explanations, such as fermentation, which had been originally promoted in Oxford by Willis, to enhance the role of the blood at the expense of the nerves. Similar to his treatment of Harveian circulation theory, Highmore accepted Willis's early theories but shifted their meanings subtly. For example, Willis had talked about fermentation as a gentle heat in the 1650's. Particles caused the blood to "ascend" in the heart; the circulation made it go around. Violent imagery, such as the "explosive copula" of muscle contraction, were generally reserved to actions that involved the nerves.

In contrast, Highmore used the rhetoric of fermenting blood, but attempted to employ it to stand Willis's arguments on their head. For Highmore, fermenting blood behaved with violent and unceasing motion. As long as this circulation was "regular", it would not cause "any of the parts to swell beyond what is natural."[53] However, when it was blocked or underwent a chemical change because of some introduction of "matter," the blood would go "into a frenzy." Hysteria was a consequence of the blood's "rushing more violently into the lungs."[54] Fermenting blood "swells

exceedingly"; it emits "flatulence"; it "boils up."[55] It was this physical expansion of the blood which led it to fill the lungs' vessels and then obstruct them, thereby causing a sense of suffocation. The evidence offered was an analogy to "new beer"; Highmore did not offer any "experimental" proofs.

In Highmore's account the nerves, far from controlling affairs, were secondary. In many ways they just did not have the same large capacity as the circulating blood. The blood, after all, was a "general treasury, quite full, from which all the costs and expenses could be defrayed for the needs and requirements of the whole body."[56] The nerves by comparison were narrow. Furthermore, in talking about them Willis had failed to show that the transmission process on which his theory of brain pre-eminence depended--nerve secretion of the nervous juice--actually occurred. As Highmore pointed out, in the Willisian *schema* the nervous fluid "is always invisible."[57] If this juice were so important, why could not one see it? Furthermore, it seemed "improbable" that such a nebulous fluid would have the function of nourishment of such important organs when "lesser" organs were supplied with an "ocean" of "magnificent and rich" blood.[58] When actual nerves were severed, so much fluid poured out that "it is impossible for a continuous amount to be supplied by the brain."[59] Even though it was almost colorless, Highmore believed that fluid derived from arterial blood.

What was not present in Highmore's treatment of women's physiology and pathology in either 1670 or 1660 were two areas that loomed so large in Willis's work: the physiology of the soul(s) and the neurology of emotion. Highmore's one mention of the soul was in reference to the "control" of the "spirited elements" by the vital soul.[60] The only possible emotion mentioned was "depression," which was listed along with sighing, a sense of suffocation, and chest spasm as a symptom of hysteria.

What was discussed in considerable detail were the motions, membranes, and ligamentous connections of the chest and abdominal contents during an hysterical attack. Highmore did not view convulsions as a necessary component of hysteria or even as a consequence of nerve stimulation of the muscles. Instead, convulsions were described as the consequence of a mass effect of expanded and "violently" moving blood on visceral organs. In this sense, Highmore's hysteric patients--and by extension the healthy "Highmorean woman"--were almost completely body.

But they possessed a body different from that of the traditional womb-dominated constructions of humoral physiology. For one thing, Highmore ascribed the causes of hysteria to the blood alone. At least, references to the womb were minimal. Instead, Highmore provided patient anecdotes to indicate that the causes arose from inordinate fermentation secondary to hemorrhoids, external abcesses, and stomach pains.[61] Presumably a uterus that was not properly functioning, and therefore "blocked", would cause a fermentative storm to ensue in the blood, thereby driving it to the lungs, but Highmore did not make the point explicitly.

The visceral organ that *was* important to Highmore was the spleen. Protesting that "the spleen always gets a bad reputation,"[62] Highmore attempted to counter Willis's characterization of that organ, a characterization which was shared by Lower and other Oxford physiologists, that the main purpose of the spleen was to handle blood excrement. That excrement, in turn, could cause a blood dyscrasis which would harm the nerves and brain. Instead, Highmore argued, the spleen was responsible for "active ferment." The spleen provided a "conjoined, moderated, and proportioned heat" that permitted digestion to be "happily carried on."[63] Significantly, I think, Highmore made no reference to van Helmont. Indeed,

rather than anoint van Helmont's "duumverate" of stomach and spleen as the body's noble organs, Highmore attributed visceral bad behavior to the stomach.

One is left with the impression that, for Highmore, the circulating and fermenting blood and spleen were enough. One reference--the only attribution in the document other than ones to Willis--was made to Galen, but it was to Galen's theory of inflammation, not his physiology of emotions or convulsions. It was as though Highmore was creating his version of the elderly Harvey's belief that the soul was in the blood and then literally and metaphorically constructing fluid mechanics of the body based on little else. Yet it was not the "beast machine" of Descartes or Hobbes; Highmore made no references to machines. Of antique precursors, perhaps the greatest similarity of Highmore is to Democritus, whose atomism endowed spherical particles with a fiery soul as well as a mind.[64]

Despite Highmore's stated determination to "bring down and destroy" Willis's theory,[65] his references to Willis, and those of Willis to him, tended to be couched in polite terms: Willis was "the celebrated London Physician;" Highmore was the "most learned Highmore." Neither resorted to the scurrilous references that Willis, Lower, and others employed when attacking their non-Oxford critics. Reviewing the controversy, the *Philosophical Transactions* declined to take a position, but instead encouraged the reader to "finde the best satisfaction in perusing the Writings themselves of both parties."[66]

The mutual politeness of the exchange as well as the Royal Society's demurral regarding preference prompts me to offer two interpretations of the controversy. The first rests on the fact that Willis and Highmore were both established members of the medical elite, albeit practitioners in different

venues. Just as O'Meara had been unhappy that Willisian theory undercut the importance of phlebotomy in the treatment of fevers, Highmore was concerned that the doctrine of the nerves under cut his treatment rationale of phlebotomy for hysteria. For Highmore, phlebotomy in hysteria was a "forced aggression" that "often succeeded." Why then did Willis denigrate him and other physicians who relied on phlebotomy when they "really wanted to help?"[67] In short, at one level the dispute may have been little more than an effort by both parties to differentiate themselves in a expanding medical marketplace.[68]

More importantly, I think the controversy helps support a larger claim that physiological explanations of what was considered a common cause of unreason were by no means settled in the seventeenth century. The "neurocentric" model of unreason deflected medical theory regarding women, but it did not achieve hegemony. The nerves, in that sense, may not have come into their own until the eighteenth century.[69] Contemporary physicians were not only divided among themselves, but even those sympathetic to Willis's neurology often held views which were internally inconsistent. The casebook of his surgical collaborator, Edmund King, for example, included entries on 277 women from 1676 to 1696. Of these, nineteen were described as hysterical, with sixteen of them carrying hysteria as the primary diagnosis. Six women complained of fits, but only one of a sense of suffocation. Two had fevers and one a renal calculus. Only two were noted to be emotionally upset. Moreover, an autopsy on one of them, Lady Clynton, who had experienced fevers and pains as well as a "violent hysteric fit", the recorded abnormalities were all in the viscera. Others who did have "violent fits" but no emotional distress and a fairly obvious organic cause were not labeled hysteric.[70]

The Stratford-on-Avon diaries of John Ward, an Anglican divine and physician who was acquainted with the Oxford physiologists from their student days together, reinforce the impression that multiple explanations might be held by one person regarding a particular clinical situation. Ward's entries, which span twenty-five years, included a grab-bag of interpretations of hysteria including those of Highmore, Willis, Sennert, Bartholin, Culpeper, and others. Noting at one point that a physician which could "cure ye minde...deserves" to have his name "blowne up" in fame, Ward nonethless remained uncertain regarding the etiology of women's emotional distresses as well as hysteria.[71] For instance, although he believed that problems in the sixth cranial nerves "may be a cause of many headaches and distempers of ye brain," he also thought that "there is nothing better for a married woman in case of suffocation of ye matrix than for her husband to annoit ye topp of his yard (penis) with a little oil of cloves...and so ly with her for this will assuredly bring down ye matrix againe."[72]

Willis was an optimist regarding therapy for people troubled with hysteria. For one thing, his treatment regime--notwithstanding Highmore's protestations to the contrary --included all the traditional learned standbys of purgings, clysters, vomits, and phlebotomies. The difference was one of emphasis: Willis cautioned that all these should be "gentle", and his bleedings were often at the neck instead of the loins. Willis's preference for "gentle" regimes did not go unnoticed by his contemporaries, a fact which suggests that what seem today only nuances of therapy may have had more significance in the period. Ward, for example, contrasted Willis's "very gentle" purges with those of another physician.[73] Willis also added "Cephalic and properly anti-convulsive medicines." These included steel medicines (for strength) as well as the root of the male paeony.[74] In keeping

with the tradition of learned medical advice regarding the regulation of the body's non-naturals, additional suggestions were proffered on an individual basis regarding diet, rest, and exercise.

Willis ignored the issue of therapeutic venery. In this regard he may have been only a more faithful observer of his patients' lifestyles: In contrast to the theoretical attribution of high risk of hysteria to virgins and widows, extant case records and women's recipe books indicate that most of the sufferers were married women who were often pregnant.[75] Worth noting, however, is Lawrence Stone's calculation that the percentage of unmarried women in those groups rose from ten per cent in the sixteenth century to nearly twenty-five per cent in the period 1675-1799.[76]

III: Empirical Challenge

A. Thomas Sydenham (1623-1689), John Locke (1632-1704) and the rise of learned empiricism

In a sense, Willis (1621-1675) and his great patron, Sheldon (1598-1677), died at the "right time." In their emphasis on the importance of explicit hierarchies, whether physiological or ecclesiastical, both represented a cultural vision that had reached its fullest expression at the height of their respective careers. Both believed in a professional order and an order of knowledge which were increasingly challenged by liberal movements in religion and politics, and by empiricism in natural philosophy and medicine.[77]

In this section I want to consider the rise of empiricism in late seventeenth century medical theory in relation to what immediately preceded it: the "rational" investigative methods and physiological theories that have been the subject of this thesis. Whereas Willis and the Oxford

physiologists had looked to reason, experiment, anatomical investigation, and reasoned experience (including clinical correlation) for understanding healthy and sick bodies, Sydenham emphasized experience alone. Indeed, what is remarkable is the thematic consistency in attacks on learned medicine during the period from 1650 through the 1690's. In criticizing learned medicine for its elitism, excess learning, and monopolistic practices, Nicholas Culpeper, writing in the 1650's, was not so very far from the Sydenham of the 1670's and 1680's who privileged "old womens experience (rather than) learned mens theories."[78]

Neither Culpeper nor Sydenham had patience with a "rational" medicine that presumed to establish cause. Indeed, for Sydenham, nature was "an abyss of cause."[79] In language that initially echoed Willis's, Sydenham described the brain as an example of the "method of the Supreme Artificer in his wondrous and wise machinery." Anatomists, however, were incapable of achieving an understanding of it, for "no diligent contemplation of its structure will tell us how so coarse a substance (a mere pulp, and that not over-nicely wrought), should subserve so noble an end."[80]

According to Sydenham, man had been shaped by God so as to perceive only the superficial aspects of reality, the "outer husk of things."[81] (Interestingly, "husk" was a contemporary trope for the nominal reality that alchemical fire would burn through to reveal the "kernal" of truth.[82]) The metaphor for true knowledge was no longer mathematics but botany: "It is necessary that all diseases be reduced to definite and certain species and that, with the same care which we see exhibited by botanists in their phytologies."[83] Moreover, by the later part of the Restoration, society's upper reaches also embraced empiricism in preference to university learning. The aristocratic sons who had flooded to Oxbridge in the 1640's and 1650's were in

the 1680's sending an increasing proportion of *their* sons and grandsons to London to study finance and law.[84]

In view of his historical *persona* , established in the eighteenth century and repeated by subsequent generations, as the next major figure *after* Harvey and the Oxford physiologists--Sydenham as an "English Hippocrates," the first English physician to accurately describe several disease states[85]--it may come as a surprise to realize that Sydenham (1624-1689) was almost an exact contemporary of Willis and his colleagues. Moreover, what university training he possessed had been acquired at Oxford in the 1640's and 1650's when the physiologists were most active.

Even when this is openly acknowledged, sympathetic modern biographers, such as Kenneth Dewhurst, have portrayed Sydenham and his thought as though they represented a spontaneous and independent approach to medicine.[86] In these portrayals, Sydenham becomes the first modern figure to reformulate Hippocratic approaches to disease in line with Baconian "natural history." Alternatively, Sydenham is described the spiritual ancestor of modern epidemiology. In the sense that he failed to acknowledge influences other than Hippocrates and the desire to do "natural history" of disease, Sydenham presented himself in much the same way. This tendency to dissociate Sydenham and his thought from the context of his background has been compounded in the most recent major account of the development of his thought provided by Donald Bates, whose doctoral dissertation was concerned with the chronological development of Sydenham's thought rather than the historical context of that thought.[87]

Amplifying these historical distortions is the fact that Sydenham's thought, though beginning to be influential in the College of Physicians in the late 1680's and 1690's, did not become *really* influential in England and

Europe until "theory-free" medical writing (and Lockean medical empiricism[88]) came into vogue in the 1750's.[89] The effect of these characterizations has been to present Sydenham--and the empiricism he championed--not only as "theory-free," a characterization which may be transmuted easily into "value-free," but also as lost somewhere in time between the middle of the seventeenth and the middle of the eighteenth centuries.

Such a portrayal renders Sydenham suitable for taking on the mantle of hero, an historical posture he assumed only in the eighteenth century, and then from a Whig culture infatuated with empiricism and "value-free" thought. Not that such treatments were confined to Sydenham. By the middle of the eighteenth century, the herbals of Nicholas Culpeper, the Interregnum medical popularizer and social critic mentioned earlier, had evolved from their cheap black-and-white octavo editions of the 1640's and 1650's to colored folios in which the author was described as "Gent.". Such portrayals continued into the nineteenth century. In 1861 William Munk, chronicling Sydenham in his history of the College of Physicians, explained away Sydenham's failure to gain full entrance into the College as the consequence of a glitch in the by-laws rather than as it was, an expression of very real Collegiate opposition to Sydenham's political views and emphatic empiricism.[90]

Thus, in terms of the relevant historiography, it is as though Sydenham and his empiricism and the Oxford physiologists and their approaches, though existing chronologically in the same time and, more or less, the same space, were ships passing in the night.[91] I want to take a different approach here. In the first place, it seems to me that one cannot divorce the medical approach of Sydenham--Parliamentary soldier, son of a

father who was an (conservative) Independent colonel and member of Parliament and a mother who was killed by Royalist soldiers[92]--from that of other notable champions of empiricism, such as Culpeper and Noah Biggs. We find the vicar/physician John Ward, for instance, recording as a student the young Sydenham's view in the 1650's that one might "as good send a man to Oxford to learn shoemaking as practicing physick."[93] Moreover, as suggested in the opening paragraphs of this chapter, Sydenham never departed significantly from these views.

Yet if the foregoing is true, it is not the whole truth or even, perhaps, its most important aspect. Sydenham and the empiricism he and his collaborator Locke espoused are most often described as the leading developments in English medicine in the later seventeenth century. Yet it would be wrong to describe the situation between empirical and rational medical viewpoints in the manner of Sydenham--as an either/or--a clash of incommensurable epistemological premises--just as I have argued in previous chapters that the dichotomies between mechanism and vitalism in Oxford physiology have been over stressed by historians. In the first place, in the hands of some physicians, learned empiricism regarding therapeutics was quite compatible with anatomical investigation and experimentation. Indeed, Willis had promoted just such a posture for learned physicians in the preface to his *Rational Therapeutics* of 1675. Among elite physicians, this was probably the prevalent view. Despite the increasing appeal of Sydenham's empiricism to English physicians, it is worth remembering that Willis's *Rational Therapeutics* outsold Sydenham's *Observationes medicae* (1676) until long after Sydenham's death in 1689.[94]

B. How learned does medicine need to be?

Key to an understanding of Sydenham's outlook is apprehension of his views on the epistemological value of anatomical investigation. Upon the death in July 1680 of Lord Ossory, for example, four of the five physicians who attended him in his final illness--a group which included Richard Lower and Marchmont Needham in addition to Sydenham--signed the post-mortem. Sydenham, however, declined to attend.[95] In a manuscript that has been attributed jointly to Locke and Sydenham, the case was made for the benefit of a limited knowledge of anatomy:

> "Anatomie noe question is absolutely necessary to a Chirurgen and to a physitian who would direct a surgeon in incision trepanning and several other operations....But that anatomie is like to afford any great improvement to the practice of physic, or assist a man in the finding out and establishing a true method, I have reason to doubt. All that Anatomie can doe is only to shew us the gross and sensible parts of the body, or the vapid and dead juices all which, after the most diligent search, will be noe more able to direct a physician how to cure a disease than how to make a man..."[96]

The fact that the bulk of the "Anatomie" cited above is in Locke's handwriting merits some comment. According to Dewhurst, Locke met Sydenham in 1667 when the former left Oxford for London to serve as physician to Lord Ashley Cooper (later created the first Earl of Shaftesbury and active in Whig political circles in the 1680's). During the period of Locke's and Sydenham's most intense association--1667-1672--the two visited often, and Locke accompanied Sydenham frequently on consultations. Importantly for Sydenham's reputation, Locke promoted the virtues of his friend's views

actively to medical people he met on the Continent--especially in Holland--during his extensive travels/exiles in the 1670's and 1680's.[97]

For Locke, who had been interested in iatrochemistry at Oxford and a lecture student of Willis's, the association with Sydenham seems to have sharpened his caution regarding *all* medical theories. Writing in 1692/3 to Dr. Thomas Molyneux, for example, Locke stated that he could say "nothing" regarding Sydenham's "late book of *Fevers*" because he had not yet read it. Nonetheless, he could say that, regarding the "Phenomena of Diseases and the Cure of Them," Sydenham's emphasis on "observ(ation) of History of Diseases" formed "a better Way" than "that Romance Way of Physick" that had been practiced by Galenists, Helmontians, or "Chymists."[98]

Adding to medicine's epistemological conundrums were the increasingly prominent claims by the champions of empiricism that medicine should be content to remain an *art* and not aspire to be a *science.* Sydenham, for one, mentioned the term only once in reference to medicine in his extant writings.[99] The mature Locke, who in his student days and up until his thirties had attended many anatomies and vivisections, despaired of certain, or *scientifical* knowledge of "natural bodies", a category that included all forms of unprocessed matter. Try as we might, we could not even know "so much as their very outward shapes, or the sensible and grosser parts of their constitutions."[100] Locke also did not use the term *science* in connection with medical knowledge.[101]

But then neither did Robert Boyle. The fact is that the epistemological value of the anatomical method to medicine was regarded ambiguously by a number of influential people in mid-century, including Boyle. In common with many clerics and members of the gentry, Boyle had an amateur medical practice of sorts. Not only did he, as did they, treat and consult on patients, he

also regularly experimented chemically, pharamacologically, and physiologically.[102] The bulk of this work was directed toward improving therapy through chemical medicines.

And in therapy, knowledge of cause did not count for much. What mattered was effect: "Why should we hastily conclude against the efficacy of specifics, taken into the body, upon the bare account of their not operationg by any obvious quality, if they be recommended unto us upon their own experience by sober and faithful persons?"[103] One of Boyle's major medical projects was his attempt to improve "Butlers' stone," a metallic compount promoted by van Helmont for its "specificall vertues" in curing a variety of ailments.[104] Yet he did not pretend that his "Butlers stone" or another substance, "Boyle's red powder," represented science, or certain knowledge.

Behind this preoccupation with improvement in therapy as the main goal of medical research lay the premise that efforts which were not *immediately* directed toward therapy were of lesser importance in medicine. Chief among these was anatomy, which Boyle believed would require a "process of time" before its *"historia facti"* would be "fully and indisputably made out" so that the resulting "theories" would have sufficient form to "highly conduce to the improvement of the therapeuticl part of physick.."[105]

If Willis and his colleagues, as well as Sprat[106] and many others were more confident, Boyle's sentiments were shared nonetheless by a number of prominent laymen. Edward, second Viscount Conway, was impressed by Harvey's *De motu cordis;* it was a "masterpiece." But this did not mean that Harvey was the best physician. The problem was that the anatomical work might be too hypothetical. He was concerned that Harvey was "to(o) much, many times governed by this Phantasy" (of anatomy). But anatomical

knowledge might not help the physician guide the "ship" safely through the "storm" of disease.[107]

In the view of Locke and Sydenham, the fact was that sense impressions, the basis of all knowledge according to Locke, were often faulty.[108] Even if perceptions were consensually validated, they probably did not penetrate to the cause. Regarding knowledge of "particular external objects," humans might have "three degrees of knowledge, viz. intuitive, demonstrative, and sensitive; in each of which there are different degrees and ways of evidence and certainty."[109] The problem with anatomical knowledge was two-fold. Not only was extensive knowledge of the body's interior not useful to a physician--a viewpoint I will take up in a moment--but the sense of the human body that could be obtained by medical investigation provided only a low order of knowledge. Even when human sense was amplified by the microscope--an instrument praised by Willis and his colleagues as helpful in the search for *cause*--knowledge of structure was too uncertain to lead to knowledge of operation:

> "For after all the fine discourses of the...changes he supposes to be the cause of this or that disorder in the body, it is certainly something more subtle and fine than what our senses can take cognizance of that is the cause of the disease, and they are the invisible and insensible parts that govern preserve and disorder the oeconomie of the body....Hence a fright which causes such diseases a as epilepsy, hysterical fits, and fatuity often cures others...and 'tis probable in these cases 'twould puzzle the quickest sighted anatomist, assisted too by the best microscope to find any sensible alteration made either in the juices or solid parts of the body."[110]

Since the value of such knowledge was low, it could not aid practice. Therefore the physician should not devote great effort to its study:

> "The laborious anatomist I will not deny knows more, but not more to the purpose, for if he cannot come to discover these little difference which preserve health or make a disease, if he cannot possible see how nature prepares those juices...he may perhaps be the better anatomist by multiplying dissections, but not a better physician, of poreing and gazeing on the parts which we dissect without perceiving the very precise way of their working is but still a superficial knowledge..."[111]

This left the physician treading the epistemological low road. Since the only knowledge we could have of the "Constitution of Health and the Operations of our own Bodies" was by "sensible Effects," there was "nothing left for a Physician to do, but to observe well, and so by Analogy argue the like Cases, and thence make to himself Rules of Practice".[112] These would not have the status of "Philosophical Truths to a Naturalist", but they might serve as an heuristic device--"artificial Helps"-- for the physician.

In a sense, Locke and Sydenham used the physiology and pathology of mind provided by Willis and his colleagues to turn the arguments of the Oxford physiologists for a high epistemological profile for learned medicine on their heads. Had not they explicated just how fragile and problematic the sensory operations of the nerves and brain were? Furthermore, by so firmly fixing "the secret places" of mind to brain--by making understanding limited to fallible organic operations--it can be argued they had rendered their epistemology vulnerable to just the sort of attack on the limits of medical *science* that Locke and Sydenham launched.

In this sense the empiricism of Sydenham and Locke represented a departure from the mid-century criticisms of the "new" philosophy by

Webster, Culpeper, the Levellers, and the radical empirics. Their reservations, unlike those of the Levellers, was not fundamentally about the social inutility (and injustice) of the professional medical (and religious and legal) hierarchy. Indeed, both Sydenham and Locke found their medical--and occasionally literal--homes in caring for the Whig aristocracy and gentry. Sydenham *wanted* full entry into the College of Physicians; Locke maneuvered for lucrative government posts and investment opportunities.[113] This shift in the political content of late seventeenth century medical empiricism reflected, I think, a broader cultural shift among literate Englishman of diverse religious belief away from a desire for broad-scale political reform to a quest for modest private improvements. For instance, unlike the millenarian Puritan reformers of the 1640's and 1650's, Anglican millenarians in the Restoration did not intend the prospect of a final Judgment to hasten the reform of social injustices.[114] Rather, their millenarianism was limited in its social ambition.

Although Sydenham characterized himself in terms that Culpeper might have used in self-description--as "dedicated to the welfare of the public"[115]--he made his arguments against anatomically based medicine solely in epistemological terms. At least he was quite clear that he was not writing popular texts for a lay audience. Complaining about the practice of prescribing "heating" medicines in pleurisy, in the *Methodus* Sydenham specifically criticized "certain women of rank" for the practice. Instead of practicing medical care, such women "would be better employed in feeding the poor than in physicking them."[116] Furthermore, Sydenham followed learned medical convention by publishing in Latin (with the help of Locke), joining the College, and attempting to merge with (and deflect) the mainstream of elite medical thought.

In regard to knowledge of nature--particularly that of natural bodies--cause was not only unknowable by definition, but also such knowledge was not useful in the practice of medicine. In a passage from the 1666 edition of the *Methodus* that may well have referred to Willis directly, Sydenham specifically eschewed interest in medical philosophy or etiology:

> "For my own part, I am not ambitious of the name of a Philosopher, and those who think themselves so, may, perhaps, consider me blamable on the score of my not having attempted to pierce into these mysteries. Now writers like these I would just recommend, before they blame others, to try their hand upon some common phenomena of Nature that meet us at every turn...Aetiology is a difficult, and perhaps, an inexplicable affair; and I choose to keep my hands clear of it."[117]

It is important to note that such a posture left Locke and Sydenham, as well as the empiricists who have existed before (and since), in a curious position regarding the architectonics of the body. By declaring anatomy and experimental physiology as being of little value, learned empiricists as well as their unlearned empirical colleagues set *themselves* up as vulnerable regarding the contours of their own knowledge base in two significant ways. In the first place, having given up any significant claim to knowledge of the body's interior or operations, their posture left them dependent on the anatomy and physiology of others.

In the Interregnum, this can be appreciated most clearly in the works of popularizers like Culpeper, whose own works as well as his amended translations of Galen, Rivierus and others were completely derivative in their physiology. But then Culpeper and his collaborators had made no pretensions beyond popularizing common medical knowledge. Like the other radical empirics, he did not present himself or empiricism as a learned

form of knowledge. Instead, he wanted to re-fashion and edit traditional learned physiology and therapy so that readers could treat themselves.

So, too, was Sydenham was left with a physiology--and hence a body--both limited in scale and wholly derivative in content. In discussing the etiology of hysteria, for example, Sydenham drew on many different physiological traditions. [118] Nerves, fibres, spirits, and muscles all played a role, and the behavioral phenomena might represent physiological interactions that sounded by turns Willisian, Galenic, or Helmontian. If this syncretic approach reflected the skepticism of the empiricists (and empirics) about the value to medical practice of *any* physiological system--even one as open-ended as that of the new physiologists--it also reflected their belief that medical knowledge of *real* value was gained through experience alone, and not experiment. But experience of what?

C. No body but a constitution

For Sydenham, the overarching biological and medical concepts became the "species" and the "constitution". Both terms were used heuristically (and often non-specifically) to categorize fevers and their effects on humans. The physician's *diagnostic* task became one of recognition of patterns of interaction between kinds of fever and constitutional factors in the atmosphere and humans. Although the term "species" was not employed until his later work, the *Observationes medicae...* of 1676, already in 1666 Sydenham described fevers, particularly the frequency of fits in tertian an quartan fevers, in species-like terms. The differentiating factors of a particular fever might be unknown and among nature's secrets, but they possessed stable differences of timing, phases, and stages.[119] Although Sydenham used "constitution" in a few places in a limited way to refer to an individual's

conformation, age, sex, and general health, much more commonly he used the term to refer to those conditions which made fevers appear in large numbers at certain times from year to year.[120]

If the use of the term "constitution", and particularly "epidemic constitution," recalled the Hippocratic writers books on epidemic fevers--a connection Sydenham acknowledged--his characterization of disease--a broader cluster of conditions in which fever enjoyed a prominent but not exclusive role-- represented a synthesis of approaches drawn from Paracelsian and Helmontian notions of disease as an invading *It.* Sydenham, however, did not acknowledge this connection. Nonetheless, in a manner similar to alchemical characterizations of disease as an alien force that molested parts of the body by dominating their particular *Archeus,* Sydenham spoke of hysteria: "Few of the maladies of miserable mortality are not imitated by it. Whatever part of the body it attacks, it will create the proper symptom of that part."[121] The description was secular in tone--the machinery of the *Archei* has been discarded--but the image of invasion and the ontology of hysteria as a thing-in-itself has been preserved. "It" frequently attacked the head, at which time it caused an "apoplexy", and "it" was almost invariably associated with a sinking of the spirits, which was why afflicted women pointed to their chests. "It" could also "take possession of the external" parts, such as the muscles of the jaws, shoulders, hands, where it "sometimes caus(es) pain, sometimes swelling."[122]

Similarly, in the context of fever, Sydenham often resorted to portrayals of febrile diseases as being the consequence of the interaction of an alien something with the blood. In these dramas, the blood behaved very much like the molested *Archeus* in the Helmontian and Paracelsian conceptions discussed in chapter one. Writing in 1666 in the *Methodus,*

Sydenham described the situation of an initial encounter between fever and blood as follows:

> "...the febrile matter which...has been imperfectly assimilated dilated with the volume of the blood, has become, not only useless, but inimical to Nature whom it frets and vexes. She, on her part, stirred up by what we may call a natural sense, and planning, as it were, an escape, creates a shivering and a shaking throughout the body, as the evidence and the measure of her aversion."[123]

D. Therapeutic consequences of the uncoupling of investigation and therapy

Such a simplistic physiology did not mean that Sydenham or his followers in the eighteenth century necessarily promoted mild treatments. Indeed, although he had a very different therapeutic program than the Helmontians did for fevers, Sydenham was no less aggressive in his approach. However, whereas they had eschewed bloodletting and promoted vigorous bowel evacuations through administration of large doses of vomitives and purgatives, phlebotomy was a mainstay of Sydenham's therapeutics. Given that the goal of fever treatment was to return the blood from "ebullition" to its normal state, one must bleed as much as necessary.[124] One administered vomitives and cathartics as needed, depending on the patient's history of evacuations, but one almost always bled, and generously. Describing the appropriate treatment for pleurisy, for example, Sydenham recounted that he "seldom abstain(ed)" from drawing blood until the amount equaled "forty-two ounces or thereabouts."[125] Given that the normal human blood volume is twelve pints (192 ounces), such a phlebotomy must have had a significant physiological effect. Sydenham acknowledged as much by

cautioning the physician to ascertain in advance of treatment "the patient's strength."

My point in recounting this anecdote on therapeutics is not to indict Sydenham but to suggest that the uncoupling of learned medicine from its "new" mid-century core disciplines of investigative anatomy and physiology had significant implications for therapy. In the case of the treatment for pleurisy, for example, what mattered, finally, was not the body as such, but only the blood as it was affected by fever. In this sense, a significant check on therapeutic aggressiveness--apprehension of the body as a physiologic totality--had been lost.

E. Locke's Mind and Willis's Brain

The unacknowledged presence of Willisian neurophysiology is particularly striking in the work of the mature Locke. Even though biographical evidence as well as the passages cited above from the Locke/Sydenham "Anatomie" of 1668 support the notion that Locke changed his allegiance from Willis (and most of what he stood for medically) to Sydenham and empiricism in the late 1660's and early 1670's, the sections on the physiology of mind in Locke's *magnum opus* of 1690, *An Essay Concerning Human Understanding*, contain a high proportion of Willisian thought.

In this sense Locke, who derided the value of anatomy and regarded philosophical speculation on the soul as "gibberish,"[126] was one of the first--as well as the most influential--of those medically informed writers publishing after the Oxford physiologists to make use of the neurocentric paradigm while dispensing with the major epistemological assumptions of its originators. Locke's famous description in Book I of the *Essay* of the mind as

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an "empty cabinet," or *tabula rasa,* which at first takes in only simple ideas based on sensory impressions, for example, was first recorded in his notes from a lecture he attended by Willis on sense in 1664.[127]

In writing on the function of the mind in the fourth edition of the *Essay,* Locke opined, much as had Willis in the *Anatomy,* that "habits of thinking" as well as "motions of the body" were but "trains of motions in the animal spirits, which, once set a going, continue in the same steps they have been used to....this may serve to explain their following one another in an habitual train...as well as it does to explain such motions of the body".[128] Immediately after this section, which follows quite closely Willis's exposition in the *Anatomy* of the relation of the intercostal nerve and the viscera, Locke used the example, just as Willis had in the same place in his lecture (as well as in the *Anatomy*), of the musician's ability to play by memory as an indication of the habitual motion of the animal spirits.[129] Whereas Willis presented these speculations as fact, however, Locke was careful to qualify them: "Whether the natural cause of these ideas....I will not determine, how probable soever, by this instance, it appears to be so."[130] Even though the mature Locke barely mentioned the brain in his long exposition of mind, when he did so, the physiological concepts almost without exception came from Willis.[131]

IV: Continental Challenge

Skepticism regarding the ability of the anatomical method to deliver certain knowledge seems to have been more present in late seventeenth century England than on the Continent. One of the more rigorous critiques of Willisian anatomical practice was provided by the peripatetic Danish anatomist, Niels Stensen, or Steno. Speaking at the Parisian salon of

Monsieur Thevenot in 1669, Steno spoke on the subject of brain anatomy in general and specifically on the work of Willis and Descartes. The influential lecture was reprinted in several editions running into the 1730's.[132]

Whereas Sydenham and Locke had criticized anatomy on the dual grounds of its minimal utility in medicine as well as the unreliability of its sense information, Steno reserved his fire for procedural problems in medical research generally. But unlike the English empiricists, he did not give up on the promise of anatomy to deliver certain knowledge or medicine to become a science. I mention his remarks briefly here in the context of emerging English skepticism because they anticipate the divergence which occurred in the early eighteenth century between English *medical* investigation and that on the Continent. Whereas the investigational practices that we have discussed in previous chapters declined markedly in England in the period 1680-1730, they flourished in diverse places on the Continent, most notably in Leiden. Whereas the Oxford physiologists had worked on a high proportion of "private" bodies, however, most of the Continental work, including almost all of the Leiden effort, was based on findings from either "public" bodies or deceased indigent patients from the civic clinics and hospitals.

Sounding much like the English apologists for the anatomical method such as Willis, Steno began his lecture by asserting that human and comparative anatomy would lead to better physiology, which would lead to better medical practice. He was confident that the "sure knowledge of anatomical parts" that dissection and illustration had the potential to provide. What was required was a "convincing certainty of dissections."[133]

The problem was not perceptual, however, but evidential: the "evidence of demonstration", which "whould oblige everyone else to agree to it", was often wanting. Brain dissections were "subject to so many errors."[134]

The problem was that the brain was literally so "soft" that it could be "molded" to fit the"systems" put forward by anatomists. Moreovers, brain "subsides after preparation, before the diagram is drawn." Willis and his colleagues had provided the "best diagrams to date," but even with them Steno found that "errors creep in here and there."[135] Furthermore, these errors were of a magnitude that made the truth of Willis's "hypotheses" not provable.[136]

Yet this did not mean that certain knowledge was not possible. Underlaying Steno's optimism in this regard was his confidence that the human body was a "machine," the operations of which could be known through knowledge of the forms and functions of its parts. But such a knowledge would only come into formation when research was properly organized. Thus, even though "almost all the new discoveries of the century" were "owe(d) to the "disection of animals," anatomy would never provide certain knowledge unless it was the product of a team of investigators who had the leisure to develop the proper methods without the distractions of patient care or of public demonstrations.[137] If that were the case, "all antomists would deomonstrate these things in the same fashion, if they used the same method"; the interpretive "systems" which resulted would be capable of withstanding strong criticism.[138] In many ways, despite his criticisms of Willis (and Descartes), Steno's programmatic for a team approach based on anatomical and physiological investigation was not very far from the *ad hoc* behavior of the Oxford physiologists.

Conclusion

Putting Steno's comments aside, one of the common features of the criticisms recounted in this chapter is the tendency of their authors to

characterize subjects, such as anatomy or the value of empiricism, in binary terms. Either one is anatomical in approach (and therefore "rational," philosophizing, and beside the point therapeutically) *or* one is "empirical" (and, hence, practical, perceptually acute, and of some utility to patients). It was as though professional life was conceived as a "zero-sum" contest: any gain on the part of the anatomical method was at the expense of the natural history method. Furthermore, I would argue that such a tendency was not limited to learned medicine. Many of the sermons of the period from both Anglicans and dissenters have a quality of "you're either for us or against us."

In short, it seems as though contemporaries allowed for only a small middle ground. Furthermore, at least in learned medicine, the tendency to polarize ran through the Interregnum and Restoration. Granted, the use of critiques as sources amplifies whatever underlying tensions existed. One of the reasons for this tension was the ambiguity of early modern formations of bodily organ systems as well as the nature of matter. Moreover, ambiguity regarding the nature and place of bodily contents was amplified by an ambiguity regarding what constituted a biological fact. Also, the political and religious tumult of the period contributed to this tendency to "take a stand."

Yet underneath the layer of polemic, a less charged reality is visible. Willis, in fact, practiced many kinds of medicine, as did John Ward and many others. Indeed, as I pointed out in chapter one, Paracelsian remedies--mainly minerals and elements--had been an important part of English *materia medica* since early in the century. Empiricism, if not empiric, was not a dirty word, at least not to Lower, Willis, and their colleagues. Yet they, and Willis in particular, were attacked from all sides: he bled too much (the criticism of Thomson cited earlier); he bled too little (O'Meara and Highmore). Why was this?

In large part I think it reflected the successful effort on the part of the Willisians to establish a new center for learned medicine in a polarized time. Not content with more passive tradtional investigational techniques, they applied chemistry and Harveian methods aggresively to new problems and areas. Nonetheless, they did so without explicitly repudiating the intellectual, social, or therapeutic traditions which had preceded them. And that, I would suggest, is why, despite their personal and professional successes, they accumulated such a diverse batch of critics. It also accounted for the fact that self-proclaimed empiricists such as Locke borrowed from their theories--then the most up-to-date available--when it suited them.

The increasing respectability of empiricism in learned medicine reflects as well a gradual change in the nature of physician/patient expectations. Although it has not been a formal subject in this dissertation, the debates between physicians over the value of tradition, phlebotomy, medicines cheap or complicated, and other subjects suggest a subtle but persistent shift in doctor/patient discourse from holistic explanations and treatments to specific explanations and treatments. It is important to realize that both the "rational" approach of the Oxford physiologists as well the unapologetic empiricism of people like Sydenham fed into this. When Lady X talked with Willis or one of his colleagues about recurrent headaches, say, the chances were that the doctor formed a mental picture of her meninges as being in a certain pathological state. She had been abstracted, in part, to her lesion. Having learned this "rationally," the goal would then be to make the treatment "rational," or as specific as possible to the problem. By quite a different rationale, the empirical "natural historian" would catalogue the "specific virtues" of medicines for illnesses which had specific contours. Ironically, as with the "rational" approach, the result would be that the

patient would be abstracted into his or her "disease." In that sense, it is no wonder that the leading framers of these approaches occasionally went at it hammer-and-tongs.

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[1] For a background on utopian thinking in the period 1630-1660, see Charles Webster, *The Great Instauration*, (London: Duckworth, 1975), pp. 45-51.

[2] For a recent review of humanist influences in seventeenth century England, see Barbara Shapiro, "Early Modern Intellectual Life: Humanism, Religion and Science in Seventeenth Century England," *Hist. Sci.*, xxix (1991), 45-71.

[3] John Webster, *Academiarum examen, or the examination of academies*, (London, 1653), "Epistle to the Reader," p. B1. A facsimile of the original, together with the Ward/Wilkins response, is contained in Allen G. Debus, *Science and Education in the Seventeenth Century*, (New York: Science History Publications, 1970).

[4] Ward/Wilkins, *Vindicae academiarum*, op. cit., pp. 29-30.

[5] Webster, in *Academiarum examen*, op. cit., p. 106

[6] Ibid, p. 106

[7] Seth Ward, *Vindicae academiarum*, (London, 1654), p. 34

[8] John Webster, 1653, op. cit., p. 74.

[9] Ibid, p. 74.

[10] Ibid, p. 74.

[11] Ibid, p. 74.

[12] J. Andrew Mendelsohn, "Alchemy and Politics in England 1649-1655," *Past & Present*, 135, May 1992: 30-78, pp. 64-5.

[13] Webster, op. cit.., p. 76.

[14] Ibid, p. 106.

[15] Ibid, p. 34

[16] Ward, op. cit.,p. 34

[17] Ibid., p. 35

[18] anonymous, "News from the dead, or a true and exact narration of the miraculous deliverance of Anne Greene," (Oxford, 1651), in *Phoenix Britannicus*, (London, 1732), vol. 1, pp. 233-240.

[19] Ward, op. cit., p. 50.

[20] Ibid, p. 50.

[21] Ibid, p. 50.

[22] Edmund O'Meara, *Examen*, preface, A5. Kenneth Dewhurst, "Introduction," to Richard Lower, *Vindicatio*, p. xiviii, (facsimile, Oxford: Tempest, 1983)

[23] John Locke, *The Correspondence of John Locke*, ed. E.S. de Beer, (Oxford: Oxford, U.P., 1976), vol. 1, pp. 162-3. Cited by Kenneth Dewhurst in "Introduction", to Richard Lower, *Vindicatio*, ed. Kenneth Dewhurst, (Oxford: Tempest, 1983), p. xvii.

[24] Kenneth Dewhurst, *Willis's Oxford Lectures*, (Oxford: Sandford, 1980), p. 14.

[25] In my review of the Annals of the College of Physicians for the years of his membership (1665-1675), I could find only two mentions of Willis's attendance at meetings. He was admitted to the Royal Society in October, 1670, when he signed the register. There is no other record of his attendance at a meeting.

[26] O'Meara, op. cit., p. 100. Cited by Dewhurst, op. cit., 1983, p. xxiii.

[27] O'Meara, op. cit., pp. 54-5.

[28] Ibid., p. 7.

[29] Fortunius Licetus, *De motu sanguinis*, (Udine, 1647); cited by O'Meara, op. cit., p. 74.

[30] O'Meara, op. cit., p. 152.

[31] Ibid, pp. 36-7.

[32] On the problem of indeterminacy in humoral physiology and vivisection, see Jerome Bylebyl, "The Medical Side of Harvey's Discovery," p. 32-4 in Bylebyl, ed., *William Harvey and his Age*, (Baltimore: Johns Hopkins U.P., 1979).

[33] O'Meara, op. cit., p. 78.

[34] Ibid, pp. 59-60.

[35] Ibid., pp. 84-5.

[36] Thomas Willis, "Preface to the Reader," in *Rational Therapeutics*, (London, 1675)

[37] O'Meara, op. cit., p. 153.

[38] See Harold J. Cook, *The Decline of the Old Medical Regime in Stuart London*, (Ithaca: Cornell U. P., 1986), chapter 1, "The Medical Marketplace of London."

[39] Robert G. Frank, "The Physician as Virtuoso in Seventeenth Century England," (UCLA: Clark Library, 1979), p. 100.

[40] O'Meara, op., cit., p. 150.

[41] Christopher Wren, *Parentalia*, (London, 1750), p. 228.

[42] Lower, *Vindicatio*, p. 21 (Latin)/214 (English).

[43] Ibid, p. 2 (Latin)/215 (English).

[44] Ibid, p. 3 (Latin)/ 206 (English).

[45] Ibid, p. 2 (Latin)/205 (English).

[46] *Philosophical Transactions*, June 5, 1665, 1, pp. 77-8.

[47] Lower, op. cit., 1665, "Epilogue," by Kenneth Dewhurst, p. 292.

[48] Conlo Cassinius, *Willisus male vindicatus,* (Dublin, 1667); Cited by Dewhurst, "Epilogue," pp. 296-7 in Lower, op. cit., 1665.

[49] *Dictionary of National Biography,* ed. Leslie Stephen and Sidney Lee, (London: Smith, Elder, 1908), vol. 9, 829-830.

[50] Nathaniel Highmore, *Corporis humani disquisitio anatomica in qua sanguinis cirulationem prosequutus est,* (The Hague, 1651).

[51] Ibid, pp. 178-9; cited by Frank, op. cit., 1980, p. 100.

[52] Nathaniel Highmore, *De passione hysterica et affectione hypochondriaca,* (London: Robert Clavel, 1670). I will be relying on an English translation by Richard Trapp and myself.

[53] Ibid, p. 3.

[54] Ibid, p. 1.

[55] Ibid, p. 7.

[56] Ibid, p. 19.

[57] Ibid, p, 17.

[58] Ibid, p. 18.

[59] Ibid., p. 17

[60] Ibid, p. 20.

[61] Ibid, p. 4.

[62] Ibid, p. 35.

[63] Ibid, p. 27.

[64] For a summary of antique Greek conceptions of the soul, see Aristotle, *On the Soul,* bk. I, ch. 2, 405a-405b., trans. J.A. Smith in *The Basic Works of Aristotle,* ed. Richard McKeon, (New York: Random House, 1941).

[65] Ibid, p.p. 7, 16.

[66] *Philosophical Transactions,* 54, Dec. 13, 1669, pp. 1089-91.

[67] Highmore, op. cit., 1670, p. 5.

[68] Andrew Wear has argued that professional differentiation was virtually the whole point of learned disputes in seventeenth-century medicine. See his, "Medical Practice in Late Seventeenth and Early Eighteenth-Century England: Continuity and Union," in *The Medical Revolution of the Seventeenth Century,* ed. Roger French and Andrew Wear, (Cambridge, U.K.: Cambridge U.P., 1989).

[69] See G. S. Rousseau, "Nerves, Spirits, and Fibres: Towards Defining the Origins of Sensibility," in Brisseden and Eade (eds), *Studies in the Eighteenth Century,* vol. 3, (Canberra: Australian National U.P., 1976).

[70] Edmund King, "Medical Casebook, 1676-96," British Library, Sloane ms. 1589, fo. 35.; for a summary, see Katherine Williams, "Hysteria in seventeenth-century case records and unpublished manuscripts," *History of Psychiatry*, i (1990):383-401, pp. 391-99.

[71] John Ward , "Diaries (1647/8-1673)", typescript by Sir D'Arcy Power, 1920, for Medical Society of London. Now in possession of Wellcome Library. P. 407 (1663). (originals in Folger Library.)

[72] Ibid, pp. 875, 895.

[73] Ibid, p. 623.

[74] Willis, *Pathology*, 1667, op. cit., p. 80.

[75] Katherine Williams, op. cit, 1990, p. 400.

[76] Lawrence Stone, *The Family, Sex and Marriage in England 1500-1800*, (Oxford: Clarendon Press, 1977), p. 44.; on the increasing loosening of control by propertied parents of their children's marriage plans in the early seventeenth century, see idem, *The Crisis of the Aristocracy*, (London: Oxford U.P., 1976), pp. 279-80.

[77] For an overview of politics and religion in the 1680's, see Paul Seaward, *The Restoration, 1660-1688*, (London: Macmillan, 1991), esp. pp. 143-148. On the challenge that Lockeian empiricism posed to Willis, see Roy Porter, "The rage of party" a glorious revolution in English psychiatry?" *Med. Hist.*, 1983, 27: 35-50; idem, *Mind-Forg'd Manacles: A History of Madness in England from the Restoration to the Regency*, (Cambridge: Harvard U.P., 1987), introduction. Also see Michael MacDonald, "Religion, Social Change, and Psychological Healing in England, 1600-1800," in *The Church and Healing, ed. W.J. Shields*, (Oxford: Blackwell, 1982), pp. 101-25.

[78] Attributed to Thomas Sydenham, the lines may have been authored by John Locke. John Locke, "Anatomie", (1668), MSS in Public Record Office 30/24/47/2, fols. 31r-38r. Sydenham first published such sentiments in *Observationes medicae* (1676).

[79] Thomas Sydenham, *The Works of Thomas Sydenham*, ed. R. G. Latham, (London: Sydenham Society, 1848), 2 vols. , 1:102.

[80] Ibid., 2:84.

[81] Ibid, 1:171.

[82] J. A. Mendelsohn, "Alchemy and Politics in England 1649-1665," *Past & Present*, 1992, 135:30-79, pp. 46-7.

[83] Sydenham, op. cit, 1:13.

[84] Lawrence Stone, *The Crisis of the Aristocracy*, 1558-1641, (Oxford: Oxford U.P., 1976), chap. 12.

[85] entry on Thomas Sydenham in *Biographia Britannica*, 1747, vi. 3879; *Dictionary of National Biography*, ed. Leslie Stephen and Sidney Lee, (London: Smith, Elder, 1909), vol. S, pp. 246-253.

[86] Kenneth Dewhurst, op. cit., 1966, "Preface" and pp. 60-67.

[87] Donald G. Bates, "Thomas Sydenham: The Development of His Thought, 1666-1676," Ph.D. dissertation, Johns Hopkins, 1975, University Microfilms.

[88] See Akihito Suzuki, "Mind and its Disease in Enightenment British Medicine," (Ph.D. dissertation, University of London, 1992). According to Roy Porter, "Suzuki shows Locke denying the mainstream medical materialist approach to mind/brain relations; he also shows Locke having almost no followers before 1760." personal communication from Porter, July 27, 1993.

[89] Bynum, op. cit., pp. 215-16.

[90] William Munk, T*he Roll of the Royal College of Physicians of London*, (London: Longman Green, 1861), p. 293.

[91] For a comparative evaluation of Willis and Sydenham in particular, see L. J. Rather, "Pathology at Mid-Century: A Reassessment of Thomas Willlis and Thomas Sydenham," in Allen G. Debus, ed., *Medicine in Seventeenth Century England*, (Berkeley: U.C. Press, 1974), pp. 71-112.

[92] Dewhurst, op. cit., 1966, pp. 9, 19.

[93] *Diary of the Rev. John Ward, M.A. (1648-1679)*, (1839), ed. Charles Severn, p. 242; cited by Dewhurst, op. cit., p. 17. I cannot find this quote in the D'Arcy Power typescript of Ward's Diary in the Wellcome Library.

[94] Kenneth Dewhurst, *Dr. Thomas Sydenham: His Life and Work*, (Berkeley: U.C. Press, 1966), p. 58.

[95] Calendar of Manuscripts of the Marquess of Ormonde, K.P., Historical Manuscripts Commission (1908), n.s., vol. V, pp. 354-5; cited by Dewhurst, op. cit., 1966, p. 50.

[96] Thomas Sydenham/John Locke, "Anatomie", 1668, Public Record Office, 30/24/47/2, ff. 60-7. Quoted by Dewhurst, op. cit., 1966, p. 85. For a milder version of this view, see Sydenham, *Works*, II: 170-2.

[97] Kenneth Dewhurst, *Sydenham*, op. cit., 1966, pp. 33-4, 56.

[98] John Locke, *Familiar Letters between Mr. John Locke and Several of his Friends* (London, 1742, 4th ed.), pp. 223-4; cited by Dewhurst, *Sydenham*, op. cit., 1966, p. 179.

[99] Thomas Sydenham, *Methodus curandi febres...*, 1666, "Preface", sect. 1.

[100] John Locke, *An Essay Concerning Human Understanding*, 1692, reprinted (New York: Dover, 1959), Bk. IV, "Extent of Human Knowledge," ch. III, sect. 25-27.

[101] See ibid, Book IV, ch. III, section 26, entitled, "Hence no Science of Bodies within our reach."

[102] For a review of this side of Boyle's work, see Lester S. King, "Robert Boyle as an Amateur Physician,"in *Medical Investigation in Seventeenth Century England,* (U.C.L. A.: Clark Library, 1968), pp. 29-49.

[103] Robert Boyle, "On the Usefulness of Natural Philosophy," p. 183, in vol. II, *The Works of the Honourable Robert Boyle,* ed. Thomas Birch, (London, 1772). Quoted in King, op. cit., p. 44.

[104] King, op. cit., pp. 41-43.

[105] Boyle, op. cit., pp. 163-4; see also King, op. cit., pp. 45-6.

[106] King, op. cit., p. 46.

[107] Lord Conway to Anne Conway, July 1, 1651 in Marjorie H. Nicholson and Sarah Hutton, rev. ed., *The Conway Letters,* (Oxford: Clarendon Press, 1992), pp. 29-30.

[108] Locke, op. cit., Book II, ch. IX, "Of Perception."

[109] Ibid, Bk. IV, "Extent of Human Knowledge," ch. II, sect. 14.

[110] Locke/Sydenham, "Anatomie", in Dewhurst, op. cit., 1966, p. 91

[111] Ibid, p. 88.

[112] Ibid., Locke to Dr. Thomas Molyneux, Jan 20, 1692/3, pp. 176-7.

[113] Despite its hagiographic tone, Fox-Bourne's nineteenth century biography of Locke provides the fullest extant narrative of the latter's career moves and worldly ambitions. See Henry Fox-Bourne, *The Life of John Locke,* (London, 1876).

[114] James R. Jacob and Margaret C. Jacob, 'The Anglican origins of modern science: the metaphysical foundations of the Whig constitution, " *Isis,* 1980, 71: 251-67, p. 259.

[115] Sydenham, "Epistolary Dissertation to Dr. Cole," op. cit., 1., p. 57.

[116] Sydenham, *Methodus,* op. cit., II.VI.3.3.

[117] Sydenham, *Methodus,* op. cit., III.I.5.5.

[118] Ilza Veith has argued that Sydenham was the first to portray hysteria as an affliction of mind. Not only would I argue that Willis (or Piso) takes priority, but I would also argue that she has mis-read Sydenham. Incidentally, I also disagree with her assessment that Hippocratic writers assigned hysteria to the womb. On Sydenham/Veith, see Ilza Veith, *Hysteria: the history of a disease,* (Chicago: U. of Chicago Press, 1965), p. 144.

[119] On the inchoate notion of species, see Sydenham, *Methodus,* op. cit., I.5.5. and I.5.27. For its development in Sydenham's mature work, see Don Bates, "Thomas Sydenham: the development of his thought, 1666-1676," (unpublished Ph.D. dissertation, Johns Hopkins, 1975), "Part III: Sydenham's Species Concept," esp. chapters 7-9.

[120] Don Bates, op. cit., p. 63.

[121] Thomas Sydenham, "Epistolary Dissertation to Dr. Cole," in *Works*, op. cit., p. 85.

[122] Ibid., p. 87.

[123] Thomas Sydenham, *Methodus curandi febres propriis observationibus superstructura*, English translation from Latham's edition of the *Works* in 1848. (Folkestone, U.K.: Winterdown Books, 1987), "Section Three: of intermittent fevers," p. 99.

[124] Ibid., "Of continued fevers," section 1.4.9, p. 25. Sydenham used "ebullition" and "fermentation" synonymously.

[125] Ibid, "Of symptoms", VI.3.4., p. 75.

[126] Locke, *Essay*, op. cit., Book III, ch. X, "Abuse of Words", sect. 14.

[127] From a 1664 lecture by Willis on sense (attended by Lower and Locke): "When a similar movement is repeated in these orbits memory is evoked as the cerebrum in infants is a *tabula rasa.*", p. 66 in Dewhurst, op. cit., 1980.

[128] Locke, "Of the Association of Ideas", a chapter which was inserted into the fourth edition of the *Essay* as Ch. XXXIII in Book II. Quote from paragraph 6. For a different viewpoint on the origin of the concept of *tabula rasa* in Locke's *Essay*, see Nicholas G. Petryszak, "Tabula Rasa--Its Origins and Implications," in *Journal of the History of the Behavioral Sciences*, 17 (1981): 15-27. Petryzak does not mention Willis.

[129] Locke, *Essay*, 4th ed., op. cit, Book II, ch. XXXIII, sect. 6. Willis, *Anatomy*, 1664, op.. cit., pp. 118-19.

[130] Locke, *Essay*, 4th ed., op. cit., Book II, ch. XXXIII, sect. 6.

[131] This point has been made emphatically, but in an undocumented way, by George Rousseau in his "Nerves, Spirits, and Fibres: Towards Defining the Origins of Sensibility," in Brissenden and Eade, eds., *Studies in the Eighteenth Century*, v. 3, (Canberra: Australian National U.P., 1976), pp. 137-157.

[132] Frans Djorup, "Steno's Ideas on Brain Research," in *Steno and Brain research in the Seventeenth Century*, ed. Gustav Sherz, (Oxford: Pergamon, 1968), p. 111.

[133] Steno, "A Lecture on the Anatomy of the Brain," (Paris, 1669), reprinted in 1965, intro. by Gustav Sherz, (Copenhagen: Nyt Nordisk Forlag, 1965), p. 144

[134] Ibid, p. 133.

[135] Ibid, p. 134.

[136] Ibid, p. 127.

[137] Ibid, pp. 151-3.

[138] Ibid, p. 126

Conclusion

I. Summary

Inspired by the methods and theories of William Harvey, a group of mostly young and mostly Anglican investigators began doing experiments on the heart and blood in the 1640's in London and at Oxford and Cambridge. Working informally in clubs, they were patronized at Oxford by John Wilkins. Due primarily to its possession of facilities and institutionally-sponsored personnel, Oxford was the primary center of human physiology. One consequence of this sponsored informality was that the work took place privately but was known publicly in a selective way. Another was that the efforts of its principal patron, John Wilkins, to divide explicit spiritual concerns from natural philosophy, made for a particular kind of physiology which sought to divorce experimental work from cosmological and political issues.

Nonetheless, the Oxford physiologists were open to many new and foreign bodily philosophies and incorporated a number of them, if only partially. Among them were acceptance of both atomistic and vitalistic conceptions of matter as propounded by Paracelsus, Bacon, van Helmont, Descartes, Gassendi, and their followers. The consequence was that the Interregnum Oxford physiologists developed an eclectic conception of the blood and circulation which displaced not only traditional approaches, but also those of the foreign thinkers mentioned above.

With the establishment of the Royal Society in 1663, debate about the organizational pattern of the body and its care became public and heated. Buoyed by the interest in (al)chemical matters at Court, a disparate group of self-identified Helmontians petitioned the crown for separate recognition as a Society of Chymical Physitians. In the meantime Oxford-trained investigators sought to

modify injection techniques of physiological investigation into therapeutic techniques of transfusion. Also, among elite learned physicians, traditional theories of physiology were losing influence to the Oxford models.

These occurrences and trends reflect the fact that learned England increasingly was experiencing at least three incommensurable models of bodily organization. Moreover, although all three claimed the blood as of primary importance, they each meant something different by the term. Both the efforts of the Helmontians for official sanction and the transfusionists for therapeutic success failed in the mid-1660's. Although the Royal Society continued to interpret "new" phenomena, such as elemental phosphorus, in light of the Interregnum Oxford models into the 1680's, "official" and "alternative" learned medical groups were unable to establish a settled place for the heart and blood in the early Restoration.

Partly because of the Restoration settlement and the opportunities it offered to loyalists for a wider personal and cosmological vision, Willis, newly created professor of natural philosophy, led his colleagues in the 1660's away from a preoccupation with the Vital Soul of the blood toward an interest in the Rational Soul of the brain and nerves. Unlike previous theories of interaction between the brain, nerves, and visceral organs, Willisian neuroanatomy of the emotions minimized unmediated access by the lower body to the (whole) brain. Furthermore, in the Willisian model the brain contained a series of pathways by which emotions always remained under the (potential) control of the cerebrum, and, hence, the Rational Soul. Yet it was built on the circulation physiology of its immediate predecessor, the bloody Vital Soul of the Interregnum. In that sense Willis never completely removed the cause of emotional disorders from the blood to the brain and nerves.

In assessing the impetus for the rapid emergence of this "neurocentric" model from a group so recently devoted to circulation physiology, two factors were emphasized. In the first place Willis's position as an endowed Oxford philosopher provided the impetus and institutional support for him to speak broadly on medical matters. Originally intending for the ministry and numbering several important divines among his friends, Willis portrayed the functions of the brain and nerves both physiologically and theologically. In attempting the latter he borrowed heavily from ideas regarding the relation of reason, emotion, and control which were current among his Anglican acquaintance as well as in the work of Pierre Gassendi. The resulting "neurocentric" model established a uniquely English body which was as comprehensive in its scope as anything the Continent had produced. As such, it provided an intellectual resource to a diverse group of thinkers who nonetheless shared some common assumptions regarding reason, order, and man's place in nature.

Although Willis paid lip service to classical notions of the Rational Soul, the basic supposition that supported his pathologies of reason (and unreason)--the adherence of mind to brain--assumed that its very ontological status might be at stake in abnormal brain and nerve conditions. In the hands of Locke, who pushed the implications of this "psychology" to their limit (while side-stepping his intellectual debts to Willis), one outcome was that tight boundaries were drawn around the human species. If Willis thought these should be inclusive in new ways for women, whose capacity to reason heretofore had been considered to be under the control of the womb, the combination of Willisian neuropathology and Lockean epistemology also tended to exclude those such as congenital idiots on account of the newly revealed defects of their brains.

Willis's theoretical construction of the nerves depended on "ocular demonstrations" and "case observations" gathered from clinical experiences and post mortem exams. In order for it to proceed, the bodies of Willis's patients had to be available as scientific resources. Patients and their families participated for a variety of reasons. The Oxford physiologists as well as others also needed the tacit approval of religious authorities. Willis's conflation of reason, philosophy and religion, and his characterization of autopsy as reasonable, promoted the practice as theologically *safe*. Also, his alignment of the role of the "rational" physician with Christ the healer emphasized his religious orthodoxy at the same time it suggested a beneficial effect of the new clinical knowledge.

Nothing like this was going on elsewhere in Europe. Anatomical investigation was being performed, especially in contemporary Holland. But the combination of private anatomies performed on affluent private patients and philosophically-couched theories based in part on those findings was unique. It was able to flourish for a time not because of institutional factors, which were negligible in England, but because of a cultural authority arising from a convergence of belief between a group of physicians, patients, and religious leaders regarding the meaning of reason, medical investigation, death, and order.

Despite their numerous successes, Oxford physiology and Willis in particular were subject to several severe criticisms. The anatomical method came in for particular attack as epistemologically unsound and therapeutically unhelpful. It was as though learned medicine had room for only one approach. Furthermore, at least in learned medicine, the tendency to polarize ran through the Interregnum and Restoration. One of the reasons for this tension was the ambiguity of early modern formations of bodily organ systems as well as the nature of matter. Moreover, ambiguity regarding the nature and place of bodily contents was amplified by an ambiguity regarding what constituted a biological

fact. Also, the political and religious tumult of the period contributed to this tendency to "take a stand."

Despite the polarizing polemic, extant evidence indicates that Willis as well as other learned physicians practiced what amounted to many kinds of medicine. Just as therapeutics were juggled in an effort to gain some ground with the patient, so, too, a variety of etiologic theories might be dusted off to help make sense of a recalcitrant problem. Empiric may have been equated with quack in many minds, but empiricism was not a dirty word in the intellectual equipment of even the most "rational" physician. Yet the Oxford physiologists, and Willis in particular, were attacked from all sides: he bled too much (the criticism of Thomson cited earlier); he bled too little (O'Meara and Highmore).

The wide-ranging nature of the attacks reflected in part the successful effort on the part of the Willisians to establish a new center for learned medicine in a tumultuous time. If they restricted their philosophical reach during the Civil War and Interregnum, in the Restoration they applied chemical thinking and Harveian methods aggressively to new problems and areas. Nonetheless, they did so without explicitly repudiating the intellectual, social, or therapeutic traditions which had preceded them. And that, I would suggest, is why, despite their personal and professional successes, they accumulated such a diverse batch of critics. Like so many others, they were trying simultaneously to be new and old. It also accounted for the fact that self-proclaimed empiricists such as Locke borrowed from their theories--then the most up-to-date available--when it suited them.

The increasing respectability of empiricism in learned medicine in the later seventeenth century reflected as well a gradual change in the nature of physician/patient expectations. The disputes between physicians over the value of tradition, phlebotomy, *materia medica* , and other subjects suggest a subtle but

persistent shift in doctor/patient discourse from holistic explanations and treatments to specific explanations and treatments. It is important to realize that both the "rational" approach of the Oxford physiologists as well the unapologetic empiricism of people like Sydenham fed into this, for both approaches tended to ontologize disease. When a patient talked with Willis or one of his colleagues about recurrent headaches, say, the chances were that the doctor formed a mental picture of her meninges as being in a certain pathological state. She had been abstracted, in part, to her lesion. Having learned this "rationally," the goal would then be to make the treatment "rational," or as specific as possible to the problem. By quite a different rationale, the empirical "natural historian" would catalogue the "specific virtues" of medicines for illnesses which had specific contours. Ironically, as with the "rational" approach, the result would be that the patient would be reduced to his or her "disease."

I. Summary of historiographic concerns

Seventeenth century English science and medicine have received an enormous amount of historical attention in the past sixty years. Both its intellectual achievements and its formation in such a tumultuous time have made it an appealing subject not only for intellectual historians who prefer to trace the history of a particular set of ideas over time, but also historians and sociologists who seek to link changes in thought formations to changes in social organization and/or belief systems.

Regarding the historical formation of the "neurocentric" body, however, comparatively little inquiry has been devoted to the links between physiological theories and the larger culture in which they emerged. This study has been motivated in part by a desire to explore that terrain. In doing so, however, I have had to address a number of positions taken by other historians whose primary

interests were peripheral to those of this study. Nonetheless, their work had been influential; not to address them would mean that my own findings and interpretations could not emerge in full form. As a consequence, this dissertation has been more occupied with issues of revision than originally intended. These have been addressed in various places throughout the body of the text. Let me summarize them by chapter here.

In chapter one two positions were put forward that challenge received historical opinion. In examining the backgrounds of the Oxford physiologists whose activities form the bulk of this thesis, it was noted that the majority came from Anglican families and that a number originally intended religious vocations. In subsequent chapters I developed some of the implications of this demography. In chapter one I pointed out that their background and outlook was different than that put forward for mid-century science and technology as a whole by Robert Merton and Charles Webster.

Secondly, I took issue with the notion that the matter theory of mid-century natural philosophy, at least as it applied to medicine, should be characterized in binary terms as a contest between vitalism and mechanism, or alchemy and chemistry. In contrast, I argued that the Oxford physiologists constructed an eclectic physiology of the blood which incorporated vitalist and mechanical ideas. It was more useful, I suggested, to think of the tension as one of discernment and choice regarding the operation of occult forces rather than one of their existence or non-existence.

In discussing the Willisian physiology of reason, the attempt was made to link anatomical and physiological characterizations to theological ideas. This did not involve challenging other interpretations as it did establishing that consideration of Anglican theology might be relevant to the emergence and formation of the "neurocentric" model.

Discussion of Willis's position on women's bodies involved the most significant digression from the main line of this dissertation. Nonetheless, I felt I could not proceed with my argument for the relative novelty of his approach without establishing what came before. And in doing that I had to take on the recent characterizations by Laqueur and Schiebinger of what came before as a "one sex" model. We cannot both be right on this. However, I do acknowledge that my efforts to establish my own view as well as critique theirs make the chapter unbalanced.

Several historiographic concerns are contained in the chapter on the anatomical method. My overall effort was directed toward breaking down the notion that European medicine proceeded in some monolithic way. Instead, Rupp's work on seventeenth century Holland and Ferrari's on Bologna as well as mine on England suggest the much more interesting idea, to me at any rate, that local historical factors had considerable influence on both the methods and theories which emerged from various anatomical centers. When one took the differing nature of the anatomical rituals as well as the sources of the bodies into account, it seemed to me to be the only approach that made sense. In that sense, I view my discussion as possibly contributory rather than revisionist.

The revisionist work of chapter five was focused on Sydenham. Sydenham as such is peripheral to this dissertation. However, the changing appeal of the empiricism which he championed was very much of a factor in the success and decline of the Oxford enterprise. As a consequence, I wanted to bring in some of his ideas. In addition, by discussing his approach to learning in the context of the Interregnum critics of Oxford, one might establish a perspective on the changing nature and appeal of medical empiricism during the four decades of this study.

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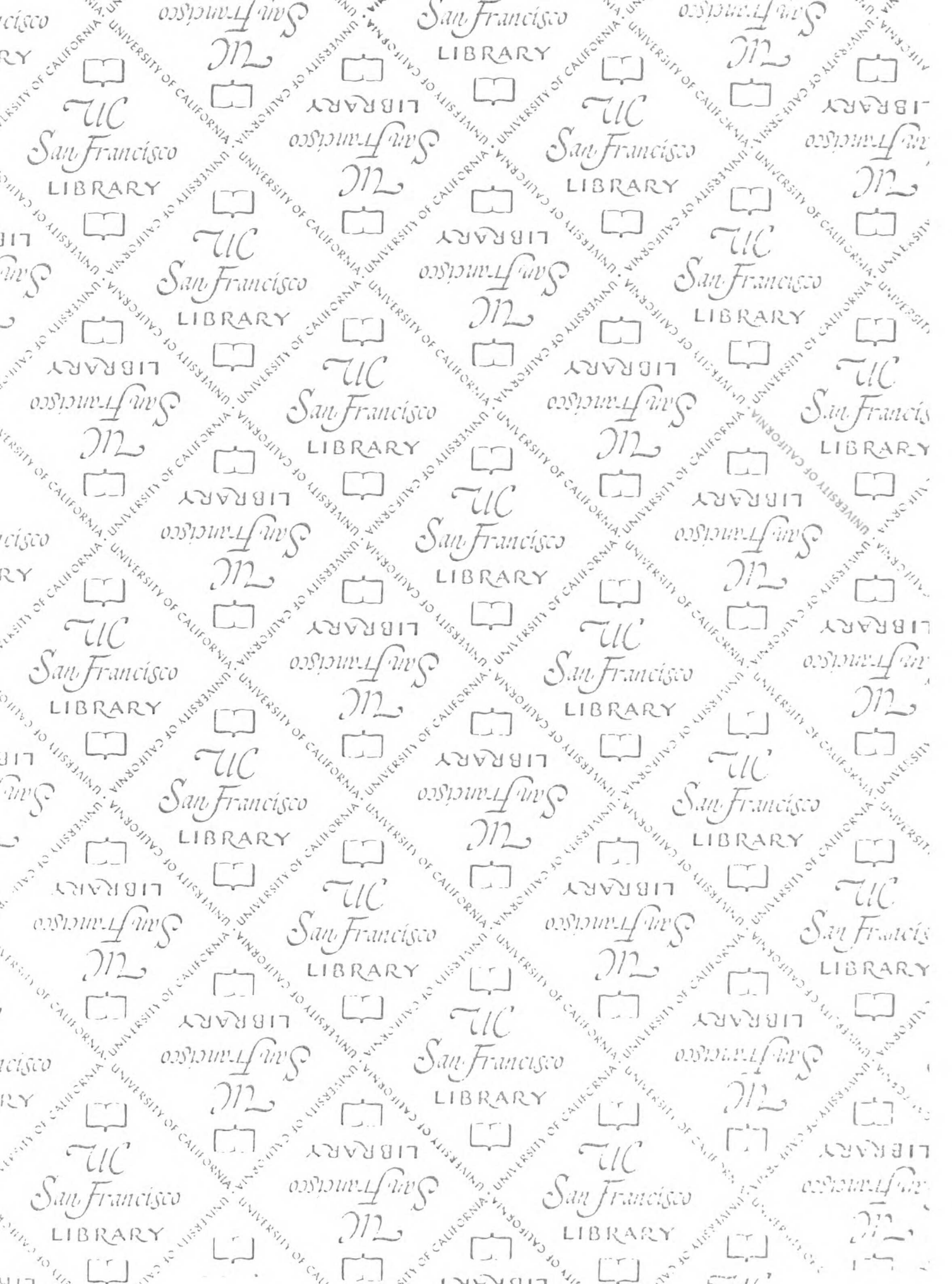
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