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(*b*. Northamptonshire, England, 1614; *d*. London, England, 19 November 1672)

theology, science, scientific and academic administration and organization.

Wilkins's career coincides with the most eventful period in modern English history–the years just before the Long Parliament to the decade after the Restoration and the formation of the Royal Society. It was not an easy time for an active man to retain influence and office, but Wilkins managed owing to his habit of prudence and a spirit of moderation and tolerance. In 1643 he subscribed to the Solemn League and Covenant and in 1649 he took the engagement of loyalty to the English Common-wealth. He was trusted by Cromwell, whom he advised on the need for a national church and episcopacy against presbytery. After the return of Charles II in 1660, he submitted to the Act of Uniformity and soon enjoyed the favor of the restored monarchy. Still, only the most unforgiving royalists ever questioned his integrity. Throughout his life, he gained and retained the friendship and respect of men of the most diverse political and religious persuasions. No doubt such personal qualities as charm,ready conversation, and energy played their part in his success, but the deeper reason would seem to lie in his commitment to beliefs that transcended the exclusive interests of any particular faction. From the first to the last, all his writings advocate scientific and religious views that they by the time of his death had proved that represented the temper of the times. The new science had triumphed, and the liberal Anglican theology known as latitudinarianism was, thanks to him, on the rise under such men as John Tillotson, Edward Stillingfleet, and Simon Patrick.

Both in print and action, Wilkins was committed to a set of principles and beliefs–generally known as natural theology–which he was the first fully to formulate and advocate in England. He never questioned the importance of the Bible and revelation as sources of faith, and in this respect his thought differs from what later became known as deism. But his writings are devoted to the argument that moral and religious philosophy can be grounded on natural religion, by which he understood what "men might know, and should be obliged unto, by the mere principles of reason, improved by consideration and experience, without the help of revelation."[1]

Owing to the omnipotence, benevolence, and wisdom of God, both the universe and man are so admirably contrived that man can ensure the welfare of his soul by the mature exercise of the faculty of reason, which is the defining quality of his nature. This faculty reveals to man the natural principles that govern creation, thus providing him with knowledge that "may conduce to the proving of a God, and making men religious," by making him understand that "such a great order and constancy amongst" the heavenly bodies "could not at first be made but by a wise providence, nor since preserved without a powerful inhabitant, nor so perpetually governed without a skillful guide."[2]

Similarly, man is endowed with a natural principle that makes him seek moral good "as a rational voluntary free agent,"[3] owing to his steady inclination "to seek his own well-being and happiness," so that "nothing properly is his duty, but what is really his interest," which is another argument "that the author of his being must be infinitely wise and powerful."[4] Man's natural desire for happiness is as certain as the descent of heavy bodies,[5] an example that Wilkins also used to illustrate that fixed laws that rule nature. Both man and nature are governed by laws that ensure the harmony of religion and science.

Consistent with these arguments, Wilkins stated the deistic principle that the salvation of the heathen is not a problem for man to decide; since "God has not thought fit to tell *us* how he will be pleased to deal with such persons, it is not fit for us to tell *Him* how he ought to deal with them."[6] In his writings, Wilkins often used the wise testimony of the ancients to support the knowledge and arguments advanced by the new science. Whether we call some of his writings scientific and others religious is a matter of emphasis; they all have the same aim: to guide man's conduct toward moral virtue, religious devotion, and ultimately the hope of salvation. The pursuit of happiness, even comfort, in this world is man's legitimate interest.

But reason alone is not sufficient. Man is also naturally "a sociable creature . . . having only these two advantages to his protection, Society and Reason . . . Adam in the state of innocence could not be happy, though in Paradise, without a companion."[7] This is a theme Wilkins stresses again and again; it is the foundation of his constant advocacy of conciliation, moderation, and tolerance, often in contexts that refer to "all that confusion and disorder, which seem to be in the affairs of these times."[8] The instrument that ensures the benefits of social intercourse is language: "Every rational creature, being of an imperfect and dependent happiness, is therefore naturally endowed with an ability to communicate his own thoughts and intentions; that so by mutual services, it might the better promote itself in the prosecution of its own well-being."[9] As useful knowledge, both natural and moral, is a function of cooperation, so successful cooperation is a function of communication; the improvement of natural knowledge and language is the response to the "two general curses inflicted on mankind," after the fall of Adam, "the one upon their labors, the other upon their language."[10] After the anniversary meeting of the Royal Society on 30 November 1667 (in which the annual election of officers also took place), Pepys recorded that some members went out for dinner, he himself choosing to sit next to Wilkins "and others whom I value." With his last work, *An Essay Towards a Real Character and a Philosophical Language,* then in the press, Wilkins stated that "man was certainly made for society, he being of all creatures the least armed for defence, and of all creatures in the world the young ones are notable to do anything to help themselves . . . and were it not for speech man would be a very mean creature." Wilkins is the chief source of the Royal Society doctrines about language and style; knowledge based on mere words and phrases has "in it this intrinsical imperfection, that tis only so far to be esteemed, as it conduces to the knowledge of things," words themselves being merely "the images of matter." To treat them otherwise is to fall into "Pygmalion's phrenzy."[11]

Wilkins' view of useful knowledge determined his attitude toward the three chief sources of authority: the Bible, antiquity, and books. Using arguments that today are perhaps best known from Galileo's *Letter to the Grand Duchess Christina,* Wilkins repeatedly rejected scriptural authority in natural philosophy, a principle to which all the new scientists were committed; if theology is allowed interference with philosophy, then the status of the latter is endangered as an independent source of the wisdom of the creator. In his first publication, Wilkins stated the principle in these terms: "It is not the endeavor of Moses or the prophets to discover any mathematical or philosophical subtleties; but rather to accommodate themselves to vulgar capacities, and ordinary speech, as nurses are wont to use their infants."[12] On scientific matters, he was also fond of citing contradictory scriptural passages, just as he criticized those among his contemporaries "who upon the invention of any new secret, will presently find out some obscure text or other to father it upon, as if the Holy Ghost must needs take notice of every particular which their partial fancies did over-value."[13]

He treated classical authors in much the same way as the Bible, using citations to suit his purposes both for and against his own principles, those in the latter category being dismissed as contrary to reason and experience. But he rejected outright the superior authority of antiquity: "In such learning as may be increased by fresh experiments and new discoveries, it is we are the fathers, and of more authority than former ages, because we have the advantage of more time than they had."[14] He was aware that the vast public structures of the Egyptians, Hebrews, Greeks, and Romans might be used to argue against the inferiority of their mechanical knowledge; he answered that if we have nothing of the sort nowadays, the reason does not lie in our knowledge, for "mechanical discoveries are much more exact now," but rather in the fact that "we have not either the same motives to attempt such works, or the same means to effect them as the ancients had." By this he meant that great wealth and power, then concentrated in the hands of a few, were now more widely diffused. "There is now a greater equality amongst mankind and the flourishing of arts and sciences has so stirred up the sparks of men's natural nobility, and made them of such active and industrious spirits, as to free themselves in a great measure from that slavery, which those former and wilder nations were subjected unto."[15]

The belief in the leveling and ennobling effect of the new knowledge found expression in Wilkins' attitude toward "bookish" men and mere bookish learning. Antiquity having slighted the mere manual and practical arts as "base and common," such studies had come to be neglected for hundreds of years, with grave consequences for the well-being of man. But the mechanical arts are just as worthy as the old and honored liberal arts such as logic and rhetoric, indeed "that discipline which discovers the general causes, effects, and proprieties of things, may truly be esteemed as a species of philosophy." Since all studies ought "to conduce to practice as their proper end," book learning is often rightly considered mere "pedantry." Wilkins was eager to overcome the prejudice that studies pertaining to the mind deserve greater respect than those that deal with material things. It was in this spirit that he devoted his *Mathematical Magick* to practical mechanical devices and labor-saving inventions "whereby nature is in any way quickened or advanced in her defects," for these are in fact "so many essays, whereby men do naturally attempt to restore themselves from the first general curse inflicted upon their labors." Wilkins' scientific writings are all of a popular nature, written not for the learned, but for "such common artificers, as are well skilled in the practice of these arts, who may be much advantaged by the right understanding of their grounds and theory." For this reason he wrote in English, referring on the authority of Ramus to the German practice of public lectures given in the vernacular, "for the capacity of every unlettered ingenious artificer."[16] Though he defended the universities on several occasions, Wilkins was aware that they must justify their teaching in terms of real use and benefit to mankind, a view that made him one of the principal advocates of university reform at Oxford and Cambridge.[17]

Wilkins' scientific writings constitute a single, well-conceived educational program to reach a larger audience outside the confines of traditional learning, both to promote natural philosophy and to lend dignity to the practical arts. He announced this program in the opening of his first publication, saying that it was his desire to "raise up some more active spirit to a search after other hidden and unknown truths: since it must needs be a great impediment unto the growth of sciences, for men still to plod on upon beaten principles, as to be afraid of entertaining anything that may seem to contradict them."[18] In this task of popular education, Wilkins' importance can hardly be overestimated. He laid the foundation for the wide participation and interest that the Royal Society enjoyed during its formative years.

The means of this success was pedagogical flair, shown both in his capacity for clear and interesting exposition, always without any suggestion of condescension, and in the choice of subjects, which in the context of the times were sensational. Was the moon inhabited? Could man find a means of flying to it? Was it much like the earth with mountains and oceans? Was the earth a planet? Could man navigate under water, lift heavy weights with little effort, or communicate effectively by other means than ordinary speech? The very titles were catchy–he did not shun the title *Mathematical Magick,* although it was certainly against his principles to suggest that there was any magic in the study of natural philosophy.[19] His more serious purpose was to gain acceptance for the new science, to bring the work of Copernicus, Kepler, Galileo, Gilbert, Mersenne, and others to the attention of his countrymen. Against the authority of the Bible, antiquity, and book learning, he answered that "we must labor to find out what things are in themselves, by our own experience, and a thorough examination of their natures, not what another says of them." Natural religion will prevail; disorder, strife, and sectarianism will vanish when disputes are resolved by giving "soft words but hard arguments."[20] There is no important principle in Thomas Sprat's *History of the Royal Society* that had not earlier been argued by Wilkins. "The universal disposition of this age," wrote Sprat, "is bent upon a rational religion." In his first work Wilkins said that the opponents of new views too often submitted to authority, a point he enforced by saying that "our opposites . . . too often do *jurare in rerba magistri"* , thus citing the well–known line in Horace from which the Royal Society drew its motto *Nullius in verba*.[21]

There is, finally, another aspect of Wilkins' character that bears some relation to his career and influence: unlike most of his scientific and ecclesiatical associates, he was a man of the world. After their first meeting, Robert Boyle remarked that Wilkins' "entertainment did as well speak him a courtier as his discourse." Anthony à Wood observed that Wilkins was "bred in the court, and was a piece of a traveller, having twice seen the prince of Orange's court at the Hague, in his journey to, and return from, Heydelburg, whither he went to wait upon the prince elector palatine, whose chaplain he was in England."[22] Without such social attainments, Wilkins' sphere of activity would hardly have reached so far beyond his humble origins.

Early Career. Wilkins was born at the North-amptonshire house of his maternal grandfather, the puritan divine John Dod, who was known for an exposition of the Ten Commandments. His mother, Jane Dod, had four children in her marriage to Walter Wilkins, an Oxford goldsmith who died in 1625. John Aubrey reports that the father was "a very ingenious man with a very mechanical head. He was much for trying experiments, and his head ran much upon the perpetual motion." In a second marriage, to Francis Pope, Jane Dod had a son, Walter, who remained close to Wilkins.[23]

After schooling at home, Wilkins began grammar school at the age of nine under the noted Greek and Latin scholar Edward Sylvester, and in May 1627 he matriculated at New Inn Hall, Oxford (later united with Balliol College). He soon transferred to Magdalen Hall, where his tutor was the Baptist divine John Tombes. He graduated B.A. 20 October 1631, and gained the M.A. degree on 11 June 1634; at this time Wilkins was tutor in his college, one of his students being Walter Charleton, who thereby "profited much beyond his years in logic and philosophy."[24] A few years later he was ordained and became vicar of Fawsley. At this time he is reported to have become chaplain to William Fiennes, first viscount Saye and Seale, who was then a supporter of the Puritans and later sat in the Westminster Assembly. But in 1641 Wilkins dedicated his *Mercury* to George Lord Berkeley (1601–1658), signing himself "your lordship's servant and chaplain." His desire to move in high places was further gratified when he became chaplain to Charles Louis, the prince elector Palatine, the king's nephew. The elector lived in England during a good part of the 1640's, befriending the parliamentary party in the hope of securing the restitution of his lost possessions. During the early months of 1646, Wilkins was officially engaged as preacher at Gray's Inn; during these years he also preached at the Savoy.[25]

On 13 April 1648, the Parliamentary Visitors made Wilkins warden of Wadham College. The holder of this office was required to take the degree of doctor of divinity, but on 5 March 1649, the Visitors gave him a year's dispensation, since Wilkins was "at this time in attendance on the prince elector, and cannot in regard of that service have time to do his exercise, and all other things necessary unto that degree."[26] He took the degree on 19 December the same year. Since this occurred at the time when Charles Louis was returning to Heidelberg to take possession of the lands that had been restored to him as a consequence of the Peace of Westphalia, we may surmise that it was at this time that Wilkins made his visits to the Continent and to The Hague.[27]

Beyond these sparse facts, we have little information about Wilkins' life during his formative years. No doubt he spent most of them in Oxford and London. It was in London that he participated in the meetings that were devoted, as John Wallis recorded, to "what has been called the New Philosophy or Experimental Philosophy," these meetings having been convened at the suggestion of Theodore Haak. It is an interesting conjunction that they began during the Westminster Assembly, of which Wallis was then secretary. For a better view of Wilkins' early career, we have his writings and some reasonable conjectures about his associations.

Although published two years apart, the *Discovery* (1638) and the *Discourse* (1640) can be considered a single work. Addressed to the common reader, the primary aim was to make known and to defend the new world picture of Copernicus, Kepler, and Galileo by showing its agreement with reason and experience against subservience to Aristotelian doctrines and literal biblical interpretation. Kepler and especially Galileo's *Siderius nuncius* (1610) and Matthias Bernegger's Latin translation (1635) of the *Dialogue Concerning the Two Chief World Systems* are frequently cited, along with a wealth of other references from the literature that had appeared within the last generation. The work is polemical, but unlike Campanella's *Apologia pro Galileo* (1622), which is cited with approval, it constantly turns the reader's attention to the positive arguments that may be drawn from rational interpretation of observable phenomena. The central argument was borrowed from Galileo: the moon is not a shining disk or whatever else men have imagined, but a world with natural features much like the earth. And if so, then the moon might also be inhabited, although Wilkins does not find sufficient grounds to say what sort of beings the inhabitants are, thus neatly avoiding the touchy question of whether they are descendants of Adam. Further, if the moon shares natural features with the earth, then the argument could be extended to form a uniformitarian view of the constitution of the entire universe, thus breaking down the Aristotelian doctrine of fixed, hierarchical spheres that obey laws other than those of the sublunar world. In both the first and the second work, Wilkins is careful to warn the reader at the outset that he is not pretending to write a precise treatise expounding unquestionable truths; but though much might still be doubtful, he is confident that the hypotheses he defends will, against all prejudice, be granted conformity with observable phenomena and with simplicity of explanation. In the 1640 edition of the *Discovery,* Wilkins added the sensational idea that it might be possible to contrive a way of flying to the moon, thus taking up a suggestion already known in England from Francis Godwin's *Man in the Moone* (1638). In the latter part of the second work, Wilkins supports his argument for the movement of the earth by reference to William Gilbert's suggestion that the earth is a lodestone. Bacon had argued against Gilbert on that point. Both works make few and only general references to Bacon, quite insufficient to attribute any important inspiration to him.

The *Discovery* and the *Discourse* have a wealth of references to recent literature–at least some thirty in each, of which nearly a dozen are new in the second work. They suggest that Wilkins found his occasion in the controversy that grew up in the wake of Philip van Lansberge's *Commentationes in motum terrae diurnum et annuum* (1630). This work was opposed by Libertus Fromondus both in *Anti-Aristarchus, live orbis-terrae immobilis* (1631) and in *Vesta, live Ant-Aristarchi vindex adversus Jac. Lansbergium* (1634), in which he defended the proscription of Copernican doctrine first issued by the congregation of cardinals in 1616 and reiterated in 1633. Fromondus was Wilkins' chief anti-Copernican opponent in both works; only the second work contains Alexander Ross's *Commentum de terrae motu circulari* (1634), which opposes both Lansberge and Nathaniel Carpenter. With a wide and mature command of the literature, Wilkins was engaged in international controversy. There can be no doubt that he succeeded in his aim of gaining acceptance for Copernicus, Kepler, and Galileo in England.[28]

We may wonder why Wilkins, still only in his middle twenties, took up the controversy with so much energy and conviction. In the *Discovery,* the "Epistle to the Reader" states that the work is "but the fruit of some lighter studies," finished in a few weeks; but the extensive reading adduced in both works could hardly have been so quickly mastered. The subject must have required longer preparation, perhaps during his student days and while he was tutor in his college. Henry Briggs, who died in 1630, was the first Savilian professor of geometry; in London he had been close to William Gilbert and Edward Wright, and in Oxford he became acquainted with John Pell and Theodore Haak, who was in Oxford during the later 1620's. Briggs was a strong Copernican and scorned astrology as "a system of groundless conceits," a view that was shared by his Savilian colleague in the astronomy chair, 1621–1643, John Bainbridge, who in London had belonged to the circle of Briggs and Nathaniel Carpenter. Both had been professors at Gresham College before coming to Oxford. It seems reasonable to assume that Wilkins had learned something from either or both of these men, who most closely illustrate the interest and orientation that characterized his career from the beginning.

Only a year later, in 1641, Wilkins published another book on a popular subject, entitled *Mercury, or the Secret and Swift Messenger, Showing How a Man May With Privacy and Speed Communicate His Thoughts to a Friend at Any Distance*. It mentions such old tricks as baking secret messages into loaves of bread, but Wilkins' chief interest was cryptography, of which he gives a wealth of examples, all ready for use. But he also deals with cryptology or secret communication by speaking, either by involving the sense in metaphors and allegories or by changing old words or inventing new ones as is done by thieves, gypsies, and lovers; and with "semeology," that is communication by signs and gestures, as used for instance by deaf-mutes. Thus *Mercury* is not merely a practical guide in the use and decoding of ciphers, but a broadly based discussion of the means of communication, or what today would be called semiotics. The opening chapter states the basic principle that men are born with a natural ability to communicate, capable of learning any language in the same manner as they can master "other arts and sciences" ; but men are not born with a single language that is natural to all mankind, for if this were so men would retain it so that all men would have a "double language, which is evidently false." In other words, like Mersenne, Wilkins rejected the natural-language doctrine then advocated by Robert Fludd. Wilkins ridiculed cabalistic interpretations of the sort that was again to occupy him in controversy with John Webster, who attacked the universities for neglecting Jacob Boehme's mystical linguistic doctrines. At the same time, Wilkins saw that the Babelistic multiplicity of languages was a great hindrance to the promotion of arts and sciences, men now wasting much time merely learning words instead of addressing themselves directly to the study of things. Citing such well-known instances as Arabic numerals, astronomical and chemical signs, and musical notes, he devoted a chapter to the possibility of creating a universal character as a remedy for the confusion. It outlines the principles he was later to follow in his final work. At the end of *Mercury,* Wilkins notes that though his work can be used to serve unlawful purposes, it can also be used to uncover them. If the abuse of useful inventions is a reason for suppressing them, he observes, "there is not any art or science which might be lawfully professed."[29]

After dealing with communication and the second curse on mankind in *Mercury,* Wilkins next turned to the remedies for the first curse, inflicted upon man's labors. This pattern shows how closely Wilkins, with most of his contemporaries, related his concerns to the biblical story of man's terrestrial life. His *Mathematical Magick* (1648) is divided in two parts: "Archimedes or Mechanical Powers" and "Daedalus or Mechanical Motions." These titles might suggest an emphasis on the theoretical problems that had occupied much of the literature on mechanics during the previous generation, but the work is almost wholly devoted to the practical uses of mechanical devices with only enough theory to give the reader a sense of scientific initiation and understanding. The address "To the Reader" explains that the present work forms part of the same educational efforts as Wilkins' previous publications by showing how "a divine power and wisdom might be discerned, even in those common arts which are so much despised." The book's aim was "real benefit," both for gentlemen in the improvement of their estates, as in the draining of mines and coalpits, and for "common artificers" in gaining a "right understanding of the grounds and theory" of the arts they practice. It is therefore a short book, a compendium of knowledge otherwise only available in large, expensive volumes in Latin rather than the vernacular, "for which these mechanical arts of all other are most proper."

The first part deals with the balance, lever, wheel, pulley, wedge, and screw in that order, all illustrated with line drawings and pictures. Then follow chapters that show how the combination of these devices may produce "infinite strength" so as to "pull up any oak by the roots with a hair, lift it up with a straw, or blow it up with one's breath," all illustrated with rather sensational pictures. The second part treats a miscellaneous collection of strange devices and possibilities, such as flying machines, moving and speaking statues, artificial spiders, the imitation of sounds made by birds and man, a land vehicle driven by sails, a submarine, Archimedes' screw, and perpetual motion. This is a strange, almost baroque assembly, but all of these subjects had already been discussed in the extensive literature on which Wilkins drew and a few years later a speaking statue was among the wonders shown to visitors at Wadham College. Automata were a legitimate scientific interest. There is little theory here, even scant hope of practical success, but much excitement. Learned fancies were being shared with a lay audience. It would be a mistake, however, to think that Wilkins was being frivolous. Even in the 1660's the Royal Society was not averse to the pursuit of such projects. There was as yet no clear distinction between what we consider good science and technology as opposed to fruitless speculation. The same scientific success that brought about the disenchantment of the universe also raised technological hopes that entered the realm of magic. Wilkins knew that wonder is the chief impulse to serious study and experiment.

A closer look at the sources of *Mathematical Magick* yields interesting information both about Wilkins' orientation and about the dating. It can easily be seen that many of the line drawings and illustrations are taken from other works along with the principles and devices they illustrate. The most recent work cited is John Greaves's description of the Egyptian pyramids, *Pyradomographia* (1646). But the works on which he chiefly relied were Guidobaldo del Monte's *Liber mechanicorum* (1577) and Marin Mersenne's *Cogitata physicomathematica* (1644).[30] The use of Mersenne is much too extensive to have been introduced in a late revision; if therefore we take seriously Wilkins' statement in the dedication to Charles Louis that "this discourse was composed some years since, at my spare hours in the university," we must conclude that he devoted a good part of his time to university affairs during the mid-and late 1640's, a fact that may explain his sudden appointment to the wardenship of Wadham in 1648. Yet those affairs left him time to write the book, perform his official preaching duties in London, attend the early scientific meetings there, and serve as chaplain to the elector. Wilkins clearly managed his diverse functions with considerable energy.

Wilkins' explanation and illustration of the six traditional mechanical devices relied chiefly on Guidobaldo; a mere visual comparison of the handsome pages of the *Liber mechanicorum* with Wilkins' modest book makes this dependence obvious. Following Pappus, Guidobaldo had reduced all these devices to the same working principle as the lever–with the exception of the wedge, which he also discussed in terms of the inclined plane without making a clear choice between the two. Wilkins altogether omitted the inclined plane, but did not reduce the wedge to the lever principle as he did for the balance, wheel, pulley, and screw, presumably because he did not wish to burden his lay readers with the finer points of theory in a work which in any event limited to the barest minimum the mathematical principles offered by his sources.[31] In the order of the six devices, however, Wilkins followed Mersenne by treating the wheel before the pulley, but he did not use Mersenne's somewhat more complicated analyses. Thus the reader of *Mathematical Magick* would not have gained a sense of the long controversy over the proper understanding of these devices, revived in 1634 by Mersenne's *Les méchaniques de Galilée*[32] From Mersenne, Wilkins also borrowed his account of the "glossocomus" or "engine of many wheels," with the analysis and illustration that show how it works like a series of interlocking levers.[33] In addition he cited works other than the *Tractatus mechanicus* from the *Cogitata* : on the bending and power of bows,[34] on the flattening of a bullet fired against a wall,[35] and on the submarine.[36]

Wilkins' debt to Mersenne is so heavy that it deserves closer attention. Mersenne is cited in the *Discovery,* the *Discourse,* and in *Mathematical Magick*. He is not mentioned in *Mercury,* but the general subject of this work forms the very core of Mersenne's own enquiries: the phenomena of communication, language, and the possibility of creating a philosophical language. It would be correct to say that Wilkins' scientific writings together present a popular version of Mersenne. The affinity of interests and orientation was too close to stem from common reliance on the same literature. The plurality of worlds was the only subject that separated them, but for Wilkins this was only a tentative suggestion of no systematic importance, confined to the *Discovery* and not repeated. Mersenne's position on the Copernican doctrine was sufficiently ambiguous not to create any problem.[37]

Mersenne and Wilkins shared the conviction that religion and morality have a rational basis, that the grounds of religious belief are not tied to the retention and defense of Aristotelian doctrines, that a rational explanation of nature is possible when firmly based on sense experience and experiment, that this explanation would be mechanical and quantitative, that man is essentially different from the animals by virtue of possessing reason, that man alone is capable of language and communication, and that the growth of knowledge is a function of communication. Both were opposed to magic and the irrational, and for this reason they opposed the belief in the magical and occult powers of words, a doctrine then chiefly associated with Jacob Boehme and Robert Fludd. Language is not part of nature, it can tell us nothing about the essences of things, and thus cannot give "real knowledge" about the things of creation. It is conventional and man-made– "a man is born without any of them, but yet capable of all," Wilkins said. If this were not so, then it would not be possible to maintain that reason and experience together form the exclusive source of scientific knowledge. Thus the nature of language is the crucial problem in the epistemology of the new science. This fact explains some evident similarities between Mersenne, Wilkins, and Locke; as Mersenne felt bound to engage in a sustained critique of Fludd, so Locke argued against Boehme and his English disciple John Webster with his doctrine of "innate notions."[38] On these grounds Mersenne repeatedly argued that only God can know the essences of things and their true causes. Like Locke, he was convinced that certainty cannot be achieved in physics, "for we do not know the true reason of the effects we clearly see, and which we submit to our uses."[39]

Wilkins stated the same principle in 1649: "In our natural enquiries after the *efficient* causes of things, when our reason is at a stand, we are fain sometimes to sit down and satisfy ourselves in the notion of occult *qualities,* and therefore much more should be content to be ignorant of the *final cause* of things, which lie more deep and obscure than the other."[40] On this central doctrine, Mersenne and Wilkins disagreed with Bacon's goal of penetrating into "the nature of things." This principle severely limits the extent to which Bacon can be said to have guided and informed the new science in England. Bacon in fact played a small role in Wilkins' thought, in no way comparable to Mersenne's role. Mersenne and Wilkins also admired Gilbert on points that Bacon did not accept. As *Mathematical Magick* shows, Wilkins also followed Mersenne in taking an interest in automata; they focused attention on interesting problems. In all their conduct and affairs, both Mersenne and Wilkins showed admirable openness and tolerance, of men as well as of opinions. In spite of the dramatic outward differences of their lives, they offer a beautiful example of the unifying, even irenic effect of the new science, in accordance with their mutual aim.[41]

If with Wilkins' contemporaries we grant that he was the chief promoter of the new science in England–not only by virtue of his writings, but also owing to his personal encouragement of individuals and his success in the shaping of scientific organization before and after the official formation of the Royal Society–then his alliance with Mersenne has far-reaching consequences for the belief that the Rosicrucian enlightenment was the seed-bed of the sort of natural philosophy that it was the aim of the Royal Society to promote. No attempt to assess Wilkins' importance can ignore these problems. Fludd and Mersenne do not go together. The groups they represent are not separated by their interest in a philosophy of nature, but they are set apart by their basic methods and principles, and it is this latter criterion that is crucial. Neither does one owe anything to the other regarding the need for formal cooperation and exchange of knowledge in a college (whether invisible or not) or an academy, for this need had been advocated by Mersenne as early as 1623; it was met by Théophraste Renaudot's conferences as early as 1629 and by Mersenne's own Academia Parisiensis at least by 1635. The ubiquitous presence of Hartlib and others shows nothing except a shared interest in natural philosophy and its results, although this presence has been the chief prop of the Rosicrucian argument. The wide tolerance of men like Mersenne and Wilkins should not be construed to mean positive approval. It has been argued that Continental influences reached England through The Hague, owing to the presence there of the exiled Queen Elizabeth of Bohemia, who for well-known reasons made some political use of such men as Hartlib and John Dury (Durie) as well as their contacts with circles that may, at least in part, be called Rosicrucian. In these matters the queen relied heavily on the services of the roving ambassador Sir Thomas Roe. On these grounds it has been argued that John Wallis' account of the first London scientific meetings in 1645 "seems to give a curiously 'Palatinate' coloring to the origins of the Royal Society."[42]

The weakness of this argument is obvious: it ignores the fact that The Hague was the home of a very different intellectual group that had lively contacts with London. It was through these contacts that Mersenne became more widely known in England. During these years, from 1633 until his death in 1649, the English ambassador at The Hague was Sir William Boswell, whose chief business of course was not with the exiled Palatinate queen, but with the court of the House of Orange. A strong royalist and a Laudian, he was successful in preventing Dutch intervention in the Civil War during the 1640's. At the center of this group in The Hague was Constantijn Huygens, whose political, cultural, and intellectual importance is well known. Huygens' correspondence shows that he was on intimate terms with Boswell,[43] and they shared many scholarly interests, including musicology. As secretary to Prince Frederic Henry of Orange, Huygens was Boswell's main contact with the court. He corresponded with both Descartes and Mersenne, as did Boswell although those letters are lost. Huygens regularly transmitted mail from Mersenne in Paris to recipients in Holland, including Descartes; Boswell occasionally did likewise. Between mid-summer of 1639 and August 1640, Boswell lived in London, and it was during this period that Haak initiated his lively correspondence with Mersenne at the encouragement of Boswell, "with whom Haak seems to have enjoyed a long-lasting and close acquaintance," beginning in 1638.[44] As was to be expected, it is evident that the contents of Mersenne's letters became widely known in London, just as these contacts were in part responsible for Mersenne's close English ties during the early 1640's[45]

Having already cited Mersenne in his first two publications, Wilkins may have written *Mercury* on a hint from Mersenne transmitted through Haak. At the beginning of this book, Wilkins tells the reader that it was occasioned by a reading of Francis Godwin's *Nuncius inanimatus, or The Mysterious Messenger* (1629), which he had mentioned in the *Discovery*. It is tempting to think that his renewed interest in speedy and secret communication was related to the fact that Haak had sent Mersenne a copy of Godwin's little book, soon receiving the well-founded judgment that it "was indeed very animated because it teaches us nothing, saying not a word about its secret of communication. What is the use of writing, 'I know such and such things,' but not tell; that is to make fun of the readers."[46] In line with this critique, Wilkins' purpose in *Mercury* was precisely to remove linguistic mystification and the secrecy of ciphers by bringing the technique out in the open. It is no wonder that Wilkins kept informed about Mersenne, so that soon after its publication in 1644 he made the *Cogitata physico-mathematica* the main source of his *Mathematical Magick*. It was at this time, in 1645, that Haak called the first London meetings, which not only discussed scientific subjects but also performed experiments. Wallis' list of the topics shows no Rosicrucian inclination, and the meetings themselves were most likely suggested by the success of Mersenne's Academia Parisiensis.[47] It was the group around Huygens and Boswell at The Hague that exerted a decisive influence in England. The chief foreign vehicle of this influence was Mersenne, its chief beneficiary was Wilkins. The Royal Society is in large measure the record of the nature and success of this influence.[48]

The Oxford Years. In 1648 Wilkins entered upon the second stage of his career. Oxford had come under increasingly severe strains during the 1640's. College finances were in disarray, new admissions dropped precipitously, teaching duties were only fitfully performed, and the academic community was torn into factions aligning royalists and men of the old stamp against Parliamentarians, feuding over religious observances, the inviolability of college statutes, the curriculum, the proper conduct and morals of students and teachers, and even proper modes of personal appearance and attire. This situation was intensified by the frothy presence of extreme Anabaptist agitators who acknowledged no authority but their own private revelations. The crisis came to a head after the victorious Parliamentary forces under Fairfax entered the town. On 1 May 1647, Parliament passed an ordinance which empowered a committee to look after "the better regulating and reformation of the University of Oxford, and the several colleges and halls in the same, and for the due correction of offences, abuses, and disorders, especially of late times committed there."

Within the next year the Parliamentary Visitors came to Oxford, ejected the old warden of Wadham College, and appointed Wilkins, who took charge on 13 April 1648. It proved a wise choice. At the young age of thirty-four, he must have impressed the authorities by his accomplishments in the university and in his varied public offices as well as by his forceful advocacy of new learning, his moderation in religious affairs, his energy, and his extensive connections. Under the guidance of a man who was not considered a bigot, the college admissions soon rose steeply, including a large number of country gentlemen and "cavaliers," a fact that may also have helped improve the finances. It is universally acknowledged that Wadham was a distinguished college during Wilkins' wardenship. Among the new fellows of Wadham who came to Oxford from Cambridge were Seth Ward and Lawrence Rooke, "who was much addicted to experimental philosophy." They were joined by other men migrating from London and the scientific meetings there to continue their work in Oxford. They met at various places, including Wadham, where Wilkins created a laboratory. They included the nucleus of the future Royal Society: John Wallis, Jonathan Goddard, William Petty, Ralph Bathurst, Thomas Willis, and Robert Boyle, to whom Wilkins wrote on 6 September 1653: "I should exceedingly rejoice in your being stayed in England this winter, and the advantage of your conversation at Oxford, where you will be a means to quicken and direct our enquiries." Not long after, Boyle took up residence in Oxford.[49] The meetings were also attended by some of the able students who came to Wadham. The most brilliant was Christopher Wren, Wilkins' special protégé in his early career. Among the others were Wilkins' half-brother Walter Pope, Thomas Sprat, William Lloyd, William Neile, and Samuel Parker.

These men and their activities created an air of modernity and intellectual excitement in the university which suited Wilkins' desire to introduce the new philosophy in a manner that at the same time demanded discipline and significant achievement. He would hardly have been disturbed that his circle was in low repute among the Aristotelians, Galenists, and "those of the old stamp, that had been eminent for school and polemical divinity, and disputations and other polite parts of learning, [who] look upon them very inconsiderably, and their experiments as much below their profound learning and the professors of them."[50] This was precisely what reform was about and why so many sought Wilkins's advice and encouragement. When Oldenburg in the spring of 1656 settled in Oxford for a while, he was glad to find lodgings near Wilkins and Wadham, waxing poetic in his description of the new garden's "design and cultivation, where pleasure rivals utility and ingenuity industry."[51] Created at no small expense, the expansion and layout of this formal garden was one of Wilkins' first innovations. It was exquisitely executed with various mechanical wonders, a Doric temple, and, on a mound, a statue of Atlas carrying the world on his shoulders. The garden shows a characteristic aspect of Wilkins' knowledge and orientation, as does his fondness for music.[52] When the warden's friend, the royalist John Evelyn, visited Wadham in July 1654, he was fascinated by the curiosities he was shown. There were not only scientific instruments, but also a "hollow statue which gave a voice and uttered words" and transparent, elaborately adorned apiaries built in the shape of castles and palaces, but constructed so as to make it possible to take out the honey without destroying the bees.[53] In those days science and ingenuity were visual. While still at the Westminster School, Robert Hooke received a copy of *Mathematical Magick* as a gift from the author; and when a few years later he became a student at Oxford, he attended the scientific meetings and sought Wilkins' advice on his experiments on the art of flying and the making of artificial muscles.[54] Ten years later Hooke concluded the preface to *Micrographia* with an eloquent tribute to Wilkins, describing him as many must have seen him during those years:

There is scarce any one invention, which this nation has produced in our age, but it has some way or other been set forward by his assistance . . . He is indeed a man born for the good of mankind, and for the honor of his country. In the sweetness of whose behavior,in the calmness of his mind, in the unbounded goodness of his heart, we have an evident instance, what the true and the primitive unpassionate religion was, before it was soured by particular factions. . . . So I may thank God, that Dr. Wilkins was an Englishman. for wherever he had lived, there had been the chief seat of generous knowledge and true philosophy.

In the midst of this busy life, Wilkins was also a member of several influential university committees, including the delegacy to which the governance of the university was entrusted by its chancellor, Oliver Cromwell, on 16 October 1652. In this work, Wilkins successfully sought to regain for the university and the colleges their lost autonomy, to mediate between contending factions, and to maintain order and discipline. He especially defended the university against the attacks of radical religious factions, both on the governance of the university and its curriculum. One such attack was Webster's *Academiarum examen* (1654), which Wilkins and Ward answered the same year in *Vindicae academiarum*. It opened with a letter by Wilkins, outlining and rejecting the three main charges. Contrary to Webster's accusations, the university was not a slavish follower of Aristotle but freely opposed him "as any contrary evidence does engage them, being ready to follow the banner of truth by whomsoever it shall be lifted up." Further, the university did not intend to direct its teachings according to the mystical linguistic doctrines of Boehme and "the highly illuminated fraternity of the Rosicrucians." Webster's trust in these authorities, said Wilkins, "may sufficiently convince what a kind of credulous fanatick reformer he is like to prove." Wilkins remained committed to the principles he shared with Mersenne.[55]

There appears to be good reason to accept Tillotson's assessment of Wilkins' achievement in the life of the university: "It is so well known to many worthy persons yet living, and has been so often acknowledged even by his enemies, that in the late times of confusion, almost all that was preserved and kept up of ingenuity and learning, of good order and government in the University of Oxford, was chiefly owning to his prudent conduct and encouragement."[56]

In the spring of 1656, Wilkins married Cromwell's sister, Robina French, which is said to have strengthened his hand with the Lord Protector in the interests of the university.[57]

Cambridge. In 1659 Wilkins made a sudden change of the sort that energetic men, confident of their powers, are prone to make when they, after success in one place, see an opportunity to apply their talents in new territory. After Cromwell's death, Wilkins had become a close adviser to Richard Cromwell, who appointed him master of Trinity College, Cambridge, "thinking he would be as serviceable in that, as he had been in the other university."[58] He took possession in late summer, resigning from the wardenship of Wadham on 3 September 1659. His tenure lasted barely a year. After the king's return to England in May 1660, Henry Ferne was made master, having successfully pressed a claim on the basis of a promise made by Charles I. The reason given was that the statutes did not allow a married master, but without Ferne's intervention this circumstance would hardly have prevented continuation. In a letter of July 1660, "numerously signed," the fellows of Trinity both offered their congratulations on the restoration and requested the reconfirmation of Wilkins, "appointed at their earnest petition, on the death of Dr. Arrowsmith, in 1658."[59]

During his brief association with Cambridge, Wilkins entered the circle of a group of men with whom he, in spite of some differences, had so much in common that he came to be considered one of them. With the Cambridge Platonists, he shared the outlook that was just then coming to be known as latitudinarianism: a commitment to tolerance and comprehension in church affairs, respect for learning, and the principle that the right understanding of religion, both revealed and natural, is essentially governed by reason. At the time of the Act of Uniformity a few years later, Richard Baxter wrote a succinct description of these men. He divided the conformists into three groups: the zealots, those who submitted for a variety of personal and other reasons, and

those called latitudinarians, who were mostly Cambridge men, Platonists or Cartesians, and many of them Arminians with some additions, having more charitable thoughts than others of the salvation of the heathens and infidels. . . . These were ingenious men and scholars, and of universal principles, and free; abhorring at first the imposition of these little things, but thinking them not great enough to stick at when imposed.[60]

Wilkins' departure from Cambridge was felt as a loss by many, one of them being Isaac Barrow, whom Wilkins helped to the geometry professorship at Gresham College in 1662, the year before Barrow assumed the Lucasian chair at Cambridge. With an uncertain future behind him, Wilkins now gravitated to London and the culmination of his career as the energetic center of the Royal Society.

The Royal Society and The Last Years. In 1660 began the third and last stage of Wilkins' career. He did not have to wait long for ecclesiastical preferment. On 28 January 1661, he was again elected preacher at Gray's inn[61]and at the end of the year George Lord Berkeley (1628–1698) presented him with the living of Cranford, Middlesex.[62] On 11 April 1662 he became vicar of St. Lawrence Jewry in London, a living that was in the king's gift; thus he soon gained royal

favor.[63] During the 1660's, he held a plurality of other ecclesiastical offices until in 1668 he became bishop of Chester.[64] Wilkins preached regularly at St. Lawrence Jewry, but his main sphere of activity was elsewhere.

During the late 1650's scientific meetings were held at Gresham College. After attending a lecture by Wren on 28 November 1660, the group gathered to discuss a plan for the founding of "a college for the promoting of physico-mathematical experimental learning." It is an unmistakable sign of Wilkins' importance that he was on this occasion appointed to the chair; within the next two weeks, Oldenburg wrote that Wilkins had been elected "president of the new English Academy very recently founded here under the patronage of the king for the advancement of the sciences."[65] Wilkins was still styled president in the first months of the new year, but on 6 March 1661 Sir Robert Moray was chosen president, no doubt owing to his close associations with the king, whose favor was eagerly and successfully sought during the first years. The rest is a familiar story. The society gained its first official charter under royal patronage a few years later, many new members joined, and an astonishing and ceaseless round of activities got under way, lasting with undiminished energy until about the time of Wilkins' death in November 1672, when attendance at meetings began to drop off and a state of seeming exhaustion set in, no doubt in part owing to a financial crisis. It is hard to say whether this decline was related to the loss of Wilkins, but the coincidence is striking.[66]

The records of these years show that Wilkins was busier than any other member in the affairs of the society. From the beginning until his death, he was each year reelected to the council, being also one of the two secretaries, another elective office, until he became bishop of Chester. He was occasionally called vice-president, although the statutes made no provision for such an office. While secretary, he attended practically every meeting and at most of them he was busy doing something: providing recent information, proposing experiments, being put in charge of this and that, appointed to special committees, asked for advice, engaged in fund-raising, and preparing suitably interesting doings for the king's visits. He proposed a very large number of candidates for membership, suggested that Robert Hooke be made curator of the collections, and proposed Nehemiah Grew as curator for the anatomy of plants.[67] At the same time he also supervised the writing of Sprat's *History of the Royal Society* (1667).[68] During the plague in the summer of 1665, Wilkins, Hooke, and William Petty removed to Durdans near Epsom in Surrey to carry out experiments on "improved chariots" and other mechanical devices; their results were reported to the society the following year. This was one of the several subjects of *Mathematical Magick* that occupied the society during the 1660's.[69]

At the beginning of 1668, Wilkins once more became involved in church affairs. After the fall of Clarendon, during the closing months of the previous year, the way was open for an attempt to bring at least some groups of nonconformists into communion with the church, a policy Wilkins had long supported in accordance with the promise made by the king in the Declaration of Breda shortly before his return to England. It was also advocated by the duke of Buckingham, now the king's first minister. Richard Baxter was approached, but he found himself unable to accept the initial terms of negotiation and requested instead that "two learned peaceable divines" be nominated "to treat with us, till we agreed on the fittest terms." One of them was Wilkins, who drew up a proposal that was revised during further deliberations. Baxter's detailed account shows that Wilkins was a skillful negotiator who tried his best to find a compromise that would satisfy all parties. This proved impossible, and when it became known that a bill for comprehension was ready, Parliament refused to accept it.[70] But Wilkins had Buckingham's patronage, and when the see of Chester fell vacant in August, he was soon appointed and duly consecrated on 14 November 1668.[71] In a diocese known for its large number of Dissenters, he was an lenient to nonconformists as his predecessor had been severe, many being brought into communion with the church owing to his "soft interpretation of the terms of conformity", while others who did not conform were still allowed to preach.[72] Early in 1669, Pepys heard that Wilkins, "my friend . . . shall be removed to Winchester and be Lord Treasurer." Although he discounted this rumor, he added that Wilkins was "a mighty rising man, as being a Latitudinarian, and the Duke of Buckingham's great friend."[73] In the midst of all his activities during the 1660's, Wilkins had also found time to prepare his greatest work, *An Essay Towards a Real Character and a Philosophical Language,* which with the official imprimatur of the Royal society was presented to it on 7 May 1668.[74]

The *Essay* is the largest and most complete work in a long tradition of speculation and effort to create an artificial language that would, in a contemporary phrase, "repair the ruins of Babel." On one level a mere universal language would accomplish this aim by removing the obstacle that ordinary languages place in the way of common communication, whether in religion, commerce, or science. The universal use of a single language, for example, Latin, would meet this problem, but as Latin lost ground during the early half of the seventeenth century, especially in scientific writings, the need for other solutions was felt with greater urgency. As knowledge grew, in large measure aided by the introduction of common, conceptual, nonverbal symbols (much like Arabic numerals), there seemed to be new hope for the idea of a different sort of language, generally traced back to Ramon Lull, which would refer directly to what knowledge and thought are about, rather than using the imperfect medium of ordinary languages. There was wide agreement with Bacon that in these languages words were a perpetual source of philosophical error, being "framed and applied according to the conceit and capacities of the vulgar sort."[75]

The traditional model for such a language, often cited in the seventeenth century, was the language Adam spoke when he named the animals in his perfect state of knowledge before the fall. In the cabalist tradition, in Boehme and Fludd, it was believed that this language could somehow be recaptured. It was, for instance, seriously believed by some that it could be found by a sort of etymological distillation from all existing languages of the hitherto hidden but original elements of the Adamic language, on the assumption that this language was Hebrew, that Hebrew was the source of all other languages, and that these elements expressed the natures or essences of things. This was the mystical way, repeatedly rejected by Mersenne as nonsense; only God can know the essences of things.

But granting that man can grasp the order of creation by sense experience and reason, it would seem possible for man to comprehend and codify this knowledge in an artificial language based on the study of things. Within the more limited range of fallen man, this language would be a substitute for the lost Adamic language; if complete, it would express all man's knowledge in a methodical, rationally ordered fashion that mirrored the fabric of nature. It would be philosophical and scientific without error. On the practical level, it could be expressed in written or spoken symbols or both. Unlike a universal language, in which knowledge was still tied to the "cheat or words," to use another contemporary phrase, it would deal directly with things. This, it was hoped, would not only make knowledge easier and quicker to attain; it would cause a vast increase inknowledge.

These hopes were sustained by an optimism for which nothing seemed unattainable, similar to other expectations that strike us as equally chimerical, for instance the perpetuum mobile and the squaring of the circle. During the first half of the seventeenth century, a wealth of texts toyed with the possibility of a philosophical language, most of them on the level of groping speculation which never reached articulate statement of basic principles. In addition to these texts, there were many rumors about men who were working on such projects. They were typically surrounded by great secrecy, and there were several instances of offers to reveal the secret, for great sums of money. The philosophical language was the exact equivalent of the philosopher's stone. Leibniz brought more conviction, energy, and intelligence to this problem; yet even he never spelled out its full meaning.[76]

Wilkins based his plan on a few basic principles. He assumed that "as men do generally agree in the same principle of reason, so do they likewise agree in the same internal notion or apprehension of things." Now, if the common notions of men could be tied to common marks, written or spoken, then mankind would be "freed from that curse in the confusion of tongues, with all the unhappy consequences of it." These marks would "signify things, and not words," conjoined "with certain invariable rules for all such grammatical derivations and inflexions, and such only, as are natural and necessary," all contrived so "as to have such a dependence upon, and relation to, one another,as might be suitable to the nature of the things and notions which they represented." Thus the various marks, with their modifications, would follow an ordered and rational analysis of knowledge. The advantage would be immense, for "besides [being] the best way to helping the memory by a natural method, the understanding likewise would be highly improved; and we should, by learning the character and the names of things, be instructed likewise in their natures."[77]

Wilkins decided, somewhat arbitrarily he admitted, on forty basic genera, which with "differences" and "species" would produce the marks that would give an inventory of the world, so to speak. Thus "world" is a genus (in the "effable" language represented by *da*), which by addition of the second difference, denoting "celestial" (with the effable sign *d*) produces the notion "heaven" (dad). "Earth" has the same elements, but to it must be added the mark for the seventh species, denoting this "globe of sea and land." This mark isy, so that the effable sign for earth is *dady* As was soon obsesrved by several critics, this entire system was after all closely tied kto English words. Yet, postulating that it followed a natural method, Wilkins believed that it could be mastered in one month.[78] This belief reveals something about the *Essay's* ancestry, for this was precisely the claim being made by mystical projectors, who, however, had the good reason for their claim that they assumed a strict interpretation of the macrocosom-microcosm harmony. For them, once the Babelistic confusion of ordinary words and false concepts was stripped away, man would regain the Adamic nakedness of pure and complete knowledge. With pure intellect thus restored, the need for memory would vanish; the small traces of it still required would be caused by the last imperfections in the system, much as friction cannot be entirely overcome.

The *Essay* was tainted by its ancestry. In *Mercury,* Wilkins had outlined some of its principles, although only for the creation of a universal language. In the *Vindicae academiarum,* having ridiculed Webster's mystical advocacy of a genuinely natural, Adamic language, Seth Ward suddenly, as if unrelated to the subject, had said: "It did presently occur to me, that by the help of logic and mathematics this might soon receive a mighty advantage." He then briefly outlined the plan Wilkins executed. "Such a language as this," Ward said, "where every word were a definition and contained the nature of the thing, might not unjustly be termed a natural language, and would afford that which the cabalists and Rosicrucians have vainly sought for in the Hebrew, and in the names as signed by Adam."[79] The evidence shows that it was soon after and with the help of Ward that Wilkins began work on his philosophical language, as he openly admits in the "Epistle to the Reader" in the *Essay*. In rather awkward fashion Wilkins straddled two traditions that in the minds of most observers could not be brought together. Mersenne had clearly outlined the plan of such a language, but stayed clear of the mystical implications; and, in the evesnt, he seems not to have had faith in its practically, although he took an interest in its theoretical aspects, much as he did in automata.[80] In the *Essay* Wilkins also modified his optimistic statements with great diffidence about the entire plan and avowals of its tentative, incomplete execution, inviting the Royal Society to appoint a committee to examine it and make suggestions for its improvement. It was fortunate for his reputation that the *Essay* came at the end of Wilkins' career.[81]

The publication of the *Essay* put the Royal Society in a difficult situation. Written by one or its best-known members, encouraged and published under its auspices, it caused a crisis of prestige. It had been much talked about before

publication, and it was soon distributed both in England and on the Continent. Yet none of the scientific members of the society had much, if any, faith in it, with the exception of Hooke, who mastered it and continued to take great interest in it.[82] Following Wilkins' wishes, the society immediately set up a committee to report on the *Essay,* but within in the society this committee was never heard from again.[83] It was, however, decided that the society's "respository" under Hooke would be organized according to the *Essay*.[84] In its outward relations, the society talked up the *Essay* with much exaggeration. Thus after Christiaan Huygens had voiced his doubts to Moray, the latter quickly wrote back that the character was easy to master; the king had already done so and everyone was now following his example.[85]

Outside the Royal Society, a group of men (some of whom were fellows) continued to seek to improve and perfect the philosophical language, but with the exception of Hooke, these were men without scientific prestige in the society.[86] Having himself already written on similar plans, Leibniz soon learned about the *Essay;* he admired it greatly, although he still found it short of his own requirements. In 1680 he wrote of this admiration to Haak, but added that something "much greater and more useful could be made of it, insofar as algebraic characters are superior to chemical signs.[87] But so far as the Royal Society was concerned, the *Essay* was quietly forgotten.

The *Essay* did have one important effect; it set John Ray to work on botanical classification. Wilkins had lost all his belongings in the Great Fire of London, including part of the as yet unpublished manuscript of the *Essay*.[88] But eager to finish it, he enlisted the help of Francis Willoughby and John Ray in October 1666. They prepared the zoological and botanical tables. Ray was at the time perhaps Wilkins' most intimate and devoted friend; he immediately went to work, spending much of the next year helping Wilkins, on several occasions spending extended periods with him at Chester. But he admitted at the same time that the project did not suit him.

I was constrained in arranging the tables not to follow the lead of nature, but to accommodate the plants to the author's prescribed system. . . . What possible hope was there that a method of that sort would be satisfactory, and not manifestly imperfect and ridiculous? I frankly and openly admit that it was, for I care for truth more than for my own reputation.[89]

It is a good question whether Wilkins knew of this criticism, which went to the heart of the matter; the *Essay* did not, as he had intended, follow the "method of nature." After publication, Ray helped Wilkins in amending the tables of natural history, just as he also at Wilkins' request made a Latin translation.[90] Later Ray brought his classifications to a perfection that he had not found it possible to achieve within the system of the *Essay*.[91]

Wilkins was now spending most of his time at Chester, with frequent journeys to London. Suffering from "fits of the stone," he unsuccessfully sought a cure at Scarborough Spa during the summer of 1672. On 10 August 1672, Lord Berkeley, recently arrived from Dublin. was nobly entertained by Wilkins at dinner in the bishop's palace at Chester.[92] On 30 October Wilkins was in London, where he attended, for the last time, a meeting of the Royal Society.[93] But the attacks persisted. Hooke and others administered medication, but to no avail. On 19 November 1672, Wilkins died at the house of John Tillotson, who had married his stepdaughter. At his death he is reported to have said that he was "prepared for the great experiment." The funeral sermon was preached by William Lloyd at the Guildhall Chapel on 12 December; "though it proved a wet day, yet his corpse was very honorably attended . . . there were above forty coaches with six horses, besides a great number of others." He was buried in the church of St. Lawrence Jewry.[94]

In his own time Wilkins' stature and influence were very considerable. He was committed to a policy of tolerance that allowed compromise both in political and ecclesiatical affairs, based on the conviction that natural and revealed religion together with the new science proved a benevolent, providential order which, if rightly understood, ensured that mankind could live happily and peacefully, even prosperously, in this world. For this reason, his influence was divided between such men as Hooke, Boyle, and Ray on the one hand, Tillotson, Stillingfleet, and Patrick on the other. In this sense he shaped the temper of England in the latter half of the seventeenth century and left a signficant impresssion on the eighteenth. His influence was acknowledged by John Ray both in the *Wisdom of God Manifested in the Works of the Creation* 1691) and *A Persuasive to a Holy life* (1700), with the telling subtitle, "From the Happiness which Attends It Both in This World and in the World to come." In science, Hooke's tribute in the *Micrographia* leaves no doubt of Wilkins' importance, although he did not make any direct contribution to science. Even those, like Anthony à Wood, whose party loyalties made them caustic critics of men with similar careers, were sparing in their criticism of Wilkins. The age is full of testimonies that are echoed in Gilbert Burnet's Summary of Wilkins' character: "He was naturally ambitious, but was the wisest clergyman I ever knew. He was a lover of mankind, and had a delight indoing good."

NOTES

1.*Of the Principles and Duties of Natural Religion,* 8th ed. (London, 1722), p. 34; 1st ed. (London 1675). It was published from Wilkins' papers by his literary executor, John Tillotson, who in the preface explains that the first 12chapters (pp. 1–165) were left ready for the press by Wilkins. They constitute the greater part of bk. I. entitled *of the Resasonableness of the Principles and Duties of Natural Religion*. The rest was put together by Tillotson from "the materials left for that purpose," including all of bk. II. *Of the Wisdom of Practicing the Duties of Natural Religion*. There are two references (pp. 48, 55) to Tillotson's Sermon Of the Wisdom of Being Religious (1664), but these may be insertions and thus do not necessarily determine the time of composition. William Lloyd's *Sermon Preach'd at the Funeral of the Right Reverend Father in God, JOhn Wilkins, D.D. Late Bishop of Chester* is included.

2.*A Discourse Concerning a New Planet, Tending to Prove, That 'Tis Probable Our Earth Is One of the Planets* (London, 1640), in *The Mathematical and Philosophical Works*. 2 vols.(London. 1802). I. 257. *The Discourse* comprises **I** . 131–261: it was published anonymously.

3.*Principles and Duties*. p. 17.

4.*Ibid*., p. 73.

5.*Ibid*., p. 17. Marine Mersenne had used the same metaphor: "Les Mechaniques peuvent enseigner a bien vivre, soit en imitant les corps de la terre comme I'esprit de I'homme doit chercher le sien dans I'essence divine qui est la source detous les esprits." Dedication in *Les méchaniques de Galilée, Bernard Rochot,* ed. (Paris, 1966).p. 14.

6.*Ibid*., p. 346.

7.*Sermons Preach'd Upon Several Occasions,* 2nd ed. (London, 1701), p. 236, 1st ed. (London, 1677, repr. 1680, 1682). There is a preface by the editor, John Tillotson. The axiom that man is a sociable creature is credited to Aristotie and, as often in Wilkins, supported by reference to the Stoics, especially Seneca.

8.*A Discourse Concerning the Beauty of Providence in all the Rugged Passages of It* (London, 1649), p.65. Similar references occur in *Sermons*. The text of the 9th sermon (pp. 263–287) is Ecclesiastes 4:9– "Two are better than one." Its opening words call Ecclesiastes "a discourse from the most profound principles of reason and philosophy." Like Issac Barrow, Wilkins had a marked preference for the Wisdom Books (see H.R. McAdoo, *The spirit of Anglicanism* [London, 1965], p.239). The 11th sermon (pp. 327–357)and 12th sermon (pp. 359–350)inculate public spiritedness and cooperation; the theme of the 13th sermon (pp. 391–427)is moderation, followed by a sermon on the evils of vengeance and wrath.

9.*Mercury, or the Secret and Swift Messenger* (London, 1641; 2nd ed., 1694). in *Mathematical and Philosophical Works*,**II** . 1.*Mercury* comprises **II** . 1–87: it was published anonymously.

10.*Mercury*,**II** , 53; these are the opening words of ch. 13 "Concerning an Universal Character. That May Be Legible to All Nations and Languages."

11.*Sermons,* p. 184. The nature of language and the sociability of man were discussed in one of Théophraste Renaudot's conferences, 21 May 1635, with views that agree with Mersenne and Wilkins. *Recited général des questions traictées és Conférences du Bureau d'Adresse*. II(Paris, 1660), 458–463: 1st ed. (paris. 1636). Wilkins had great influence on prose style, both in scientific discourse and in sermons. This is succinctly pointed out by Gilbert Burnet, *History of his Own Time*.**6** vols., 2nd ed. enlarged (Oxford, 1833), **I** . 347–348. See also Francis Christensen, "John Wilkins and the Royal Society Reform of Prose Style," in *Modern Language Ouarterly*,**7** (1946), 179–187, 279–290, and esp. W.S. Howell, *Eighteenth-Century British Logic and Rhetoric* (Princeton, 1971), pp. 448–502. Wilkins' basic stylistic doctrine is already stated in the last section of *Ecclesiastes, or a Discourse Concerning the Gift of Preaching as It Falls Under the Rules of Art*. This section, "Concerning Expression," says that "obscurities in the discourse is an argument of ignorance in the mind. The greatest learning is to be seen in the gresatest plainness. The more clearly we understand anything ourselves, the more easily we can expound it to others. When the notion itself is good, the best way to set it off, is in the most obvious plain expression." 3rd ed. (1651), p. 128; 1st ed. (1646). This was Wilkins' most popular work, often reprinted and steadily expanded, also after his death, having reached at least ten printings and its 7th ed. by 1693.

12.*The Discovery of a World in the Moon, Or, a Discourse Tending to Prove, That 'tis Probable There May Be Another Habitable World in Than Planet* (London, 1638). in *Mathematical and Philosophical Works*,**I** . 19. The *Discovery* comprises **1** . 1–130 : it was published anonymously. The 1640 printing contains chapter 14 on the possibility of flying to the moon. Since 1640, the *Discovery* and the *Discourse*. have been published together: there was a 5th ed. in 1684, As Wilkins indicated, the words quoted here are taken from Edward Wright's preface to William Gilbert's *De Magnete* (1600). On the same point, Wilkins also refers to john Calvin's *Commentaries on the First Book of Moses, Called Genesis* (see the translation by John King [Edinburgh, 1847], pp. 84–87, 141, 177,256). I see no evidence that Wilkins knew Galileo's *Letter* with its closely similar arguments, first published in Italian with Latin translation in 1636. In 1640 Wilkins devoted chs. 3–6 of the *Discourse* (I, 149–203) to the same issue, again citing Calvin (now including the *Commentary on the Psalms*), many passages from the Bible and the Church Fathers, and also such modern writers as Girolamo Zanchi, Franciscus Valesius, Christoph Clavius, Gaspar Sanctius, and Mersenne. Their religious and scientific allegiances were diverse : Sanctius and Clavius were Jesuits, the latter a friend of Galileo but opponent of Copernican astronomy : Zanchi studied at Padua and died at Heidelberg where he served the Palatine rulers; Valesius

was a Spanish physician; Mersenne, often cited by Wilkins, took an ambiguous attitude toward Copernicus, but found no scriptural evidence for a charge of heresy, as Wilkins pointed out in the *Discourse*. (I.160). C.f. William s. Hine, "Mersenne and Copernicanism," *Isis*,**64** (1973), 18–32. Zanchi (1516–1590) was a Reformed theologian of pronounced irenic tendencies. His use by Wilkins at this time is noteworthy because he was also, along with especially Hugo Grotius, an authority with William Chillingworth in the *Religion of Protestants* (1638). See the excellent study by Robert R. Orr, *Reason and Authority, the Thought of William Chillingworth* (Oxford, 1967). There are other suggestive similarities between Chilling-worth and Wilkins. Thus *Principles and Duties,* p. 27, cites the last section in bk. II of Grotius' *De veritate religionis Christianae* for the very same purpose as Chillingworth in *Religion,* ch.6, sect.51.

13.*Discourse*,**I** , 172.

14.*Ibid*.,**I** 138 Cf. *Discovery,* "To the Reader" : "it is a flase conceit for us to think that amongst the ancient variety and search of opinions, the best has still prevailed." (In the *Mathematical and Philospical Works* [1802] this "To the Reader" is placed at the front of vol. I, before "The life of the Author.") Mersenne makes the same point in *Questions inouyes* (paris, 1634), pp.144–148.

15.*Mathematical Magick, or the Wonders That May Be Performed by Mechanical Geometry* (London, 1648), in *Mathematical and Philosophical Works*,**II** ,127,131. *Mathematical Magick* comprises **II** , 89–260, but the dedication to the prince elector Palatine and "To the Reader." are placed at the very front of vol. **1** . There was a 4th ed. in 1691.

16.*Mathematical Magick,* "To the Reader." For the other points, often repeated in his writings, see the opening chapters, *ibid*. (**II** , 91–97); cf. *Sermons,* p. 254.

17.*Sermons,* p. 254.

18.*Discovery,* "To the Reader."

19.*Mathematical magick,* "To the Reader," points out that the title was suggested by Cornelius Agrippa, *De vanitate scientiarum,* ch.42.

20.*Discourse*,**I** 136–137, 134.

21.*Discovery*,**I** , 14. The full line in Epistle **I** , 14, reads *Nullius addictus juare in verba magistri* ("Not pledged to echo the opinions of any master") but the entire context of lines 10–18 is relevant. It was John Evelyn who suggested the motto. In "Praefatio ad lectorem" of the *Quoestiones in Genesim,* Mersenne had recalled the same Horatian passage for precisely the same purpose, against Aristotelian authority and in favour of our own experience of phenomena; Wilkins cited this work in the *Discovery* and in the *Discourse*. See Robert Lenoble, *Mersenne ou la naissance du mécanisme* (paris. 1943), p. 224; cf. p. 222.

22. R. E. W. Maddison, *The Life of the Honourable Robert Boyle* (London, 1969), p. 85(Boyle to Hartlib, 14 September1655); Anthony à wood, *Athenae Oxonienses,* Philip Bliss, ed.,**III** (London, 1817),col.971. Wood's information is also in Walter Pope. *Life of Seth Ward* (London, 1697), *p*. 29

23. The information often given that Wilkins was born at Fawsley, Northamptonshire, is not certain; see Barbara J. Shapiro, *John Wilkins* 1614–1672. *An Intellectual Biography* (Berkeley, 1969), pp. 12–13, 254–255.

24. Wood. *op. cit*.,**IV** (1820), col. 752. Edward Sylvester also taught Chillingworth.

25. Reginald. J. Fletcher, *The Pension Book of Gray's Inn, 1569–1669* (London, 1901), PP. 355–357. There is good reason to accept the explanation that it was Wilkins' "skill in the mathematics that chiefly recommended him" to Charles Louis, "his Electoral highness being a great lover and favourer of those sciences, in which he must needs have been very agreeable to his Chaplain, who was entirely of the same turn and temper." See vol. VI (1756), 4266, in *Biographia Britannica,* 7 vols. (London, 1747–1766); this very full and well-informed article is the best biographical account of Wilkins (it covers pp. 4266–4275 and was most likely the work of Thomas Birch).

26. Montague Burrows, ed., *The Register of the Visitors of the University of Oxford from AD 1647 to AD 1658* (London, 1881),p.22, Camden Society, n.s.29.

27. It is not clear whether Wilkins made two journeys during 1648–1649 or whether one of them occurred earlier or, less likely, later. Charles Louis spent most of the years between 1644 and his return (May 1649) in England. In 1644 he was invited to attend the sessions of the Westminster Assembly (Bulstrode Whitelocke, *Memorials* [London, 1732], p. 108). Wilkins was formally accepted by the Assembly on 25 September 1643.

28. It is hard to accept Grant McColley's argument that Campanella's *Apologia* is the main source of both the *Discovery* and the *Discourse*. The reason is not merely that the two writers had little in common except their defense of Galileo, but especially that Wilkins used the important literature published since the *Apologia* (1622). including Galileo's own *Dialogue* in the Latin translation (1635), See "The Debt of Bishop Wilkins to the *Apologia pro Galileo* of Tomaso Campanella" in *Annals of Science*,**4** (1939). 150–168. Campanella,*The Defence of Galiteo,* tr. by Grant McColley, in *Smith College Studies in History*.**22,** nos. 3–4 (April–July 1937), intro. McColley. "The Ross-Wilkins Controversy," in *Annals of Science*,**3** (1938), 153–189. All these items have much useful information, although they are committed to a view of conflict between science and religion that is now outmoded. Hartlib's "Ephemerides" indicate that Campanella was in London during 1635. Ross answered Wilkins in *The New Planet no Planet* (London.1646) The entry on Wilkins in *Biographia Britannica* plausibly suggests that the *Discourse* was not merely a treatise on the new astronomy but written as a defense of Galileo: "It was the first just treatise of its kind, and more effectually exposed the folly and absurdity as well as cruelty of the proceedings in the Inquisition by taking no direct notice of them" (*op. cit*., p. 4268). It is remarkable that Wilkins' defense on the question of biblical authority uses the same arguments as Galileo in the *Letter to the Grand Duchess,* which was presumably not known to Wilkins.

29. Like his two previous books, *Mercury* cites a wealth of sources, both ancient and modern, with some fifty in the latter category. Among the most important are Johannes Trithemius, *De polygraphia* and *stenographia,* Herman nus Hugo, *De origine scribendi* (1617),and Gustaphus Selenus, De *cryptographia* (1624), the name is a pseudonym for the learned Duke August of Braunschweig-Lüneburg. In 1630 John Pell had written "'A Key to Unlock the Meaning of Johannes Trithemius' in His Steganography; Which Key Mr. Pell the Same Year Imparted to Mr. Samuel Hartlib." (See Wood. *Fastic Oxonienses,* Philip Bliss. ed. [London, 1815], I, 463.) Like the *Discovery* and the *Discourse, Mercury* was published anonymously, but the dedication is signed "J. W." It has five commendatory poems at the front, two of them addressing the author as their friend: Richard Hatton, who entered Magdalen Hall. Oxford, on 7 July 1637; and Richart West, who matriculated at Christ Church, Oxford, on 15 February 1633; both presumably knew Wilkins at Oxford, which adds a little to the sparse information we have of Wilkins' life during those years. Another poem is by Sir Francis Kynaston, the center of a literary coterie at court. who in 1635 founded Musaeum Minerva, an academy for young noblemen. Wilkins was clearly getting known in wider circles.

30. Among other recent works are Pierre Gassendi, *Vita Peireskii* (1641), A. Kircher, *De magnete* (1643), and Mario Bettini, *Apiaraia universae philosophia mathematicae, quibus paradoxa et nova pleraque machinamenta ad usus eximios traducta et facillimis demonstrationibus confirmata exhibentur,* 2 vols.(Bologna, 1641–1642).

31. Wilkins mentions Guidobaldo among his chief sources. An abbreviated version of the *Mechanicorum Liber* is in *Mechanics in Sixteenth-Century Italy,* tr. and annotated by Stillman Drake and I. E. Drabkin (University of Wisconsin Press, 1960), pp. 239–328. It includes, on a reduced scale, the line drawings and illustrations of the original. In the final pages of *Mathematical Magick,* Wilkins discussed Arichimedes' screw with reference to Guidobaldo's *De cochlea* (1615). This device also interested Mersenne.

32. The only point on which Wilkins may be indebted to Galileo is the subject "concerning the proportion of slowness and swiftness in mechanical motions" (*Mathematical Magick,* II, 146–148), which shows similarity with chapters 1 and 5 of *Les méchaniques* (see Rochot, ed., pp. 23–25, 32–34), but it is possible that Wilkins could also have found this in some other source. In that work Galileo did not deal with the wedge, but explained the rest on the principle of the lever. The Mersenne work in question is *Tractatus mechanicus theoricus et practicus* (96 pp.) contained in the *Cogitata physico-mathematica,* which was ready from the press on 1 April 1644. This collective volume also contains other pieces to which Wilkins refers. Mersenne explained the screw in terms of the inclined plane, the balance and the wheel in terms of the lever, and the pulley and the wedge in terms that combined the lever and the inclined plane. During the 1630's. Descartes also treated these devices in a number of letters to Mersenne (about August-October 1630 and again at greater length on 13 July 1638)(see C. de Waard *et al*., Mersenne, *Correspondance,* II [1937]. 602–620, and VII [1962], 347–375); and in the letter to Constantijn Huygens 5 October 1637 (Descartes. *Correspondance*. Ch. Adam and G. Milhaud. eds. 11 [Paris, 1939], 31–41). These letters do not all offer the same explanations, but Descartes had a low opinion of Guidobaldo's reduction of the pulley to the lever principle, while Galileo found Guidobaldo the best of all writers on these subjects (see Rochot, ed., p. 77).

33.*Mathematical Magick,* II, 137, 135, 138, 148; cf. *Tractatus,* pp. 39–43. Mersenne's term is *glossocomus*. With the same name, this device was also discussed and explained on the principle of interlocking levers, with illustration, in Bettini, *Apiaria,* I, pt. 4. 31–34, with reference to the source in bk. VIII of Pappus, *Mathematicae collectiones* (1588). This book gave an account of the mechanics of Hero of Alexandria, of which the full text was not known until the late nineteenth century. Pappus attributed the term *glossocomus* to Hero, who is also the source of other terms in the technical vocabulary of mechanics. First published in the late sixteenth century, both his *Automata* and *Pneumatics* were very influential, clearly seen, for instance, in Salomon de Caus, *Les raisons des forces mouvantes avec diverses machines tant utilles que plaisantes*. *Aus quelles sont adjoints plusieurs desseings de grottes et fontaines* (Frankfurt, 1615), Book I. theorem XVI, on the lifting of heavy burdens by the multiplication of forces, has an illustration that bears a striking resemblance to Wilkins' illustration in *Mathematical Magick,* II, 143. De Caus' garden designs found expression in the garden at Wadham College, for instance the mound with a statue (cf. de Caus, bk. II. problem X; bk. I,

problem XII, deals with perpetual motion). In John Bate, *The Mysteries of Nature and Art* (London. 1634), bk. I, "Of Water Works," is a popular exposition of Hero's *Pneumatics,* with illustrations from the Italian edition, showing how to make mechanical chirping birds and the like, all subjects that also fascinated Mersenne and Wilkins, who was clearly much indebted to this tradition stemming from Hero. De Caus was active in England and Heidelberg in the early seventeenth century. On de Caus, see C. S. Makes, *Salomon de Caus 1576–1626* (Paris, 1935).

34.*Ibid*., II, 162 ; cf. Mersenne, *Ballistica et acontismologia* in *Cogitata*.

35.*Ibid*., II 174 ; cf. *De hydraulicus et pneumaticus phaenomenis,* pp. 149–153.

36.*Ibid*., II, 188–194, "Concerning the Possibility of Framing an Ark for Submarine Navigations" ; cf. *De hydraulicus*. pp. 207–208, and *Tractatus de magnetis proprietatibus,* pp. 251–259. In the former, Mersenne, like Wilkins, referred to the submarine constructed by Cornelis Drebbel, who was also known for his work on other devices, including the perpetuum mobile; the name recurs elsewhere in Mersenne. Already in 1634, Mersenne had asked in question 21 of the *Questions inooyes,* pp. 84–89, "Peut-on faire des navires, et des bateaux qui nagent entre deux eaux." The same work opened with one of Wilkins' favorite topics, "A sçavoir si l'art de voller est possible," a problem that recurs in the *Cogitata* (e.g., *Tractatus mechanicus,* p. 41). It is curious that Wilkins already in the *Discovery* (I. 118) had discussed why a man under water does not feel the weight of the water above him, a subject Mersenne treated in the *De hydraulicus,* pp. 204–206. *Mathematical Magick* (II,192) credits information about an especially accomplished French diver to a note to *Tractatus de magnetis,* placed in the pagination of *Harmoniae liber,* p. 368 (also part of the *Cogitata*). For the greater part of his career, Drebbel was active in England, where he died in 1633 During his stay in London in the early 1620's Constantijn Huygens was intimately acquainted with Drebbel's projects and inventions, which were also widely discussed later in the century by Boyle, Wren, and Hooke, in addition to Wilkins. See Gerrit Tierie, *Cornelis Drebbel (1572–1633)* (Paris–Amsterdam, 1932); and L. E. Harris, *The Two Netherlanders Huniphrey Bradley and Cornelis Drebbel* (Cambridge, 1961), pp. 119–227.

37. See Hine, cited at end of note 12. Some time around 1660, Isaac Newton took extensive notes from the *Mathematical Magick;* see Frank E. Manuel, *A Portrait of Isaac Newton* (Cambridge, Mass., 1968), pp. 11,49. The same notebook also has long excerpts from Bate, *Mysteries,* bk. III, "Of Drawing, Washing, Limming, Painting, and Engraving." See E. N. da C. Andrade, "Newton's Early Notebook," in *Nature***135** (1935),360.

38. The term is in Webster's *Academiarum examen* (1654); see Aarsleff, "Leibniz on Locke on Language,", in *Amercian Philosophical Quarterly*,**1** (1964).180.

39.*Questions inouyes,* pp. 69–74, where Mersenne also argues that certainty is possible in mathematics since it deals with quantities, it is "une science de l'imagination, ou de pure intelligence, comme la métaphysique, qui ne se soucie pas d'autre objet que du possible absolut."

40.*Discourse concerning the Beauty of Providence,* p. 71. Belonging to the year of the king's execution, this sermon argued that, "we may infer, how all that confusion and disorder, which seems to be in the affairs of these times, is not so much in the things themselves,. as in our mistake of them" (p.65); it is characteristic of Mersenne and Wilkins that moral and religious arguments jostle statements of scientific principle. In this text Wilkins often cites the Stoics, especially Seneca.

41. For an excellent introduction to Mersenne, see A. C. Crombie's article in *Dictionary of Scientific Biography*,**IX** (1974). 316–322.

42. Frances Yates, *The Rosicrucian Enlightenment* (London, 1972).p. 182; cf. p.183: "We have thus here a chain of tradition leading from the Rosicrucian movement to the antecedents of the Royal Society." See also p. 175 and the reference to H.R. Trevor-Roper there.

43. Boswell has a brief entry in the *Dictionary of National Biography;* there is a much fuller life in *Autobiography of Thomas Raymond and Memoirs of the Family of Guise of Elmore* (London, 1917),G. Davis, ed., pp. 69–80 (Camden Society, third series, vol. 18). Boswell was one of the literary executors of Bacon's estate, possessing among other things the important writings edited by Isaac Gruter,*Francisci Baconi de Verulamio scripta in naturali et universali philosophiâ* (Amsterdam, 1n 1651, Gruter published another manuscript in Boswell's possession, William Gilbert. *De mundo nostro sublunari philosophia nova,* often known as "Physiologia nova." Bacon used this work in some of his writings, though without citation. Mersenne knew of this work, writing to John Pell, on 20 January 1640, that Gilbert had written on "Selenography or the geography of the moon, which however has not been published" (*Correspondance,* IX [1965].52). The most likely source of this information is surely Boswell. Boswell also had a collection of John Dee's papers, some of which he intended to publish himself (C. H. Josten, ed., *Elias Ashmole 1617–1692,* 5 vols. [Oxford, 1966]. II. 1242; IV, 1372). This was known to Hartlib, who recorded it in the "Ephemerides" in 1639; he said there and later repeated (see Davies, p. 77) that Boswell attributed "all his proficiency in learning whatever it be, to the goodness" of Dee's Preface to Euclid. There is no compelling reason to believe that respect for that Preface means commitment to cabalistic doctrines; it is perhaps wiser to accept Leibniz' opinion that Edward Kelley was an impostor who abused Dee. Boswell was secretary to Lord Herbert of Cherbury in 1620 while the latter was ambassador at Paris. There are references to Boswell in *De Briefwisseling van Constantijn Huygens* (1608–1687), J. A. Worp. ed., 6 vols. (The Hague, 1911–1917). (These are vols. XV, XIX, XXI, XXIV, XXVIII, XXXII in the series *Rijks geschiedkundige Publicatien*.) The Mersenne *Correspondance* is of primary importance.

44. Pamela Barnett. *Theodore Haak* (The Hague, 1962), p. 32. Wood, *Athenae Oxonienses,* IV, 280, has an instructive list of Haak's "many great and learned acquaintance," including John Williams, John Selden, Henry Briggs, John Pell, Wilkins, and Boswell, "who encouraged him to keep and continue his correspondence with the learned Mersennus, and others of later time" Wood says of Boswell: "He was a learned man, a great encourager of learning, zealous for the Church of England, faithful in the execution of his embassy, and highly valued by eminent persons" (*Fasti,* I, 332), In the 1640's, Haak and Boswell helped Pell to academic appointments in Holland.

45. In 1639 and 1640, Hartlib's "Ephemerides" show knowledge of the Mersenne-Haak correspondence; during Boswell's stay in London at this time, there is also information about him. For information about Haak, see the entry in *Dictionary of Scienctific Biography,* IV (1972), 606–608.

46.*Correspondance,* XI (1970), 412 (to Haak, 4 September 1640). Mersenne also wrote to Haak on other subjects that occur in Wilkins, e.g., universal language, underwater navigation, and flying (XI, 417,408,435). On 16 November 1640, he wrote to Haak: "Vous avez raison de dire, que ni Dieu, ni les sciences ne sont point léees aux langues, et en effet, chacune est capable d'dzpliquer toute chose." This statement expresses both his own and Wilkins' rejection of mystical linguistic doctrines (XI,420).

47. Christoph J. Scriba, "The Autobiography of John Wallis" in *Notes and Records of the Royal Society*,**25** (1970),40.

48. During the mid-1640's both Wilkins and Haak, himself a native Palatine, were associated with Charles Louis. Both his mother's and his own letters have been extensively published; the letters give no indication that Rosicrucian influence could have come from that source, or even that the writers had any interest in it, An informative recent article is G. A. Benrath. "Die konfessionellen Unionsabestre bungen des Kurfürsten Karl Ludwigs von der Pfalz (*d* 1680)," in *Zeitschrift für die Geschichte des Oberrheins,***116** (1968), 187–252.

49. Boyle, *Works,* Thomas Birch, ed., 6 vols. (London, 1772), VI,633; this is one of the few Wilkins letters on record. At this time, Wilkins found a place at Wadham for the instrument maker Christopher Brooke (or Brookes), "purposely to encourage his ingenuity" (see Wood, *Fasti,* I, 403; aslo E. G. R. Taylor. *The Mathematical Practitioners of Tudor and Stuart England* [Cambridge, 1954], p. 234; this book has a valuable alphabetical collection of brief biographies [pp.165–3071]. followed by al list of works in chronological order [pp, 311–441]).

50. Anthony à Wood, *The History of the Antiquities of the Colleges and Halls in the University of Oxford,* John Gutch, ed., 2 vols (Oxford, 1792–1796), II.pt.1,633–634. Though seen with a somewhat prejudiced eye, this is one of the chief sources for the history of Oxford in this period, with the relevant material on pp. 501–708. Another important source is Montague Burrows, *Register of the Visitors*. The handiest narrative source is Charles Edward Mallet,*A History of the university of Oxford,* 3 vols. (London, 1924–1926). See esp, vol. II. *The Sixteenth and Seventeenth Centuries* (1924).

51.*Correspondence,* A. R. and M. B. Hall, eds., I 94 (letter to Edward Lawrence. April 1656).

52. See T. G. Jackson. *Wadham College* (Oxford. 1843). on the gardens (with illustration). pp. 211–212, on music. p. 117; there is an account of a famous musical evening at Wadham in "The Life of Anthony à wood," in *Athenae Oxonienses,* I (1813),XXXii.

53.*Diary,* E. S. de Beer.ed., III. 105–110(1–13 July 1654).

54. R. T. Gunther, *Early Science at Oxford*. VI (Oxford. 1930). *The Life and Work of Robert Hooke*. pp. 5–9.

55. The two pieces have been reprinted in Allen G. Debus, *Science and Education in the Seventeenth Century; the Webster-Word Debate* (London. 1970). In his letter to Ward, Wilkins nearly verbatim repeats some passages from the opening chapter of his *Discourse Concerning the Gift of Prayer* (1651; 9th ed., 1718) on the three gifts requisite in a minister.

56. "To the Reader," in *Sermons*. Tillotson was specifically rejecting some critical remarks in Wood's *Historia et Antiquitates Universitatis Oxoniensis* (1674), which was a Latin version done by John Fell from Wood's English manuscript. Wood was much displeased with this version. both because of its bad Latin and because Fell had taken the liberty of inserting his own comments, of which the depreciation of Wilkins was one. In the late summer of 1654. some of the Wadham fellows made official complaint about Wilkins' conduct of college affairs, but after due consideration

the charges were rejected by the Visitors: it is not clear the charges were rejected by the Visitors: it is not clear what the issue was. See Burrows, *Register,* pp. 394–397.

57. She had previously been married to Peter French of Christ Church, also a man of some importance in the university. Tillotson married a daughter of that marriage. It is an often repeated error that Wilkins on this occasion gained permission to marry from Cromwell. then chancellor of the university; the Wadham statutes had already been altered in 1651 so as to permit the warden to marry–one wonders whether Wilkins contemplated marriage at that time or whether he was acting on principle. See Jackson. *Wadham College* p. 116. In June 1670. Wilkins was the only bishop to favor a divorce act. then pending (see Edmund Ludlow. *Memoirs*. C. H. Firth. ed., 2 vols [Oxford. 1894]. II, 503). Robina Wilkins died in 1689; she and Wilkins had no children.

58. Mark Noble *Memoirs of the Protectoral-House of Cromwell,* 2 vols. (London.1787).I,314.

59.*Calendar of State Papers, Domestic,* 1660. In preparation for the appointment. Wilkins had been incorporated doctor of divinity at Cambridge on 18 March 1659.

60.*Reliquiae Baxterianae* (London,1696), pt. I, p. 386. Baxter especially sought the churches where he "heard a learned minister that had not obtruded himself upon the people, but was chosen by them, and preached well (as Dr. Wilkins, Dr. Tillotson . . .)" (*ibid*., p. 537). Gilbert Burnet made the same point, counting Benjamin Whichcote, Ralph Cudworth, Henry More,and John Worthington along with Wilkins among "the divines called Latitudinarians." "At Cambridge," he wrote. Wilkins "joined with those who studied to propagate better thoughts, to take men off from being in parties, or from narrow notions, from superstitious conceits, and a fierceness about opinions" (*History of His Own Time,* 1, 340). I see no reason at all for the opinion, heard in the eighteenth century and repeated by John Tulloch, that Wilkins "was a Calvinist . . . of a somewhat strict type" (*Rational Theology and Christian Philosophy in England in the Seventeenth Century,* 2 vols. [Edinburgh, 1872]. II, 442). The terms "latitude-men," "latitudinarianism," and "latitudinarianism" first occurred in the 1660's in a pejorative sense, but were soon adopted as the common term. In 1662 the term was used to refer to the men we call the Cambridge Platonists with stress on the connection between them and the mechanical philosophy. (The generic term Cambridge Platonists did not occur until after the middle of the nineteenth century.) see the pamphlet by S. P., *A Brief Account of the New Sect of Latitude-Men Together With Some Reflections on the New Philosophy*. (S. P. is traditionally identified as Simon Patrick, who was also the first English translator (1680) of Grotius' *De veritate*.) There is an illuminating contemporary account in Edward Fowler, *The Principles and Practices of Certain Moderate Divines of the Church of England (Greatly Misunderstood) Truly Represented and Defended* (London, 1670). Thus this book was published soon after the failure of the bill for comprehension. Fowler calls the latitudinarians "persons of great moderation" and says they are also called "rational preachers" and "moral preachers." He names More, CudWorth, John Worthington, Joseph Mede, and Chillingworth. John Beardmore said that Wilkins "was looked upon as the head of the *Latitudinarians,* as they were then stiled." See "Some Memorials of the Most Reverend Dr. John Tillotson . . . Written Upon the News of His Death [1694] by J. B.," in Thomas Birch. *The Life of the Most Reverend Dr. John Tillotson,* 2nd ed. (London, 1753), p. 390. The term "latitude" is given prominence by Chillingworth: "This Deifying of our own Interpretations, and tyrannous inforcing them upon others; Restraining of the World of God from that latitude and generality, and the Understandings of Men from that liberty, wherein Christ and the Apostles left of the Church . . . the common Incendiary of Christendom" *(Religion of Protestants,* ch. 4.sect. 16: in this passage Chillingworth cites the agreement of Zanchi). The two chief influences on Tillotson were Chillingworth and Wilkins. Ernst Cassirer's *Die Platonische Renaissance in England and die Schule von Cambridge* (Leipzig-Berlin, 1932), opens with the surprising opinion that the Cambridge Platonists were hostile to the new mechanical philosophy and had little understanding of it. With characteristic misjudgment, R. F. Jones believed that Samuel Parker's *A Free and impartial Censure of the Platonick Philosophy* (Oxford, 1666 was "a vigorous attack" on the Cambridge Platonists; in agreement with the common use of the term "Platonic" at that time, it was a critique of the chief opponents of the new philosophy, *i.e.,* enthusiasts and Rosicrucians of the sort illustrated by John Webster, whose *Academiarum Examen* Jones, astonishingly, calls "the most important expression of the new scientific outlook between Bacon and the Restoration" (*Ancients and Moderns* [paper-back ed., 1965], pp. 188. 108). For reliable information and interpretation, see Marjorie Nicolson, "Christ's College and the Latitude-Men," in *Modern Philology,***27** (1929), 35–53, and McAdoo,*The Spirit of Anglicanism*.

61. Fletcher, *Pension Book,* 435–436.

62. White Kennett, *Historical Register* (London, 1706), p. 576. Wilkins succeeded Thomas Fuller on 10 December 1661. The appointment shows Wilkins' life-long association with the Berkeley family, this George Berkeley being the son of the man to whom *Mercury* was dedicated.

63. Kennett, p. 658; Wilkins succeeded Seth Ward, who became bishop of Exeter.

64. Some of these offices are listed in R. B. Gardiner, *The Registers of Wadham college,* pt. I. 1613–1719 (London, 1889),p. 171.

65.*Correspondence,* I, 406 (Oldenburg to Boreel, 13 December 1660). The term "physico-mathematical" may have been heard before, but it brings to mind the title of Mersenne's *Cogitata physico-mathemactica;* was it perhaps Wilkins who had brought in the proposal?

66. Wilkins willed £400 to the Society.

67. Among the candidates Wilkins proposed were Haak, John Hoskins, Francis Willoughby, Edward Bysshe, George Smyth, Thomas Sprat, Henry Power, Henry More. John Ray, and Anthony Lowther; they were all elected; he also proposed Ralph Cudworth. who for some reason never joined. *The Record of the Royal Society of London,* 4th ed.(London,1940), does not list Cudworth among the members contrary to statements in the recent literature, e.g., J. A. Passmore. *Ralph Cudworth* (Cambridge, 1951), p.2; and McAdoo, p. 121.

68. I have dealt with that important function in the entry on Thomas Sprat in *Dictionary of Scientific Biography,* XII (1975), 580–587.

69. Thomas Birch, *History of the Royal Society,* 4 vols. (London, 1756–1757), II, 30, 41, 60, 66, 74, 89, Durdans was the property of Lord Berkeley. On his return from Oxford on 7 September 1665, Evelyn stopped at "Durdans by the way, where I found Dr. Wilkins, Sir William Petty and Mr. Hooke contriving chariots, new rigs for ships, a wheel for one to run races in, and other mechanical inventions, and perhaps three such persons together were not to be found elsewhere in Europe, for parts and ingenuity." Samuel Pepys was interested in the same matter; see entries in his *Diary* under 11 and 22 January 1666. See also letter from Hooke to Boyle, 8 July 1665, in Gunther, *Early Science,* VI, 248.

70. Baxter, *Reliquiae,* pt. III. pp. 23 ff; Burnet, *History,* I, 477. On the Comprehension scheme, see Norman Sykes, *From Sheldon to Seeker. Aspects of English Church History 1660–1678* (Cambridge,1959), pp. 71–75. At this time Sir Matthew Hale and Wilkins "came to contract a firm and familiar friendship." so close that "there was an intimacy and freedom in [Hale's] converse with Bishop Wilkins that was singular to him alone." See Gilbert Burnet, *The Life and Death of Sir Matthew Hale, Kt. Sometime Lord Chief Justice of His Majesty's Court of Kings's Bench* (London, 1700). Hale was also close to James Ussher and Baxter.

71. Burnet, *History,* I, 464; Evelyn's description in *Diary* under that date. Benjamin Whichcote succeeded Wilkins as vicar of St. Lawrence Jewry.

72. Kennett, *Register,* pp.815, 817, 921.

73. Pepys, *Diary,* 16 March 1669.

74. In a meeting of the Royal Society on 29 October 1662, "Dr. Wilkins was put in mind to prosecute his design of an *universal language"* (Birch, *History,* I, 119).

75. Aarsleff, "Leibniz on Locke on Language," p. 178.

76. Albert Heinekamp, "Ars characteristica und natürliche Sprache bei Leibniz," in *Tijdschrift voor Filosofie*,**34** (1972), 452; this article is an excellent treatment of the subject. The classic treatment is Louis Couturat, *La logique de Leibniz* (Paris, 1901), esp. chs. 2–5. A briefer discussion is found in L. Couturat and L. Leau, *Histoire de la langue universells* (Paris. 1907), with a section on Wilkins, pp. 19–22. Paolo Rossi, *Clavis universalis, arti mnemoniche e logica combinatroia da Lullo a Leibmniz* (Milan, 1960), is the best history of the subject. In the literature, both primary and secondary, the *locus classicus* for the philosophical language is Descartes's letter to Mersenne, 20 November 1629 (Mersenne, *Correspondance,***11,** 323–339), written in response to a project of which Mersenne had sent him a copy. The subject is often mentioned in the Mersenne correspondence, but unfortunately the notes, usually so informative, attached both to the Descartes letter and others on the same subject are very confused; this confusion has gradually been cleared up in recent volumes, It is an index of the low conceptual level of much recent secondary writing on this popular topic that it fails to make the distinction between a merely universal and a philosophical language; this has made it possible for some to argue that the philosophical language came about by a sort of evolutionary growth of stenography.

77. Wilkins, *Essay,* pp. 20–21.

78.*Ibid*., pp. 51–52, 398, 454.

79. Debus. pp. 214–216 (original pagination, also given there, pp. 20–22). Ward's basic outline does not state anything that had not been said earlier.

80. For the relevant passages in Mersenne, see references given in notes 50–51 to the entry on Mersenne in *Dictionary of Scientific Biography,* IX, 322. Cf. Lenoble, *Mersenne,* pp. 514–518; Eberhard Knobloch. "Marin Mersenne's Beitrag zur Kombinatorik," in *Südhoffs Archiev*,**58** (1974) 356–379.

81. There are useful illustrations in E. N. da C. Andrade, "The Real Character of Bishop Wilkins," in *Annals of Science,* I (1936), 1–12. An informative account is Jonathan Cohen, "On the Project of a Universal Character," in *Mind*,**63** (1954), 49–63. Although weak on the intellectual and philosophical context there is much useful detail on contemporary projects in Vivian Salmon, *The Works of Francis Lodwick. A Study of his Writings in the intellectual Context of the Seventeenth Century* (London, 1972). In a monograph entitled *Zum Weltsprachenproblem in England im 17. Jahrhundert. G. Dalgarno's 'Ars singnorum' und J. Wilkins' 'Essay' (1668)* (Heidelberg, 1929; *Anglistische Forschungen,* Heft 69), Otto Funke argued that Bacon was the inspiration for such projects and that Wilkins was in large measure indebted to Dalgarno. Funke does not consider Mersenne. In a useful article on "The Evolution of Dalgarno's *Ars Signorum*," in *Studies in Language and Literature in Honour of Margaret Schlauch* (Warsaw, 1966), pp. 353–371, Vivian Salmon, along somewhat similar lines, argued that "without Dalgarno, Wilkins would never have begun the task which led to the Essay" (p. 370); the evidence, including troublesome questions of dating and personal relationships, does not warrant that conclusion. Neither Funke nor Salmon considered the cogent contemporary discussion in Robert Plot's *Natural History of Oxfordshire* (London, 1677), pp. 282–285, which concludes that the question must be left open. Anthony à Wood is the source of the persistent belief that Wilkins cribbed from Dalgarno's *Ars signorum,* saying that the author showed it, before it went to press, to Wilkins "who from thence taking a hint of a greater matter, carried it on, and brought it up to that which you see extant" (*Athenae Oxonienses*,**III** , 970; this opinion is repeated in the entry on Wilkins in the *Dictionary of National Biography*), Benjamin DeMott has unconvincingly argued for strong Comenian influence on Wilkins ("Comenius and the Real Character in England," in *Publications of the Modern Language Association,***70** [1955], 1068–1081; "The Sources and Development of John Wilkins' Philosophical Language," in *Journal of English and Germanic Philology,***57** [1958], 1–13). He rests his argument chiefly on the claim for the irenic religious effect of the philosophical language, but this is a common claim that cannot be used for such identification, but the fundamental difficulty is that what Comenius had to say on this subject was not original. DeMott ignores Mersenne. Salmon argues against DeMott in "Language-Planning in Seventeenth-century England," *In Memory of J. R. Firth* (London, 1966), pp. 370–397. R.F. Jones, "Science and Language in England of the Mid-Seventeenth Century," in Jones. *The Seventeenth Century* (Stanford, 1951; original publ. 1932), was always a poor guide and is now thoroughly outmoded. Jorge Luis Borges' quaint essay "The Analytical Language of John Wilkins' has brought Wilkins and the *Essay* to the attention of the literati (in *Other Inquisitions 1937–1952*. Ruth L.C. Sims, trans. [New York, 1966], pp. 106–110). See also the entries on Boehme, in *Dictionary of Scientific Biography*,**II** (1970). 222–224; and on Comenius, *ibid.,* III (1971), 359–363.

82. R.T. Gunther. *Early Science in Oxford*. vol. VIII *The Cutler Lectures of Robert Hooke* (Oxford, 1931), pp. 150–152, with illustration (reproduced in Andrade). Hooke found it "so truly philosophical, and so perfectly and throughly methodical, that there seems to be nothing wanting to make it have the utmost perfection." Hooke's faith in the philosophical language is closely related to his belief in demonstrability in natural science, a belief not shared by his scientific colleagues in the Royal Society.

83. Since this is true also of other committees appointed by the Society during these years, the failure to report cannot be taken as evidence one way or the other.

84. This had been suggested by Wilkins in the "Epistle dedicatory" of the *Essay*. See also Sprat, *History of the Royal Society,* p. 251. Hooke called memory a "respository." His conception intimates a link with the mnemonic tradition; in John Willis' *The Art of Memory* (London, 1612; later reissued), *repository* is the word for the memory device of "an imaginary house or building."

85. Huygens, *Oeuvres,* VI, 397 (Huygens to Moray, 30 March 1669); *ibid*., p. 425 (Moray to Huygens, 16 April 1669).

86. This correspondence is in the Aubrey MSS in the Bodleian Library, Oxford. They have recently been examined by Vivian Salmon in "John Wilkins' *Essay* (1668): Critics and Continuators," in *Historiographia Linguistica,***1** (1974), 147–163. Great efforts were made to elicit a plan from Seth Ward, but when it finally came it was found disappointing, inclining "too much to Lullius" (MS Aubrey 13, fol. 113v, Thomas Pigott to Aubrey at Hooke's Oxford, 14 April 1678).

87. Leibniz, *Philosophische Schriften*. C.I. Gerharbt, ed., 7 vols. (Berlin, 1875–1890), VII 16.

88. On this occasion Seth Ward helped Wilkins to a precentorship at Exeter; see Pope, *Lie of Seth Ward*. p. 56

89. Ray to Martin Lister (7 May 1669), quoted in Charles E. Raven, *John Ray* (London, 1950), p. 182. Ray repeats this judgment in several other letters of the same years.

90. Several Continental scholars, including Leibniz, had called for a translation. Ray's translation is known to have been in the archives of the Royal Society for more than a century, but has since been lost. As late as May 1678. Aubrey wrote to Ray: "I have at length gotten my desire, viz. an able Frenchman to translate the real Character into French. It is Dr. Lewis du Moulin," W. Derham, *Philosophical Letters of Ray* (London, 1718), p. 144.

91. There is an illuminating discussion of these problems in Phillip R. Sloan, "John Locke, John Ray, and the Problems of Natural System," in *Journal of the History of Biology,***5** (1972), 1–53. Locke said in the *Essay:* "**I** am not so vain to think that anyone can pretend to attempt the perfect reforming the languages of the world, no, not so much as of his own country, without making himself ridiculous" (Book III. ch. 11, paragraph 2). This represents the general view of the Royal Society. There is cogent criticism of Wilkins' *Essay in Reflections Upon Learning* (1699) by the antiquary and critic of the new science, Thomas Baker; see *Reflections,* 4th ed. (1708), pp. 21–22.

92.*Calendar of State Papers, Domestic,* 1672.

93.*Diary of Robert Hooke,* 1672–1680, Henry W. Robinson and Walter Adams, eds. (London, 1935), p. 11.

94. The death is reported in Hooke's *Diary* under 19 November: "Lord Bishop of Chester died about 9 in the morning of a suppression of the Urine." On the next day, he had more details: "Dr. Needham brought in account of Lord Chester's having no stoppage in his uriters nor defect in the kidneys. There was only found 2 small stones in one kidney and some little gravel in one uriter but neither big enough to stop the water. 'Twas believed his opiates and some other medicines killed him, there being no visible cause of his death, he died very quickly and with little pain, lament of all." The cause of Wilkins' death continued to be a matter of debate. In 1695, the physician Edward Baynard published "An Account of the Probable Causes of the Pain in Rheumatisms: as also of the Cure of a Total Suppression of Urine, not caused by a Stone, by the Use of Acids," in *Philosophical Transactions of the Royal Society,***19** (Jan.–Feb. 1695), 19–20. Baynard suggests that Wilkins' case was falsely diagnosed.

BIBLIOGRAPHY

I. Original Works. In addition to the works in the notes. see the following: *A Sermon Preached Before the King on March 7, 1669* (London, 1669). *A Sermon Preached Before the King on March 19, 1671* (London, 1671). These two sermons are not reprinted in Tillotson's collection of fifteen sermons.

When the *Discovery* and the *Discourse* were first published together, in 1640, they appeared under the title *A Discourse Concerning a New World and Another Planet in Two Books*. Several of Wilkins' works have been issued in reprints in recent years. *The Mathematical and Philosophical Works* (London, 1708) is the first collection of the works covered by that title. They are here placed in chronological order of publication with separate paginations and title pages. This edition opens with a "Life of the Author and an Account of His Writings," and closes with "An Abstract of Dr. Wilkins' *Essay Towards a Real Character and a Philosophical Language*." The contents are the same as in the 1802 edition

II. Secondary Literature. This literature is given in the notes. Our knowledge of Wilkins' life derives chiefly from the early biographical writings: William Lloyd's funeral sermon; Walter Pope, *The Life of Seth Ward . . . With a Brief Account of Bishop Wilkins, Mr. Lawrence Rooke, Dr. Isaac Barrow, Dr. Turberville, and Others* (London, 1697); John Aubrey, "John Wilkins," in *Aubrey's Brief Lives,* Oliver Lawson Dick, ed., (Ann Arbor, 1957), pp. 319–320; A. à Wood, *Athenae Oxonienses,* Bliss, ed., III (1817), cols. 967–971, but this rich source has much relevant information scattered throughout the four volumes. This is also true of Wood, *Fasti Oxonienses,* and *History of the Antiquities of the Colleges and Halls in the University of Oxford,* John Gutch, ed. See also Pierre Bayle, *A General Dictionary,Historical and Critical . . .* John Peter Bernard, Thomas Birch, John Lockman, eds., 10 vols. (London, 1734–1741), X, 160–164. The best biographical entry on Wilkins is the one in *Biographia Britannica* ; see n. 25. It is much better than the entry in the *Dictionary of National Biography*. (In the article on Thomas Sprat in the *Dictionary of Scientific Biography* I attributed independent value to the biographical notice of Wilkins entered at the time of his death in Birch. *History of the Royal Society,* III 67–68; I now believe that this notice was inserted by Birch.) These sources have formed the bases of entries in biographical reference works since the eighteenth century, with the accretion of more or less reliable anecdotal matter from other sources.

Since Wilkins was so widely known in his own time, he is mentioned in most contemporary records, some published long ago and some only recently, such as the diaries of John Evelyn and Samuel Pepys, Birch's *History of the Royal Society,* the correspondence of Henry Oldenburg, and *The Diary and Correspondence of Dr. John Worthington,* James Crossley, ed., 2 vols in three parts (Manchester, 1855, 1886, with vol. II, part II edited by R. C. Christie). (These are vols. 13, 36 and 114 in the publications of the Chetham Society.)

On Wilkins and Wadham College, the most important treatment is Jackson's *Wadham College,* but see also J. Wells, *Wadham College* (London, 1898,) pp. 69–87. Patrick A. W. Henderson, *The Life and Times of John Wilkins* (London, 1910), is chiefly about Wadham College. The best modern biography is Dorothy Stimson, "Dr. Wilkins and the Royal

Society," in *Journal of Modern History*,**3** (1931), 539–563. Neither J. G. Crowther, *Founders of British Science* (London, 1960), nor E. J. Bowen and Sir Harold Hartley, "John Wilkins" in *The Royal Society, Its Origins and Founders* Sir Harold Hartley, ed. (London, 1960), pp. 47–56, offer anything new, and they are not reliable. For some reason, the subject of Wilkins at large has proved an open field for guesswork, partisan interpretation, and free anecdotal accretion. The intellectual history of England in the mid–seventeenth century has been treated in a number of recent books that show great diversity of interpretation, e.g., Christopher Hill, *Intellectual Origins of the English Revolution* (Oxford, 1965), and Frances A. Yates, *The Rosicrucian Enlightenment* (London, 1972); this literature tends to be occupied with polemics rather than substance. Barbara J. Shapiro, *John Wilkins* 1614–1672 *An Intellectual Biography* (Berkeley, 1969), has some new biographical information, but does not meet its claim to being an intellectual biography. Based on a small part of the relevant literature, Henry G. van Leeuwen presents an illuminating discussion of his subject in *The Problem of Certainty in English Thought* 1630–1690 (The Hague, 1963). He argues that Chillingworth's discussion was followed by Tillotson, which is correct, but then postulates that Wilkins and Glanvill, learning from Tillotson, "secularized" the argument for the benefit of science and the Royal Society. Simple chronology is enough to refute that interpretation. The deeper problem. however, is that van Leeuwen ignores Wilkins' early writings except *Mercury,* and that he makes a distinction between religion and science (as is also clearly shown in the notion of secularization) that is not warranted by the texts and the intellectual framework of the time; the term "natural religion" should be a sufficient reminder of that fact. (Van Leeuwen also states that *Mathematical Magick* was composed, "like most of [Wilkins'] earlier works, during his school days" [p. 56]) Shapiro rightly argues against van Leeuwen (pp. 232–316); see also Shapiro, "Latitudinarianism and Science in Seventeenth-Century England," in *Past and Present,* no. 40 (July 1968), 16–41. Marjorie Hope Nicolson's *Voyages to the Moon* (New York, 1948) is the classic treatment of a subject that has come to be associated with Wilkins. There is an excellent account of Wilkins in H. R. McAdoo, *The Spirit of Anglicanism. A Survey of Anglican Theological Method in the Seventeenth Century* (London, 1965), esp. pp. 203–231; it is the most important recent treatment of Wilkins. See also the bibliographies under the entries for Theodore Haak and Thomas Sprat in the *Dictionary of Scientific Biography*

I have also used material contained in five lectures given under the auspices of the Program in the History and Philosophy of Science at Princeton University in the spring of 1964, entitled "Language, Man, and Knowledge in the 16th and 17th Centuries."

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