MATHEMATICAL MESSIAH: ROBERT RECORDE AND THE
POPULARIZATION OF MATHEMATICS IN THE
SIXTEENTH CENTURY

THESIS

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Robert Recorde (c. 1510-1557) was a pioneer in the teaching of mathematics in the English language. His attempt to popularize mathematics, in fact, was without precedent in any language. Mathematics in the 1500s was still exclusively reserved for mathematicians, and people in general had no interest in the subject. Within a hundred years after Recorde had popularized mathematics, however, this situation had changed. The scientific revolution of the seventeenth century occurred and mathematics became an indispensible aspect of man's knowledge. This thesis examines the background and development of Recorde's attempt to popularize mathematics and evaluates that attempt in terms of its relation to the position of science in the modern world.
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INTRODUCTION

Mathematics today is at once functional and aesthetic. In its pure form, mathematics represents the Idea of absolute perfection that exists independent of the mind and out of this world. The pursuit of mathematics in this form, remarks Alfred North Whitehead, is "a divine madness of the human spirit, a refuge from the goading urgency of contingent happenings."\(^1\) In its lesser form, mathematics is capable of being immensely useful in the mundane realities of life. Few persons in the modern world can conduct their daily lives without at least a fundamental knowledge of mathematics. The recognition of this usefulness alone has made mathematics the only truly universal language among mankind.

The universality of mathematics has not always existed, however. When the pursuit was initially developed in the Western world, where the present form of mathematical study and practice originated, it was ontological and highly exclusive, a spiritual quest for the hidden mysteries of the universe through the use of numbers. The numbers themselves were not tools but the aspects of the fundamental nature of things, and the relationship among

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them resembled the harmonies of heavenly music. Pythagoras, the legendary founder of the Greek mathematical movement in the sixth century B.C., was not interested in making mathematics applicable in the practical sense of the word.² His concerns were with the quintessence of nature—the general, not the particular. As the number one was the essence of oneness (the beginning of all numbers as well as their unity), the number seven, by the same token, could be referred to any seven entities indifferently. Due to the mysticism that surrounded the cult of mathematics, all potential members were required to undergo a long testing period and rigorous selection. The uninitiated were not allowed to share the cult's secrets; its members regarded the masses as unworthy and held them in contempt. All in all, the Pythagoreans were a small group of men who religiously practiced their mathematics in isolation. Their pursuit was an elitist spiritual holiday that precluded the possible development of any practical aspects of their knowledge.

As a group, the Pythagoreans no doubt made great discoveries in spite of, or perhaps because of, their mystical conception of the universe. But their collective

effort was also foredoomed from the beginning. Without the practical basis for their mathematics, their study was not scientia but sapentia; it was demonstrative, not theoretical. The problem was intrinsic and could not be easily solved without destroying the basis that had led the Pythagoreans to the study of mathematics in the first place. The dilemma involved their commitment to the notion of mathematical perfection which derived directly from the regular and eternal movements of the heavenly bodies. From this divine perfection, they were able to formulate numerical rules that were absolute and inviolable. The only drawback in this formulation was that phenomena in the sublunary sphere had a tendency to deviate from the general rules. To rid themselves of these irritable anomalies, the Pythagoreans excluded the earth from their grand mathematical scheme and made it the exception. This action, although an effective method for eliminating contradictions, produced an unforeseen repercussion. To separate earthly occurrences from the rest of the cosmos, the Pythagoreans

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4"The heavens do not declare the glory of God, they are the glory of God; for the cosmos is a living god, welded into a single divine unity by the marvellous power of mathematical and musical harmony." Guthrie, p. 308.
violated their own most fundamental tenet that "all is number" and created a serious flaw within the rules they had so painstakingly constructed. As long as there were two opposing spheres, one above and the other below, there was no possibility that an absolute and universal mathematics could be attained.

Plato was probably the only individual in antiquity who recognized the Pythagoreans' predicament and tried to remedy the situation with his concept of the Divine Mind that would link the two worlds together. The Platonic god, as A. O. Lovejoy points out, was a "Two-Gods in One" who was as perfect as he was imperfect. On one hand, he was the incorporeal deity who was as self-sufficient, self-contained, and eternal as the celestial realm in which he dwelled. On the other hand, he was a corporeal entity "whose prime attribute was generativeness, whose manifestation was to be found in the diversity of creatures and therefore in the temporal orders and the manifold spectacle of nature's processes." By attributing these dualistic features to a single being, Plato maintained that there was a "great chain of being" that extended from the heavens

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5 The relationship between Plato and the Pythagoreans is to be expounded further in this text. See pp. 42-43.


7 Ibid., p. 315.
to the earth. Since mathematics was the very essence of this god, it was conceivable that it, too, was dualistic and as applicable to this world as to the cosmos.

It was unfortunate that this particular aspect of Plato's chief disciple, chose not to bridge but to confirm the divisibility of the material and the spiritual worlds. Mathematics was pronounced as belonging to the realm of metaphysics. For things physical, Aristotle classified rather than measured. The "golden age" of Hellenistic mathematics that came after this period, marked by the figures of Ptolemy and Archimedes, was as much the last breath of classical mathematics as its glory. The Archimedean mechanic and the Ptolemaic cosmology had no common ground in which the spiritual and the material realm could unite; their works forced the issue without providing an answer. Torn by its own contradiction, the Olympian mathematics that had begun so magnificently went into a state of limbo. It is not surprising that, when great medieval thinkers like Albertus Magnus and Thomas Aquinas attempted to reconstruct the chain of being, the vital link in their chains was biological rather than mathematical. There was little chance for viable mathematics before the connection between the two worlds could be found and firmly established. It appeared that the eternity of mathematics, like that of the Platonic god,
could not survive without the service of man, a mere transient player in the cosmic opera.

The attempt to resurrect mathematics came during the Renaissance. It coincided with the advent of the printing press, the development of humanism, and the revival of Platnoism in the fifteenth century. The movement was probably initiated by Regiomontanus (Johannes Müller) from Padua.\(^8\) Even then, however, the new generation of Renaissance mathematicians seemed to be no less oblivious to the contradiction that had led the whole tradition to its doom centuries earlier. Along with the actual knowledge of how to make mathematics, the ancient lores and codes of conduct were brought back to life in their totality. As late as 1543, Copernicus, who was undoubtedly influenced by Regiomontanus' program, warned the ignorant masses not to contaminate holy texts with their ignorance. "Mathematics," he wrote, "is written for mathematicians."\(^9\) Those who were not initiated into the art should not pry into it; in doing so they had nothing to gain and a great deal to lose.

Yet, despite these traditional restrictions and inhibitions on the part of mathematicians, the knowledge of

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mathematics was soon to spread throughout the world and to all walks of life. In some cases, that knowledge might be as rudimentary as addition, subtraction, multiplication, and division, but these functions, although basic, are mathematics, nevertheless. The levels of mathematical knowledge that have now been attained are considerably higher than those in the possession of the thirteenth-century European "advanced students." Between the time of Regiomontanus and the scientific revolution of the seventeenth century, some occurrences took place to alter the mathematical tradition and allowed it to expand as well as advance, for it is during this period that the cyclical conception of the Greeks was broken and mathematics was universalized and popularized all at once. From this point onward, the field of mathematics became inclusive rather than exclusive and a mistress of science and modern man.

How the knowledge of mathematics was disseminated is the overall framework of this paper. In particular, it will deal with the life and works of Robert Recorde, a Tudor mathematician whose importance as the pioneer in the teaching of mathematics in the English language is widely acknowledged. His published texts on the subject are the earliest notable works of their kind. For almost two

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centuries after their publication, these texts were extremely popular and influential, so much so that the Dictionary of National Biography (DNB) credits Recorde as being "practically the founder of an English school of mathematical writers."  

What is less apparent is that Recorde's works also represent the first comprehensive attempt to educate the public in mathematics in any European vernacular. No precedent existed upon which he could base or justify this undertaking; thus, one is moved to ask why a sixteenth-century mathematician would subject himself to such a demeaning endeavor and appoint himself a popularizer of the knowledge that was supposed to be the well-guarded secret of his discipline. Equally puzzling but crucially pertinent is how Recorde managed to cross the spiritual and intellectual gulf, enforced by over a millennium of traditional distrust and contempt, to create a bridge between one mathematical mind and the rest of humanity. Finally, one must inquire into the substance and ideas behind these abstract texts that gained them such wide and immediate acceptance. By exploring answers to these questions,


12This aspect of Recorde's texts is first indicated by Francis R. Johnson and Sanford V. Larkey in "Robert Recorde's Mathematical Teaching and the Anti-Aristotelian Movement," The Huntington Library Bulletin, VII (April, 1935), 78.
through an examination of Recorde's life and textual analysis of his works, it is believed that part of the larger picture of how mathematics came to play its indispensable role in the modern world will be revealed.
CHAPTER I

ROBERT RECORDE: LIFE AND DEVELOPMENT
OF A MATHEMATICS TEACHER

Few historical figures are more neglected by modern scholars than Robert Recorde. His role as a "popularizer of mathematics" makes him an unlikely candidate for an intensive inquiry; historians of science shun him for not being a great theorist responsible for significant advances in the development of his discipline, and historians in other areas have no great love for mathematics and seem content to let anything mathematical be written by mathematicians. In either case, Recorde is lost. He becomes that unsavory figure who exists in the penumbral area somewhere between a highly specialized and general history. Bits and pieces of his life's story are left scattered and unanalyzed. Despite the acknowledgment of his contribution to the expansion of mathematical study, thus far only one comprehensive study on him exists, and its emphasis is on his position as a Renaissance scientist.¹ The main attempt of this section will be to organize the fragmented

information available about Recorde's life and evaluate it in relation to his career as the man who first popularized mathematics.

Robert Recorde was born of a "genteel family," around 1510, in Tenby, Pembrokeshire, Wales. He entered Oxford at about the age of fifteen and graduated with a B.A. before he was twenty-one. After graduation, he became a Fellow of All Souls College, a graduate school of Oxford established especially for advanced studies in theology and in civil and canon law. Recorde's fellowship at the College suggested that he intended to pursue a career in one of these three professions at the time of his enrollment. But, for some obscure reason, he apparently gave up that intention and left for Cambridge soon after.

Recorde's departure from Oxford at this time proved to be a turning point in his life and thus deserves further investigation. Both Cambridge and Oxford have their own versions of the event. A record from Cambridge suggests that Recorde experienced a sudden change of heart. The subjects offered at All Souls no longer interested him. He wanted to switch to sciences but "found that there was no room at [Oxford] for those who wished to study science

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2Anthony a Wood, Anthenae Oxonienses: An Exact History of All the Writers and Bishops Who have had their Education in the University of Oxford, 3rd edition with additions by Philip Bliss (London, T. Bensley, 1813; facsimile edition, Hildesheim, West Germany, Georg Olms Verlagsbuchhandlung, 1969), I, 255.
beyond the traditional and narrow limits of the quadrivium."³ As a result, he had no other choice but to go to Cambridge where such studies were available.

Oxford's version of Recorde's decision to leave the school is not more revealing, but implies a far more complicated circumstance. Recorde is said to have left the university because he found "the society at All Souls somewhat uncongenial" and went to another academic community in which he could live a happier life.⁴ The nature of this uncongeniality was not stated, but it is reasonable to assume that it had something to do with Recorde's political and religious involvement. During the early part of the 1530s, when Recorde left Oxford, England's intellectual world was in a state of turmoil over the problem of Henry VIII's intended divorce from Catherine of Aragon.⁵ This further involved two other larger issues, royal supremacy and the English Reformation, both of which stood to profit by the success of the royal divorce. They, in turn, would ensure the break with Rome and undermine the


⁵The problem was by no means limited to England; continental scholars were equally split over the issue. See Philip Hughes, The Reformation in England (New York, The Macmillan Company, 1951), pp. 215-216.
validity of traditional theology and canon law—the two subjects of study which All Souls aimed to uphold. Caught up by the spirit of the day, it is likely that Recorde was advocating the cause of the king as much as he was reputedly "active[ly] champion[ing] . . . the protestant reformation." It would be difficult to do one and not the other, for the two ideals were inextricably intertwined.

When the truth became known, Recorde could have found himself being ostracized by his fellow students, whose dependence on the Roman Church was as much a matter of future career as of faith. The supremacy of the king over the Church would eliminate any need for canon law and, at the same time, encourage the development of a new theology that was dictated by the king rather than by the Pope. Neither of these changes was acceptable to most All Souls students, who were trained especially to function and gain their livelihood from the traditional rules and practices surrounding the Church. Anyone who favored fundamental changes that would endanger the status quo would find himself amidst very "uncongenial" company indeed.7


7Recorde was not, of course, the only Protestant at All Souls. The best-known base involves Thomas Garett, a curate of that College, who was caught distributing Tyndale's New Testament and jailed in 1528. After Cardinal Wolsey released him, he, too, went to Cambridge. See A. G. Dickens, The English Reformation (New York, Schocken Books, 1964), pp. 76-81.
After his move to Cambridge, Recorde seemed to have deliberately refrained from drawing attention to himself for over ten years. He did not emerge again until all the matters were well settled and decidedly along the line that he had hoped they would be. England of the 1540s was independent politically and spiritually, and her king reigned supreme. As if wishing to celebrate the dawn of this new age, Recorde published his first mathematical text, The Grounde of Artes, an elementary arithmetic, in 1543. The book was Recorde's first as well as the first notable work on the subject in the English language. It enjoyed tremendous success in terms of public reception, went through numerous editions, and "throughout the next hundred years it was the most popular arithmetical work in England . . . and even continued in use until the beginning of the eighteenth century."10

8 The first edition of The Grounde has been variously dated at 1540, 1542, and 1543. The 1540 edition is not--or probably has never been--extant; the 1542 edition (STC 20798), which is used in this paper, has been redated upward between 1545 and 1549. The 1543 edition (formerly 20799; now 20797.5) is presently considered the oldest. See Joy B. Easton, "The Early Editions of Recorde's Grounde of Artes," Isis, LVIII (Winter, 1967), 517.

9 One arithmetical text in the vernacular preceded Recorde's work. It was published anonymously in 1543 and went through a limited circulation. See A. W. Richeson, "The First Arithmetic Printed in English," Isis, XXXVII (May, 1947), 47.

Several ingredients went into the making of this success. The English reading public had to be educated enough to find this recondite "art of numbryng" useful to them in a contemporary setting, and, more importantly, Recorde had to write the book in such a way that it was comprehensible to them in the first place. In order to produce this kind of work, it was imperative that he be familiar with the needs of his audience, know the language necessary to communicate with them, and possess adequate teaching experience. How Recorde gained this experience and method of instruction is not certain, but he undoubtedly acquired them during his ten years of obscurity before the book was actually published.

No definite information has been found regarding the genesis of The Grounde, but several suggestions have been made. The traditional speculation was that the book was probably conceived at the time when Recorde was teaching mathematics and medicine at Cambridge. The reasoning behind this suggestion was that, because Recorde was teaching without any vernacular text, he wrote one as an aid to his lecture. This view, unfortunately, contradicts the whole trend of the development of science during the Renaissance. The sixteenth-century European universities were far from being a home for new ideas and experiments.

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**Footnote:** DNB, XVI, 510.
Recent studies on the subject have found that contemporary men of science in general regarded the universities as bastions of conservatism and preferred to work and publish independent of institutional ties.\textsuperscript{12} According to this finding, there is no basis upon which to suggest that The Grounde—an unorthodox arithmetic text—had any university connection. In fact, there is not even an indication that Recorde could have taught at Cambridge at this particular time. Before the publication of his work, he was a totally unknown scholar with no apparent achievement. If he gained any teaching position at that university, it came not before but after 1543, when his book had established him as a well-known mathematician.

An alternative to this traditional view was that, for an undetermined period of time, Recorde became a private tutor to a child of one Richard Whalley.\textsuperscript{13} This tutoring experience is assumed to have given him an idea of producing work of similar content for public consumption. The strength of this suggestion is based on the fact that Recorde himself dedicated The Grounde to "the Right worshipful maister Rycharde Whalley," and he did mention Whalley's


\textsuperscript{13}Easton, "Reorde's Grounde of Artes," p. 523.
children in his introduction; its weakness, however, is equally pronounced. Neither in the dedication nor in the introduction to The Grounde did Recorde state anything more than that he knew Whalley's family intimately and that he admired Whalley greatly. This admiration has nothing to do with the actual writing of the book apart from the fact that Whalley shared his enthusiasm and agreed with him on the necessity of such a work. Furthermore, the volume was a handbook for adults to use in learning mathematics by themselves, not a text for children. In the final analysis, to produce a work of this type, Recorde needed a wider-ranging experience than the one-to-one teaching situation that tutoring would provide.

In all probability, the knowledge that helped make The Grounde successful came from another source entirely. It is most likely that the book was an indirect result of Recorde's repeated encounters with a group of printers rather than with any students. These printers were in their own right pioneer scientists of the Renaissance. At the time when printing technology had just begun to develop, printers were constantly searching for new and more effective ways of improving their products. Lacking formal education, they had to use the process of trial and

error to acquire their knowledge in both mechanical and chemical aspects of their work. Because of their experimentation, these printers became natural partners to academic scientists, who possessed training but lacked experience. The collaboration between them benefited both sides and became a foundation for further progress.\footnote{15}

Most sixteenth-century scholars, however, became involved with this group of artisan-scientists for another purpose. Besides experimenting in new methods of production, printers required the services of scholars to help them in the selection of works to be published as well as to organize old manuscripts in proper order. The scholars who fulfilled this function were usually not mentioned in the final products unless their names would promote greater sales. Recorde probably came to be associated with the printers originally on this basis. His name also failed to appear in any of their works until 1559, a year after his death, as a person who was "employed by kyngston the printer to collate the first and third editions of Fabian's Chronicle."\footnote{16} When Recorde began this employment is difficult to determine, but it is reasonable to assume that the


\footnote{16}Wood, p. 256.
work started in this period and continued throughout his life. From this association, Recorde gained insights into the needs of the less educated public, opportunities to practice his teaching skills, and encouragement to publish simple mathematical texts for the daily use of these people.

The immense success of *The Grounde* did not keep Recorde from completing his study. In 1545, he eventually received the medical degree, "Doctor of Physike," from Cambridge. Immediately after his graduation, he returned to Oxford as a lecturer on mathematics and medicine. The popularity of his work established him as a legitimate scholar, and the medical degree provided him with a license to teach at his old university. What the degree and the reputation could not do, however, was immunize him against Oxford's conservatism. Within a period of two years, his position on religious and political issues undoubtedly caused him problems with the university again. The death of Henry VIII in January of 1547 could not possibly have made the situation any easier for Recorde. Sometime during this year, he moved to London and permanently gave up further plans of becoming a teacher for any institution.

During his residence in London, Recorde practiced medicine and acquired a reputation as a well-known scholar in the city. It has also been claimed that he became a physician to Edward VI and the future Mary I, "to whom he
dedicated some of his books."\textsuperscript{17} Although it is quite certain that Recorde had powerful friends in the government, there is no evidence to suggest that he ever acted as a court physician. His connection at court seemed to have been with the Duke of Somerset, the Lord Protector, rather than with the young Edward and Mary.

Recorde's involvement in a curious incident in 1548 verified this view. Toward the end of the year, a rumor spread throughout London that Edward was dead and a prophet named Rechard Allen came forth to confirm the rumor to be true. Since the rumor was as false as it was disruptive, Allen was suspected as its author and taken to the Tower of London for questioning. Despite the fact that the king was very much alive, Allen refused to submit. Arguing that his knowledge came from consultation with the stars, he insisted that nothing anyone could do would change his mind. Not wanting the rumor to become any more dangerous than it already was, the privy council summoned a group of scholars to interrogate Allen and either convince him of the truth or discredit his dangerous rumor. The scholars also failed because Allen further claimed that they lacked his type of knowledge. He "knewe more in the syence off astronomy then alle the universyties off

\textsuperscript{17}\textit{DNB}, XVI, 810.
Oxforde and Cambryge." A scholar whose name was well known to the public and acceptable to Allen was needed to settle the matter. The Duke of Somerset, who, as Lord Protector stood to lose the most as a result of the rumor, took charge of the interrogation and invited Recorde to participate in it. One Edward Underhill, who was present through the whole proceeding, wrote down in his memoirs several years later, "doctor Recorde . . . examined hym, and found that Allen knew nott the rules of astronomye, but a very unlearned asse and a socerer, for the wiche he was worthye of hangynge." The accuracy of Underhill's recollection of the incident is difficult to determine, for Allen survived the ordeal and lived well into the reign of Mary I. Two things seemed reasonably clear, however. Recorde was indeed known to the Duke of Somerset, and he became involved in the interrogation of Allen because Somerset wished him to do so. Furthermore, following this incident Recorde was drawn increasingly into the Duke's administration, and his future career with the government was to rise and fall along with Somerset's fortunes.


19 Ibid.
In the year following the Allen incident, Recorde was appointed comptroller of two newly-created mint houses, the first at Durham House in London and the second at Bristol. Troubles with English coinage, which had begun during the latter part of Henry's reign, continued to plague the country. The government was in need of knowledgeable personnel to help remedy the situation, and Recorde was more than qualified for the job; among several of his scholarly endeavors, he was also recognized by his contemporaries for his specialty in metallurgy.\(^2\) But a shortage of bullion unfortunately forced the closing of these mint houses late in 1549, and, consequently, Recorde's first official position came to an early end.

If the lack of precious ore had been Recorde's only problem, he could very well have been transferred to some other governmental post. But other and far more serious trouble was brewing concurrent with the ore shortage. In the political arena, Somerset was losing ground to the Earl of Warwick's faction in their struggle to control the privy council. At the prospect of being without his powerful friend at a time when his own job was endangered, Recorde should have acted like all good bureaucrats by not antagonizing any of his superiors at that particular

time. Prudence, however, was not among Recorde's many fine qualities. Instead, he chose to defy most of the privy council and, in effect, became his own worst enemy.

The trouble originally had nothing to do with Recorde or his function as a comptroller. It involved a spontaneous uprising in the countryside as the result of a bad harvest in 1547. By June and August of 1548, in Cornwall, west of London, the agrarian problem merged with religious discontent. The conservative clergy, who wished to continue to conduct their services in Latin as they had done during Henry VIII's reign, moved to organize the rebellion and thus intensified the danger of the situation.²¹ The privy council dispatched Sir William Herbert, later Earl of Pembroke, to restore order to the region. Herbert was successful, but news reached London that his treatment of the rebels was unnecessarily cruel, even by the standards of the time. Hanging and quartering of prisoners were not uncommon sights.²² According to contemporary reports, Somerset was supposedly appalled by this inhumane action but could not halt it against the other members of the council, who wished the rebels to be punished as harshly as possible. Regardless of the merit of the report,


Recorde decided to take the matter into his own hands. When the council sent for money from the mint house to finance further suppression, Recorde defiantly refused to provide the needed cash.

This direct insubordination angered Herbert most of all because he required the money to pay his mercenary troops. Upon his return to London, he accused Recorde of treason. Somerset's presence at the court probably saved Recorde for the time being. But in October, Somerset was toppled from power and Warwick (soon to be made Duke of Northumberland) emerged victorious. With his protector imprisoned in the Tower, Recorde's own trial was quick to follow. In the same month as the Duke's fall, Recorde was judged guilty as charged and confined at the court for sixty days.²³

Upon his release, Recorde seemed to have come to the decision that positions with the government did not suit his temperament. Early in 1550, he switched direction completely and returned to his private practice. In this same year, he also became involved with the newly-formed Muscovy Company in an effort to find the northwest passage to India. The company was made up of merchants and navigators whose employees included learned men in various

fields. Recorde became the company's cosmographer, and his position seemed to be held in high regard. His advice was considered necessary before any important undertakings were begun. On one occasion, a member in one of the meetings recorded: "upon the encouragement of Mr. Chancellor that just found for us the Musco, and Doctor Recordes conference in my house . . . a plott of the West India 'sumitted' doth agree with the opinion of Doctor Recorde." When Recorde died a premature death eight years later, his passing was believed to have precluded the "fulfillment of his purpose, and the Company lost the services of a valuable adviser." Recorde's association with these navigators proved to be as beneficial as that with the printers. These two groups of men shared two vital similarities; first, they lacked formal training in fundamental knowledge, and, second, they looked toward science to help them improve their trades. As was the case earlier, Recorde's work among the navigators extended beyond the specific task at hand to include the writing of a handbook for their use. If the success of The Grounde, his first book, was not enough to convince him of the public's need for

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25 Ibid.
mathematical knowledge, his experience with the seamen of the Muscovy Company helped to reinforce his sense of duty, which was soon to expand into a full-fledged mission. Either because of the realization of the scope of his task ahead or because of his recent connection with the government, Recorde no longer believed that a single individual's effort was sufficient to carry on the work. In his second book, *The Pathway to Knowledge* (1551), an elementary text on geometry, he urged the king to come to his aid. The dedication of the book read: "To the most noble and puissant prince Edward the sixte by the grace of God, of England Fraunce and Ireland kynge, defendour of the faithe, and of the Churche of England and Ireland in earth the supreme head."\(^{26}\)

Although one should always exercise caution with regard to this type of dedication, which was often made for personal gain or to solicit protection from persecution, Recorde's statement seemed sincere. His mathematics text was neither a religious nor a political tract and was unlikely to antagonize anyone. Moreover, there was no pressing need for him to abandon his earlier practice of

\(^{26}\)Robert Recorde, *The Pathway to knowledge, containing the first principles of Geometrie, as they may moste aptly be applied vnto practise, bothe for use of instrumentes Geometricall, and astronomica\ll and also for protection of plattes in euery Kinde, and therefore much necessary for all sortes of men* (London, Reynold Wolfe, 1551; facsimile edition, Amsterdam, Walter J. Johnson, Inc., 1974), p. g.iii.
dedicating his work to his scholarly colleagues. By dedicating *The Pathway* to Edward, Recorde simply recognized the king as the most powerful scholar in all England who was capable of aiding him in his cause. Nor was his hope for the king's support merely wishful thinking. Since the age of five, Edward had been closely trained by John Cheke, Richard Cox of Eaton, and Jean Belmain, a French humanist scholar; and the young king himself had shown a remarkable zest for learning.\(^{27}\) By way of dedication, Recorde hoped to gain the king's attention to mathematics and eventually his patronage of science in general.

Recorde's dedication of *The Pathway* also revealed another significant aspect of his life. His Protestant leaning, which had been suspected all along since the days at All Souls, emerged into the open for the first time in this treatise. Unlike his father, Edward VI was brought up as a Protestant and the title of "defendour of the faithe" had never officially been conferred upon him. The fact that Edward was probably "the most determined lay Protestant in the realm"\(^ {28}\) made the carrying over of the Roman-conferred title seem ludicrous, but the title was important in a new sense. The Church of England had just been established, and it needed defending against


\(^{28}\) Elton, p. 371.
surrounding Catholic states. By dedicating his book to Edward with the words "defendour of the faithe," Recorde not only recognized the king's power and ability to promote scientific study, but expressed his full support for the English church as well.

Soon after the publication of The Pathway, the Duke of Somerset was released from his confinement and readmitted to the privy council. Within a few months of this event, Recorde also returned to official life. In May, 1551, he became the King's Surveyor of the Mines and Monies in Ireland. Whether Somerset had any hand in this change of heart on Recorde's part and in the appointment itself is not known. But since Recorde seemed to have been completely exonerated for his past misbehavior and elevated to a higher position than the one he had previously held, the Duke's influence is strongly suspected in both cases.

The government also had good reason for needing men of Recorde's quality at that time. Northumberland's administration was in serious financial difficulty. Among other problems, the English coins issued in this period were unacceptable to most foreign traders because of their impurity. As the saying of the day went, Northumberland "rang as false on the counter as one of the bad coins"

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29 Frances Marguerite Clarke, "New Light on Robert Recorde," *Isis*, VIII (June, 1926), 56.
issued by his government." To improve the quality of the coins, several new mines were opened in Ireland, but there was no one to run them. Recorde was a knowledgeable person of trusted and proven quality in this field, and his expertise and honesty could help lessen the severity of the situation. All Somerset had to do was to convince the council that Recorde's ability and integrity were assets rather than liabilities. Sending Recorde to Ireland, at any rate, would decrease the chance that he could cause problems for anyone in London.

To be far away from London, however, was no guarantee that Recorde would not be a problem to himself, for his knack for trouble was not limited to any specific location. His independent mind did not conform easily to bureaucratic regulations and his second chance at a career with the government was to end as disastrously as the first. In this particular instance, however, the problems initially arose from Recorde's subordinates rather than from his superiors as was the case earlier.

As the King's Surveyor, Recorde had complete authority over the whole Irish mining project which had begun in 1550. Prior to his coming, it was under the direction of a German mining specialist, Captain Gundelfinger, who brought with him a large company of miners from Germany.

With the arrival of Recorde, Gundelfinger was relegated to the position of second in command, which understandably provoked much resentment on his part. Personal conflict soon led to disagreement over English and German mining technology. The German struck first by sending a letter to London accusing Recorde of incompetence. Although this accusation could very well have been valid, since Recorde had no practical experience in the job, Gundelfinger's dissatisfaction stemmed as much from his personal stake in the matter as from any professional concern. When the privy council asked Recorde to provide a complete report of the circumstances, he, as usual, chose to ignore the request; only after persistent demands did he finally decide to comply. Even then his reply was not exactly what the council had asked for but, rather, an indirect answer to Gundelfinger's charge, stating that the German was in no position to judge because "English and Irish men can better skill of that work than the Almains can." The council was either satisfied with this patriotic answer or too preoccupied with the renewed struggle for power between Somerset and Northumberland to pursue the matter further; no additional inquiry was made.

If the council was satisfied with Recorde's answer, Gundelfinger certainly was not. He wanted Recorde removed.

\footnote{Clarke, p. 58.}
and continued to bombard London with his accusations. By the end of 1551, one Gerard Harmon was finally sent by the council to investigate the matter. Unfortunately for Recorde, Harmon was the original English representative who arranged for Gundelfinger to come to Ireland in the first place and was therefore in complete sympathy with the German's predicament. Upon his return, Harmon presented the council with a lengthy report of Recorde's incompetence. All of the charges, however, seemed to have been based on Recorde's refusal to follow the lead of the German specialist rather than on actual guilt. Exemplifying Harmon's report was the statement that "The said Mr. Recorde, Surveior, toke uppon hym such knowledge and conyng as he wolde not consent unto the devises and requests made unto hym by Captyn (Goldelfinger) . . . but following his owne wilfull minde. . . . "

Because of the seriousness of the charge, Recorde was summoned to London in 1552. The council must have found the report to be either false or exaggerated, for Recorde was not prosecuted and was ordered to resume his post in Ireland soon after. The decision to have Recorde returned to work could not have been influenced by his friendly patron, the Duke of Somerset, as appeared to be the case earlier, for the Duke had already been defeated by

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32 Ibid., p. 65.
Northumberland by the end of 1551. When Recorde reached London sometime in 1552, Somerset had already been executed.

Despite the dubiousness of Harmon's charges, they do provide valuable insight into Recorde's attitude toward learning during the years he spent in Ireland. According to one of the charges, Recorde took the miners from their regular duties and "set them to work at the King's cost practicing the devices of his owned brayne whereof to no proficit to H.M."\(^3\) As if the failure to devote his time to performing official functions were not serious enough, Recorde also subordinated his duty to teaching, for another statement reads: "Recorde was oft advertised and required by straunge Myners and also by such Englishmen as were desirous to learn . . . [from him]."\(^3\)\(^4\)

These two accusations on one hand showed that Recorde was definitely not an efficient administrator, but, on the other hand, they demonstrated that he was a good experimental scientist and an attentive teacher who always made himself available to anyone who sought to learn from him. It was the experience acquired from working, teaching, and learning from these miners, like the printers and the seamen before them, in actual working conditions, that set Recorde apart from other scholars of his time.

\(^3\)Ibid., p. 63.  
\(^4\)Ibid., p. 62.
and rendered him the most effective person for the task of popularizing mathematics in his own language.

Not all the miners in the Irish project wanted to learn from Recorde; Gundelfinger and his men certainly did not share Recorde's enthusiasm for learning. The German not only considered Recorde's behavior to be disturbing in general, but detrimental to the project in particular and continued to complain to London at every opportunity. The controversy between Recorde and his German counterpart became so disruptive that the government decided to put an end to it permanently. In February, 1553, it was ordered that Recorde, Gundelfinger, and the rest of the miners be discharged from their duties and the mines be closed.\textsuperscript{35}

The order came without warning. It appeared that Edward's illness and the ensuing power struggle between Northumberland and Princess Mary immediately after the king's death were chaotic enough and the government did not wish to add the Irish mining problems to the situation. At the time of the dismissal, no investigations were made. But since Recorde was the person in charge, he had to bear the responsibility for the trouble that had been caused and a proceeding against him was presumably pending until the government could free itself from internal strife.

\textsuperscript{35}Ibid., p. 66.
A few months after Recorde's dismissal, Mary became Queen of England. Her determination to convert the country back to Catholicism prohibited any quick return to normalcy in England. Her plan to marry Philip, a Spanish prince, and events such as the Wyatte Rebellion and the Smithfield fire created additional burdens for the government and kept it busy with these pressing matters. It was little wonder, then, that a hearing on Recorde's case and the problems at the Irish mines was not to be held for the next several years.

During this time, Recorde returned to London, presumably to practice medicine and make preparations for his future books. As a Protestant scholar during the height of the Marian heresy-hunt, Recorde, whose problem with the law was as yet unresolved, had to refrain from drawing attention to himself as much as possible. All things went well for two years, until circumstances forced him to choose between his faith and his safety.

An occurrence that drew Recorde away from his quiet living concerned the same Edward Underhill whom he had known from the Allen incident in 1548. Underhill, who proudly admitted that he was "the greatest heretyke in London," was imprisoned in 1555. The unsanitary conditions in prison made Underhill ill, and Recorde, worried

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35 Nichols, p. 150.
about his friend's health, went to see him. Of this visit, Underhill admiringly and respectfully wrote: "my very frende mr. Recorde, doctor off physyke, who syngulary sene in alle the seven syencis, and a great devyne, visited me in the presone . . . to his greate parrelle yff it hadde byne knowne." 37

Underhill's statement revealed the extent of Recorde's commitment to the English Reformation as much as it confused the understanding of his position in relation to the movement. By simultaneously referring to him as a "mr." and a "great devyne," Underhill indicated in the same sentence that Recorde was both an ordinary lay person as well as a theologian. In all probability, Recorde was a highly respected theologian among his own circle, and his influence could not have been totally negligible. Whatever he was, Recorde's standing in Protestantism could not have been an absolute secret, and it probably compounded his problems with the court.

The actual investigation of Recorde was renewed in April, 1556. 38 Three months afterward, a letter was sent to Recorde and to his printer, Reginald Wolfe, ordering them to appear before the privy council within a period of one year. The exact date of the trial was not yet

37 Ibid., p. 151. Italics added.
38 Clarke, p. 66.
set, but they were to be given ten days' advance notice when the council decided on one.

This notification of an upcoming trial after a long silence disturbed Recorde more than any of the other difficulties to which his troubled career with the government had thus far subjected him. The requirement to have Wolfe appear with him suggested that the trial involved more than a simple case of mining problems. The rise of his old enemy, the Earl of Pembroke (formerly Sir William Herbert), who also sat in the council, to the rank of Mary's most trusted lieutenant was also a cause for particular concern. In panic, Recorde urged Queen Mary and Cardinal Pole to come to his aid by dedicating his newest book to them.

In his elementary text on astronomy, The Castle of Knowledge, published in 1556, both the queen and the cardinal were asked to protect the new learning and the "castle" of that knowledge from "cruell Fortune." The queen in particular was asked to "supplye that that wantedth, that knowledge maye reste vnder safe protection . . . and by your highness speciall defence, Knowledge myght bee maintained. . . ."39 Nevertheless, Recorde realized that the chances for either Mary or Pole

to come to his defense were poor and decided to depend on himself as much as he could. Toward the end of the book, after voicing complaints against "infidels" and "false Christians," he abruptly cut off his discussion and stated: "nowe farewell for a time: I amm dryven to omytte teachings of Astronomye, and must of force to learne some lawe." 40

As circumstances developed, all of Recorde's efforts to save himself were inadequate. Before the end of 1556, possibly during the course of the investigation, he unwittingly added to his problems by insulting the Earl of Pembroke with a malfeasance charge.41 Whatever motivated Recorde into this reckless action, it had no chance of success. The Earl had Mary's complete trust and was one of the most powerful nobles on whom she depended to secure her throne against domestic disturbances.42 Consequently, by retaliating against him in this fashion, all Recorde achieved was to jeopardize his own case with regard to the queen as well as the rest of the council.

In October of 1556, Pembroke sued Recorde for libel, and a hearing was held in January of the following year. The sentencing was quick and severe. In February, Recorde was judged guilty and was ordered to pay £1,000 in damages to the Earl. Whether Recorde paid this sum is uncertain;

40 Ibid., p. 284.  
41 DSB, p. 338.  
but by November of 1557, when he published his last work, *The Whetstone of Witte*, an algebra text, he was in an obvious state of despair. There was no more hope that the queen would come to his rescue, and his book was dedicated to "The gouerners, Consulles, and the rest of the companie of venturers into Muscouia." On the final page of the book, Recorde's resignation was reflected in a statement that "there [is] noe remedie ... I must neglect all studies, and teaching, for to withstande those daungers."

Recorde was correct in his assessment of the situation; there was no more hope for him. In 1558, he was sent to King's Bench prison, probably for failure to pay the damages awarded to Pembroke, his maladministration of the Irish mines, or a combination of both. In any case, there is no reason to suspect that his imprisonment came about as a result of debt, as has been traditionally believed. In his will, which he dictated sometime during that year, soon before his death, Recorde seemed to be in full possession of all his belongings and properties, which he dispersed freely among his relatives, the warden of King's Bench, and other inmates.

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44 "Ibid., p. 166.
45 A facsimile of Recorde's will can be seen in David Eugene Smith, "New Information Respecting Robert Recorde," *American Mathematical Monthly*, XXVIII (August-September, 1921), 298-299.
Robert Recorde was a scholar and a teacher and showed remarkable zeal for scholarship and teaching throughout his short life. His efforts to popularize mathematics, the subject which he believed to be the most useful of all knowledge, were sustained, uninterrupted, and persistent to the final moment of his life. Even while he was working as a governmental official, he retained his independent spirit and never failed to provide all those who were "desirious to learn" with his particular brand of instruction. The work at the Irish mines was a case in point. It is possible that Recorde took the job mainly for the opportunity to work in a mining operation and to be associated with miners rather than for the money he would earn from the position, since, for the entire duration of his stay in Ireland, he did not take any pay for his work. In 1570, two years after his death, when Queen Elizabeth I was notified of this fact, she decided to compensate Recorde's estate by some £1,000 for the services he had performed in Ireland.\textsuperscript{6}

To popularize mathematics was a mission for Recorde. His constant association with newly-emerging groups such as the printers, miners, merchants, and seamen helped him to realize that they were truly in need of the knowledge he possessed. The experience he gained from working with

\textsuperscript{6}DSB, p. 338.
them provided him with a vocabulary they could understand and a method they could easily follow. The success of his books was not a matter of genius on his part but, rather, of practical experience. As the first mathematician who wished to make his knowledge public property, Recorde was indeed very well equipped for his task.
CHAPTER II

A RELIGIOUS PYTHAGOREAN

The year 1543 is the dividing point between ancient and modern science. The reason for this sharp chronological division is the first appearance in this year of Nicholas Copernicus' *On the Revolutions of the Heavenly Spheres*, which literally sent the previously immobile earth spinning along its present orbit. There was nothing new or modern, however, about Copernicus' ideas and intentions. His book in fact had a very limited aim. All he desired to do was to correct the existing incongruities between the mathematical maxim of the constant velocity of a perfect sphere and the observed motions of the planets. But by mathematically replacing the earth with the sun as the center of his universe, Copernicus made heliocentricity part of progressive scientific thought and not just wild fantasy. The initial criticism and the later vindication of his system changed the whole structure of scientific thinking.

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1For a general discussion and illustrations of the mathematical problems that faced Copernicus, see J. R. Ravetz, "Origins of the Copernican Revolution," *Scientific American*, CCXXIX (October, 1966), 88-98.

2Alexandre Koyré, *From the Closed World to the Infinite Universe* (Baltimore, Johns Hopkins Press, 1957);
The aura of modernity surrounding the Copernican system was at best deceptive and at worst accidental. The sources from which Copernicus drew both the inspiration and framework for his creation predated the Ptolemaic-Aristotelian scientific paradigm that they were later to replace. The idea went as far back as the mythical Egyptian figure Hermes Trismegistus, who was credited with having originated the doctrine of the sun-centered universe. The Hermetic belief coincided with the doctrine of the "central fire" of the Pythagoreans, who devoted their lives to the study of mathematics. These pre-Socratic philosopher-mathematicians discovered that nature possessed shapes of triangles, cubes, and circles, and the study of these shapes was regarded as the study of the mysteries of nature itself. It was through Aristarchus of Samos and especially through Plato that the belief in the aesthetic properties of mathematics and the heliocentric doctrine coalesced into a comprehensive system.

For Plato, mathematical relationships were eternal and perfect--being, not becoming--and therefore the real and the true. His love for things permanent led him to

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accept circular motion as the only ideal mathematical expression. The movements of the heavenly bodies in turn became the celebrated illustration of perfection in his scheme. But for the sun, or the Divine Mind in Platonic terminology, to emanate freely and perfectly upon the stars, which moved circularly and uniformly, it had to be amidst those stars. The central position of the sun thus became the pivotal point upon which the rest of mathematical ideals orbited. From this point on, the heliocentric universe developed hand in hand with the secret mania of numerology. The Platonic-Pythagorean (mathematical) tradition that the sixteenth century inherited became characterized by three watchwords: mystery, mysticism, and secrecy.

Few modern scholars would deny that, when Copernicus reconstructed the universe, the Ptolemaic system was already in serious trouble and Copernicus' primary concern was to resolve the internal crisis of science. But, then, few would contend that the approach he took and the system he created were being scientific. His monumental work was based on no more than seventy observations, which spanned over his seventy-year life, and they were conducted

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5Dissatisfaction with the Ptolemaic system had been apparent long before the sixteenth century. As early as the thirteenth century, Alphonso X, for example, complained that if God had consulted him before creating the universe, he would have given Him a much better plan. Kuhn, p. 69.
with astronomical instruments less advanced than those used by the ancient Greeks.  

Better tools were available, but Copernicus was simply not interested in obtaining them. His system was the result of the examination of mathematical figures, not the stars. It was ironic, but undeniable, that the whole concept of modern cosmology—and the modern world—was founded on this ancient Pythagorean rite of mathematical contemplation.

The reason to publish The Revolutions was itself mathematically determined. To publish his "discovery," which was to popularize it, Copernicus had to risk violating his traditional code of secrecy, but not to publish it was to see further abuse of his ideals. He did not have much choice in the matter. Even then, had it not been for the persistent encouragement of his associates, the book that laid the foundation of the present world probably would never have been published at all.  

Copernicus' contempt for the masses was ingrained in the very discipline he was trying to preserve. To allow them to know the secrets of the cosmos was to contaminate the thing he

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7 Ibid., pp. 154-162.
tried to purify, so he insisted from the beginning that his book was written exclusively for those who were the initiates of the holy art. Those who were not should stay away from the book because it in no way concerned them.

In actuality, Copernicus' warning and anxiety were superfluous and misplaced. Few persons in the sixteenth century possessed enough knowledge of mathematics to understand his supremely dense and highly specialized work, and ordinary people had no interest in his thesis. Opposition to his system came rather from mathematicians in general and from theological mathematicians in particular. The sun-centered universe defied all natural perceptions and could not be proven at the time by any other means except mathematics, which made it an exceedingly difficult concept to accept. Thus, a person had to regard the theory as an article of faith and either believed or rejected it in its totality. Consequently, apart from a few eccentrics and extreme Pythagoreans like Copernicus himself, most people had chosen to denounce

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8The Revolutions, as Koestler points out, is one of the "all-time worst-sellers." It was almost a century before anyone took Copernicanism seriously. Ibid., p. 191.

and ridicule the system as nonsensical. Only a century later, after the telescope was developed and several other major mathematical problems solved, did the heliocentric system become a part of modern "common sense."

Because the Copernican system generated great scientific controversy, it was customary to classify the scientists of the period as for or against Copernicus and his theory. Between the seventeenth and the early part of the twentieth century, Robert Recorde was invariably believed to be one of the few who voiced support for Copernicus and his system. This classification changed, however, as knowledge about Copernicus expanded and it became apparent that the objectives of the two men's writings were diametrically opposed. While Copernicus sought to maintain the exclusive practice of the mathematical tradition, Recorde was actively spreading such knowledge among the public. Since their intentions seemed to clash on this major issue, the current

10 An extensive listing of anti-Copernican scholars during the sixteenth and seventeenth centuries can be found in Edward Rosen, "Galileo Misstatements about Copernicus," Isis, XLIX (September, 1958), 319-330.

11 DNB is a good example of this. It suggests that Recorde was possibly the first known Copernican in England. See Sidney Lee, editor, Dictionary of National Biography (London, Smith, Elder & Co., 1909), XVI, 811.
assumption is that Recorde could not possibly have been a Copernican.\textsuperscript{12}

The basis for the revision of Recorde's position concerning Copernicus is believed to have rested on a passage Recorde himself wrote about the immobility of the earth. In his introductory text to astronomy, The Castle of Knowledge, Recorde noted:

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\ldots \text{as for the quietnes of the earth I neede not spende anye tyme in proouing of it, syth that opinoin is so firmelye fixed in moste mensen headdes, that they accompt it mere madness to bring the question in doubt. And therefore it is as muche follye to trauaile to proue that which no man denieth, as it were with great study to diswade that thinge, which no man doth couette \ldots \text{or to blame that which no manne praiseth, nother anye manne lyketh.}\]
\textsuperscript{13}

Since the role Recorde played in history indicated that he was a stable sort, the argument goes, he was not likely to have repudiated the opinion that was "so firmelye fixed in moste mensen headdes," and, therefore, could not have been a supporter of the heliocentric system.

This type of argument has two distinctly undesirable implications. First, inasmuch as he was the popularizer of mathematics, Recorde could neither be a Pythagorean nor a believer in a system that glorified Pythagoreanism.

\textsuperscript{12}A thorough discussion on this point may be seen in Louise Diehl Patterson, "Recorde's Cosmography, 1556," Isis, XLII (October, 1951), 208-218.

Second, because he was neither a Copernican nor a Pythagorean, he was not bound by his traditional attitude toward the masses and was able to become a mathematics teacher for the public. This assumed causal relationship between Recorde's desire to spread the knowledge of mathematics and his rejection of the Pythagorean tradition is impossible to maintain. It is based entirely on the belief that if Recorde had not observed the code of secrecy he would have been compelled to abandon everything else that was sacred to his discipline, but such would not necessarily have been the case. In fact, as will become apparent in the following pages, such an assumption directly contradicts Recorde's statements concerning both mathematics and Copernicus. Furthermore, it was probably his allegiance to the mathematical tradition of the Pythagorean-Platonic sect, which was evident in his ardent support of Copernicanism, that made him the popularizer of mathematics that he was.

Unlike many other English scholars at the time, Recorde had never travelled abroad; he obtained all his academic degrees within his own country, so there was no possibility that he could have known the controversial Polish astronomer personally. The monkish life Copernicus led also prohibited details about his life and work from becoming widely known. The only way most people learned
of him was through rumors about his peculiar system. Yet, such scanty information on Copernicus did not deter Recorde from forming a high opinion of the man. In a passage that immediately followed his statement about the stationary earth so often cited as proof for Recorde's anti-Copernicanism, he praised Copernicus as a "man of greate learninge, of muche experience, and of wonderfull diligence in obseruation." On all counts, there was no evidence to indicate that Recorde regarded Copernicus as anything less than a great astronomer.

With little knowledge about Copernicus, how, then, did Recorde come to be an admirer of this man whom the whole academic community condemned as a lunatic? This, too, is clear. His admiration for Copernicus was based on the system that Copernicus founded rather than on Copernicus himself. Copernicus was a great man because he was able to supply definite mathematical proof for the long-dreamed-of solar universe and "renewed the opinion of Aristarchus Samius, and affirmeth that the earthe not only moueth circularye about his owne centre, but also maybe, yeh and is, continuallye out of the precise cite of the world 38 hundredth thousand miles." From this passage, there is little doubt that the alluring concept

14 Koestler, p. 153. 15 Recorde, Castle, p. 165. 16 Ibid.
of heliocentricity captivated Recorde's mathematical mind as much as it did Copernicus' own.

To carry the point further, Recorde was also prepared to defend Copernicus against the adversaries of his system. First of all, he warned his readers not to form negative opinions about Copernicus and his system because they needed more mathematical knowledge before coming to a decision about such a great and complex matter. Recorde himself could not yet provide them with that knowledge "because the understanding of that controversy dependeth of profounder knowledg then in this Introduction maybe vttered conueniently."\(^{17}\) As if anticipating that his readers might not be easily persuaded, Recorde had his imaginary student in the book reply:

Nay syr in good faith, I desire not to heare such vaine phantasies, so farre againste common reason, and repugnante to the consente of all the learned multitude of Wryters, and therefore lette it passe for euer. . . . \(^{18}\)

Recorde was, of course, fully aware that his attitude toward Copernicus' system was "againste common reason, and repugnante to the consente of all the learned multitude of Wryters"; he simply restated the argument against Copernicus here so that he could launch a counter-offensive. Copernicus was not a common man and his system could not

\(^{17}\)Ibid. \(^{18}\)Ibid.
be understood by common means. Mathematics was above common sense, and the reader had better realize that fact.

In The Castle of Knowledge, however, the student was the one who took the brunt of Recorde's exhortation:

You are to yonge to be a good judge in so great a matter, it passeth farre your learninge and theirs also thae are muche better learned then you, to improue his supposition by good argumentes, and therefore you were best condemne no thinge that you do not well understand.19

Anyone who opposed Copernicus and his system was seen as suffering from the limitations of his own ignorance. But there was a glimpse of hope, nevertheless. In the end, Recorde promised the student, along with his readers, that "an other time . . . I will so declare his supposition that you shall not only wonder to hear it, but also peradventure be as earnest then to credite it, as you are now to condemne it."20 With this promise, Recorde could hardly have made his position toward Copernicanism any clearer. Once his readers understood mathematics, he believed that they naturally would be "as earnest then to credite" Copernicanism as he himself had been.

All modern scholars concerned with Recorde have chosen to ignore the obvious and sought to find the nonexistent essence to Recorde's anti-Copernicanism elsewhere. Claiming that Recorde's statements about Copernicus were "far from being crystal clear," Edward Kaplan, for example,

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19 Ibid.  
20 Ibid.
pronounces that Recorde could not be a Copernican, declaring that it was Recorde's "intellectual honesty" that forced him to mention the Copernican system at all. The fact that Recorde could have neglected altogether to mention this controversial issue in *The Castle of Knowledge* is conveniently overlooked. This work, in which both the pro and con of Recorde's statements about Copernicus appear, was after all only an introductory astronomy text. As Recorde himself pointed out, any discussion on Copernicus "dependeth of profounder knowledg then in this Introduction maybe vttered conuenently." The only reason he mentioned Copernicanism certainly was not because he was forced to but because he wanted to.

Others choose to ignore Recorde's Copernicanism by emphasizing the context in which his statement about Copernicus appeared. Louise D. Patterson, in particular, contends that, apart from the one passage cited above, there was no mention of Copernicus or his system anywhere else in Recorde's work. Furthermore, she argues, *The Castle of Knowledge* was written from the Ptolemaic, not the Copernican, viewpoint. Finally, she concludes, "In general, there is enough discrepancy between the diffuse and obscure discourse . . . in Recorde's work to suggest either that the author was confused or that the favorable mention of Copernicus was an afterthought."\(^2^2\)

\(^2^2\) Patterson, p. 218.
"afterthought" it might have been, but there was nothing confusing about Recorde's admiration for Copernicus. If Recorde felt that the passage was important enough to be inserted into the text after its completion, this clearly indicated that the Copernican issue was of overriding significance for him and required his immediate attention. Otherwise, he could have let the book be published the way it was without the interpolation. The fact was that Recorde made special note of the Copernican controversy in this particular book and made it in such a favorable way that there could be no doubt about his opinion of it.

It is unfortunate that the vagueness in the current arguments against the traditional view of Recorde's Copernicanism has been matched by the vagueness in the arguments supporting it. E. G. R. Taylor calls Recorde's adherence to heliocentrity the product of a "mature mind" but believes that he felt "it was too strong meat for the pupil (or perhaps for the pupil's parents)."2 3 Francis R. Johnson, on the other hand, stresses Recorde's pedagogical aims and the superiority of the Ptolemaic over the Copernican system as an educational tool, but fails

to provide clear-cut support for Recorde's affinity toward Copernicanism.  

All of the arguments against Recorde's pro-Copernican position appear to be the results of an anachronistic approach. For some reason, Recorde has always been viewed as a modern mathematician because he popularized mathematics, and Copernicus has been regarded as traditional because he tried to exclude the public from reading his work. This type of reasoning might be cogent for judging mathematicians of today, but it is not applicable to the situation of the sixteenth century. Recorde was no less traditional, or less modern, than Copernicus. As Copernicus was right for the wrong reason when he made the sun the center of the universe, Recorde was also "modern" for his antiquated view when he popularized mathematics.


25Concerning Copernicus, Edward Rosen is the only person who persistently argues that nothing as good as modern science could have come out of the mystical tradition. His pronouncement is "Out of Renaissance magic and astrology came, not modern science, but modern magic and astrology." With this motto, he takes on the whole school of scientific historians from Lynn Thorndike to T. S. Kuhn. See Edward Rosen, "Was Copernicus a Hermetist?" Minnesota Studies in the Philosophy of Science, edited by Roger H. Stuewer, V (Minneapolis, University of Minnesota Press, 1970), 163-171. For the most explicit statement on the unscientific outlook of Copernicus, see Thomas W. Africa, "Copernicus' Relation to Aristarchus and Pythagoras," Isis, LII (September, 1962), 403-409.
power of mathematics dominated him as much as it did Copernicus, and the appeal of the sun-centered concept exerted an equally powerful influence in both men. Furthermore, Recorde's acceptance of the Copernican system did not necessarily mean that he was forced to first reject the Ptolemaic paradigm. As Johannes Kepler complained a century later, Copernicus himself was interpreting Ptolemy rather than nature when he rearranged the universe. He did not want to create a new system to replace the existing one; he merely wanted to reform it. By the same token, Recorde did not have to choose one system over the other. Both systems had their own merits for him. The Ptolemaic method was simple to teach and easily understood by students, but it also suffered from one serious drawback. It was, as Copernicus remarked earlier, "neither sufficiently absolute nor pleasing to the mind." A true mathematician could never be satisfied with a mere tool for instruction; he demanded absolute perfection from his art. Without this aesthetic quality, it would be pointless to be a mathematician. To this end, Copernicus offered his system for all mathematicians, and Recorde was one of the first to recognize it for what it was.

26 Africa, p. 404.

Recorde's Pythagoreanism went far beyond his acceptance of Copernicus' sun-centered universe. In other instances, he appeared to be even more extreme in his adherence to the tradition than Copernicus himself. Expanding on the brotherhood's original dictum that "all is number," Recorde contended that "perfection" was not all there was to mathematics. If mathematics was restricted to perfection, all that was imperfect was left out of its scheme. To encompass all that ever was and ever will be, mathematics had to embrace both the perfect and the imperfect. Hence, Recorde noted, "Wherefore I maie truely saie that if any imperfection be in nomber . . . it is because that nomber is the commodities of itself." 28

Out of this conviction of the pervasiveness of mathematics, he further declared:

There is not in all the worlde, any thing that can excede the quantitie of it; Nother the grasse on the ground, nother the droppes of water in the sea no not the small grains of Sande through the whole masse of the Yearth. 29

As number was infinite, the property of it was also infinite, and "if there were infinite worldes, it would at the full comprehend them all." 30 Copernicus had never been willing to go so far. Toying with the concept of

29 Ibid.
30 Ibid.
infinity was always a tricky business. The Copernican system was immense, but it was not infinite. Copernicus' Christian belief in a finite creation did not permit him to explore this abstract mathematical notion and stopped him from constructing an endless universe.\(^3\) To do so would put God, who lived outside of His creation, beyond reach. But such theological considerations did not bind Recorde. His Christian framework fitted smoothly over his Pythagorean views. Instead of being in conflict with one another, Recorde regarded the infinite nature of mathematics as enhancing the power of God. If mathematics was infinite so, too, was the power of God. To limit the boundary of mathematics would in turn limit the power of the Creator.

The inclusion of God in his Pythagorean argument was not a mere intellectual exercise for Recorde. It came from his deeply religious view that mathematics and Christianity were not only compatible with one another but different expressions of the same thing. God was the ultimate source of Christian doctrine as He was "that true fountayne of perfect nomber, which wrought the hole world by nomber and measure: he is trinity in unitie, and unitie in trinitie: to whome be all prayse honour and

\(^3\)Koyré, pp. 33-34.
glorye, Amen."\(^3\)\(^2\) Since both of these types of knowledge came directly from the Almighty there was no doubt in Recorde's mind that his pursuit of mathematics was not any less religious an activity than theology itself.

In his insistence that mathematics possessed a divine connection, Recorde was also able to use theology to supplement his Pythagorean ideals. Although all things were created by numbers, he agreed that not everything in creation was mathematically determined. There were certain cases when God chose not to abide by the rules of mathematics. To the question of why water, which by volume was far greater than land, did not engulf the whole earth according to mathematical rules, Recorde replied that such phenomena could not be understood by mathematical calculations. It "fauoreth more of the determinations theological, then of the demonstrations mathematical."\(^3\)\(^3\) To put man on this earth, God saw fit to provide him with dry land. Mathematics could not be held accountable for such phenomena in creation; it would be held responsible only for the part of the creation that was demonstrable. To understand things of unexplainable nature, one had to turn to theology.

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\(^3\)\(^3\)Recorde, *Castle*, p. 141 [misprint 243].
To admit that theology was significant did not of course imply that it was as important as mathematics. As in the other aspects of his writings, there was a Pythagorean tinge to Recorde's theology. The knowledge comprised in theology might be vitally important to all men, but, Recorde insisted, it had to be built on the foundation of mathematics. Paraphrasing Plato to prove his point, he told his readers that God spoke in a mathematical language and "was alwaies workinge by Geometrie." All theologians, he declared, would be hopelessly lost without a thorough knowledge of mathematics because, without it, they would lack the means to interpret what God was trying to say to them.

If the source of Recorde's belief in the symbiotic relation between mathematics and theology came exclusively from his esoteric tradition, it would have been inconsequential to anyone but other mathematicians. Recorde, however, maintained that the Bible itself would verify all his claims. God communicated with man through mathematics and His miracles were best understood through the

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34 Robert Recorde, The Pathway to Knowledg, containing the first principles of Geometrie as they may moste aptly be applied unto practise, bothe for use of instrumentes Geometrical, and astronomicall and also for projection of platten in euerye kinde, and thencefore much necessary for all sortes of men (London, Reynold Wolfe, 1551; facsimile edition, Amsterdam, Walter J. Johnson, Inc., 1974), pp. i-ii.
science of astrology. Refusing to listen to any argument on this point, Recorde claimed that

d... above all other things the testimonye of Christe in the scripture doth most approve it, when he dothe declare that signes of his coming, . . . Also . . . he testified that many did marke the face of heaven, and pronounce truly of the wether, and therfore blameth them that thei could not marke and iudge the signes of the comming of the Sonne of man.95

In another passage, Recorde came close to suggesting that all a person needed to understand the words of God was mathematics. As recorded in the Bible, the three wise men, after all, were able to "iudge the signes of the comming of the Sonne of man" without any knowledge of theology. With knowledge of mathematics, they were able to detect anomalies in the face of the heaven and came to honor the birth of Christ before anyone else realized the significance of the event:

... the starre in the easte dyd gouerne the Wise- men, and taughte them the very region where Christe should be borne. And farther by it they understode, that he was the true kynge of Jews, and sauiour of Israel. And thoughge manye sawe the starres as well as they, yet fewe or none knewe the signification but they yet dyd God at the beginning ordaine the starres to be as signes and tokens of times alteration.96

Without their training in mathematics, this detection would not have been possible, and it proved beyond any doubt for Recorde that mathematics was also ordained by

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95 Recorde, Castle, p. [a.vii].
96 Ibid., pp. a.iv-a.v.
God to be studied by men in order that He could communicate with them.

In this religious context, the study of mathematics acquired an expanded meaning. It was no longer an elitist intellectual undertaking suitable for the select few, but a religious duty which should be practiced by all men. In the same breath that Recorde sought theological support for mathematics, he also expounded upon the ultimate relationship between God, mathematics, and man:

Oh meruailous maker, oh God of good gouernaunce: thy woorkes are all wonderous, thy cunning vnknowed: yet seedes of all knowledge in that booke are sowen. . . . And yet in that boke who rightly can reade, to all secrete knowledge it will him straigthe leade. . . . These woorkes the more strange they be, the more ought men to esteeme the frute of them: to magnifie the knowledge of them, and to studye to understaunde the mean to attaine them, but most of all to honour, praise and glorifie the author of them.37

No one could excuse himself by claiming that he was so far away from God that he could not "heare his preachinge" because God wrote His words in the heaven where every man could see them. It was the primary duty of all Christian men to observe and understand the messages God gave to them. All they had to do was to immerse themselves in mathematics and they would be able to understand the most complex of His revelations. Mathematics, in short, was a key, if not the only key, to all Christian understanding.

37Ibid.
Few theologians would have found Recorde's mathematical interpretations of Scripture acceptable, but they would not have been likely to find his ideas heretical either. Recorde was as much a devoted Christian as a devoted Pythagorean. His conviction of the indivisibility of the Christian doctrine and mathematics was conceived from the Scriptures as much as from the ancient philosophy of his discipline. In effect, he had infused the mysticism of mathematics into the mainstream of Christian dogma and prepared the way for a theological justification of pre-Christian practices and ideals. If no theologian could find fault with Recorde's arguments, he found their mathematical knowledge lacking. "Many scrupulous divines," Recorde complained to his readers, "by mysse understandinge of scripture, haue abhorred the studye of Astronomye, and so of philosophye, and often tymes doo more sharply then discretely raile at these bothe, and yet understande thy not any thinge in eyther of them both." Such individuals were not truly divines; they were ignorant men and no one should pay attention to their words.

In this regard, Recorde was more of an ultra-Pythagorean than even Copernicus himself. Not even God

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38 For a discussion of the possibility that Recorde became a mathematician because he was converted to Protestantism, see pp. 12-14 in this text.

39 Recorde, Castle, p. 103.
was allowed to be outside Recorde's mathematics, and he 
made Him into the Zeus of a mathematical pantheon. But 
his synthesis of Christianity and Pythagorean concepts 
and ideals could not leave his traditional outlook in 
mathematics unaffected. The rules of God did not have to 
adhere to mathematical maxims; rather, mathematical maxims 
adhered to the rules of God, who was omnipotent. He could 
defy any rules at will, and His rules would be binding on 
all things in His creation including mathematics. His 
rules were universal, and it was in this doctrine of the 
universality of the Christian Church that Recorde's 
Pythagoreanism had to give way to the supremacy of God's 
commandment.

As a mathematician, Recorde had his share of contempt 
for the masses:

. . . the ignoraunte multitude doeth, but it was 
euer wonte, enuie that knowledge, whiche thei can 
not attaine, and wishe all men ignoraunt, like vnto 
themself, but all gentle natures, contemmeth such 
malice: and despiseth theim as blinde wormes, whom 
nature doeth plague, to stay the poisone of their 
vernomous styng.\(^0\)

Being "blinde wormes," they were destined by their nature 
to remain ignorant. They could not obtain knowledge and 
would always be jealous of those who could. Recorde urged 
his readers not to think about these beings and forbade his 
students to discuss them because "as these men do trouble

\(^0\) Recorde, Whetstone, p. a.i.
the good state of the wourlde, so the talke of them will hynder the talke of the worldes knowledge." They should be left unto themselves until, by "tomblinge in the dyche of the ignoraunce," they leave the world a better place.

To regard the masses as "blinde wormes" might be in keeping with the attitude of Recorde's elitist tradition, but it was nonetheless in direct conflict with the whole Christian theology of creation. God created the universe for all mankind, and no man could claim exclusive right to anything in this creation. As Recorde himself admitted, everything in the universe from "the sonne, the Moone and the Starres, were ordained of God to serue all the nations that be vnder the heavens." How, then, could anyone righteously claim that mathematics, the language of the Creator, was made for the select few to understand and enjoy? This question was particularly pertinent to Christians whose main duty was to learn and understand the words and the works of God. No amount of justification would be enough to keep the secret away from the masses if Recorde wished to maintain the divine link between mathematics and Christianity. To be consistent, as required by the discipline of mathematics, he had to forego the Pythagorean code of secrecy for the sake of mathematical universality.

"1Ibid.  "2Ibid.  "3Recorde, Castle, p. a.v.ii.
As the word of the Scripture was the ultimate source of Recorde's belief in the divinity of mathematics, the Pythagorean concept of the pervasive power of numbers was his conclusive proof for the educability of the masses. Of all things in God's creation, Recorde wrote, "where can there bee any testimonie for Nomber, then that the celestiale bodies doe kepe an unfallible nomber, in all their wonderfulle motions." The movements of the stars were the best "testimonie for Nomber" simply because they were perceivable through the natural senses. But mathematics was not the most divine knowledge merely because it was applicable to the natural realm; it was also "above all naturalle thynges." It transcended reality to the plane of things spiritual. The stars might be perfect, but they were not the finest of God's creation. It was in man, whom He created after His own image, that the most sublime nature of mathematics could be found. Mathematics, Recorde pointed out, was "not onely the constitution of the whole worlde . . . but also the composition of manne, yeh and the whole substance of the soule." Man, in essence, therefore, was a mathematical being by the manner in which he was created. Man's ability to comprehend the mathematical art, the holiest of all knowledge, proved

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44 Recorde, Whetstone, p. b.ii.  
45 Ibid., p. b.i.  
46 Ibid.
this. It went without saying that to repudiate any man's right and ability to study mathematics was to desecrate the sanctity of mathematics itself.

Once the compatibility of the masses and mathematics was established, it remained for Recorde to supply the rationalization as to why most people remained ignorant of the very stuff of which they had supposedly been made. This task was easier than it first appeared. In two short dialogues, Recorde told his inquiring student that these men were ignorant because they were too inadequately tutored to recognize their own ignorance and thus lacked desire to learn.

S . . . This oftentyme as I haue considerd, make me to muse what mynd is in them, whiche care for no knowledge, nor esteem any science. M . . . The greatest pointe of all ignorance is not to know the grossenes of ignorance, and not to vnderstand the benefite of knowledge, and with this faulte are a greate number spotted.47

The great number of the "ignorant multitude," then, were not inherently ignorant or "blinde wormes, whom na-
ture doeth plague." With the right kind of knowledge and instruction, they could be instructed and come to "know the grossenes of ignorance." It remained for those more gifted than they to help them get started along the right course. Mathematicians were gifted men and consequently had been given that duty because "These excellente giftes

47Ibid., p. a.i.
are not lente vnto mee, to be hidden. And there are a great multitude that thrust, and long moche for soche aide." It became imperative for Recorde, as a Christian and a mathematician, to assign himself a mission to help the masses to emancipate themselves from the yoke of ignorance.

How Recorde overcame the secretive inhibitions of his discipline and became the pioneer in the teaching of mathematics in the English language has been a matter of speculation and dispute. Admitting that Recorde showed strong Pythagorean tendencies, Kaplan suggests that "Recorde's attitudes in general were influenced by the Tudor middle-class Weltanschauung." The idea behind this suggestion is that Recorde was a member of the middle class and shared that class's concern for practical knowledge. Since mathematics was one form of practical knowledge, he attempted to disseminate it among the public.

Recorde indeed came from a "genteel family," and he also was concerned with the utilitarian aspect of mathematics. But the Tudor gentry was hardly a synonym for the present-day middle class. As J. H. Hexter points out, they were not even a "class" but a group of people who existed somewhere between the nobles and the commoners.

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48 Ibid., p. a.i.i.  
49 Kaplan, p. 93.  
50 See pp. 77-79 in this text.  
In the main, they adopted the outlooks of their social superiors with whom they competed for education, positions, and the favor of the Tudor monarchs. Since the gentry lacked an independent value system, it would be practically impossible to conceive how their Weltanschauung would differ from that of the nobility. All things considered, Recorde's emphasis on the utilitarianism of mathematics could not have come from the Tudor middle class, and his aspiration to become a popularizer could not have come from that highly elusive concept of Weltanschauung.

Recorde's ability to rise above his Pythagorean fear of the masses was the result not of any external forces of mathematical discipline but of an internal one. The strength of his conviction in the mysterious power of numbers compelled him to admit that all men—the beings who were physically and spiritually composed of numbers—were already attuned, to a certain degree, with the mathematical music. Without this concession, the whole argument that Recorde constructed on the relationship between mathematics and the act of creation would collapse. Without the divine connection, the overall significance of mathematics could not be maintained. Since the whole conception of the pervasive power of mathematics was an integral part of the universality of Christian doctrine, the admission of all mankind into the grand mathematical scheme was essential. To deny any man's right to mathematical texts was
equivalent to denying him access to the holy Scripture. To provide him with a path to this knowledge was, conversely, a missionary act. It was in part this combined sense of religious duty and the mystical conception of numbers that provided Recorde with the impetus to educate the public in his recondite art.

If Recorde was a victim of his own logic in admitting the right of the masses to study mathematics, it was his individual effort to see this logic to the conclusive end that made the most telling contribution. By a slight shift of emphasis from the "multitude" to the "ignorant," he transformed the enemy of the tradition from things actual to things abstract and added a sense of dynamism to the pursuit of mathematics. The opposition of the "ignorant" could be subdued with the knowledge already possessed. No mathematicians had to keep themselves secluded and their works hidden. On the contrary, they should bring themselves and their works to the people in a joint effort to struggle against the force of ignorance. When

52 The need to establish some type of realtionship between science and theology was common among English scientists of the sixteenth century. Recorde, however, was the first mathematician to suggest that God did not merely passively permit science but actively required it. He also "displayed an inner security that religion was on friendly terms with his subject and that he was serving God by helping to lift men up to the divine through the contemplation of mathematical law." See Paul H. Kocher, Science and Religion in Elizabethan England (San Marino, California, The Huntington Library, 195-), pp. 24-25, 156-157.
this new outlook was expressed in religious terms, as Recorde presented it all along, the war acquired the character of a crusade. No "stynge of ignoraunce," Recorde predicted, would be able to stand against the "prike of knowledge" in this holy war because "the pointe in Geometrie, and the unitite in Arithmetike, though bothe be vndiuisible . . . increase greater multitudes, then the brutishe bande of ignoraunce is hable to withstande." Armed with his magical spear and his unshakable faith in mathematics, Recorde set out to "vanquishe ignoraunce" by converting the masses to his brand of Christian Pythagoreanism.

53 Recorde, Whetstone, p. a.i.
CHAPTER III

A PATRIOTIC HUMANIST

Renaissance humanism was a multi-faceted movement of diverse origins and character. No one specific definition could adequately describe the whole range of humanist writings and activities. Yet all humanists shared certain traits that Paul O. Kristeller regards as their common denominators. First, they all had an unbounded admiration for classical antiquity. Second, they shared a mutual allegiance to the studia humanitatis and subscribed to the critical method of scholarship on which their discipline was founded. Third, and probably the most crucial, they shared "a belief in the recent or impending rebirth of learning and literature, and also an emphatic and genuine concern with man and with human, that is, primarily moral, problems."¹

In their common training and interests, the humanists sought to emulate the examples provided for them in classical literature. Their concern with man led them to the belief that they could use their knowledge to influence

the affairs of this world and thus improve the condition of mankind. Because of their preoccupation with worldly affairs, which clearly distinguished them from their scholastic predecessors, they were at times looked upon as secular and moral scholars who "emphasized nature rather than grace, ethics rather than theology and action rather than contemplation."² Although these are accurate descriptions of certain humanist manifestations, they reveal only the parts of the picture that are most discernible. Behind those civic facets, the humanists were as religious and spiritual as any man before or since. As Douglas Bush observes, "Humanism in the Renaissance normally means Christian faith in alliance with God-given reason, which is the most human faculty in man."³ The humanists' apparent concerns for ethics and "secularism" should not be emphasized over this fact. In spite of any temporal appearances, the keystone to humanism was the Christian religion.

Bush's observation might not be true in general,⁴ but it was certainly true of the English humanists in particular.


⁴While fully agreeing with Bush on the religious emphasis of the English humanist movement, Kristeller doubts that the term "Christian Humanism" could be used to describe the humanists as a group. See Kristeller, p. 20.
From the beginning of its development in the last quarter of the fifteenth century, English humanism was dominated either by men of the Church or by men closely associated with it. These men, Bush points out, "sought to make the rational wisdom of antiquity supplement the teaching of Christ." It was also true that, from this deeply religious background, the English humanists aimed to reform the educational program as a means of worshiping God as well as the way to the good life. There was no good reason to arbitrarily distinguish a difference between the two. As A. M. Fairbairn pointed out long ago, "The distinction is neither formally correct or materially exact. The Renaissance was not necessarily secular and classical—it might be, and often was, both religious and Christian."6

Humanism became a vital force in England late in the fifteenth century. As on the continent, it first developed among university towns and gradually spread outward. All learning centers were affected. But it is worthy to note that, by the early decades of the sixteenth century, most of the outstanding English humanists were men of Oxford.7 Starting with John Colet, Thomas Linacre,

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5Bush, p. 78.


William Grocyn, Thomas More, William Latimer, Thomas Wolsey, and including Reginald Pole, Thomas Elyot, and Thomas Starkey, all received their initial training in the classics from that university. Although few of these "Oxford Reformers" were academicians as such, together their combined efforts and activities helped to establish humanist knowledge in England.

By the time Robert Recorde entered Oxford in 1525, most of the original reformers had long departed for London. Their influence, however, did not diminish in their absence. In fact, their positions at Henry VIII's court gave both More and Wolsey added leverage against traditional schoolmen, who wished to abolish the nascent humanist study for its possible connection with the Reformation movement. The coming of Erasmus and Juan Luis Vives to England in this general period furthered the humanists' cause for educational reforms. Along with Colet, Erasmus helped to set the overall character and direction of the new learning in the country. Vives, who lacked the international reputation of Erasmus but

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8Linacre, the founder of the College of Physicians, and Latimer, Pole's tutor at Magdelen, in particular were, like Recorde, one-time fellows of All Souls. See Fritz Caspari, Humanism and Social Order in Tudor England (Chicago, University of Chicago Press, 1954), pp. 24-25.

was probably a far more original educationalist than his famous contemporary, came to Oxford in 1522 and remained there until 1528.\textsuperscript{10} With him, the English humanist movement expanded from scriptural and scholarly enterprise to include men from various occupations and, most importantly, involved these men in technological study.

Recorde's desire to combat the evil of ignorance among the masses reflected the influence of his humanistic training. His fundamental concept of man, "that men were shaped by education rather than by birth and that it was entirely possible for them to follow reason, after the right kind of education had enabled them to recognize it," was decidedly Erasmian.\textsuperscript{11} His attempt to popularize mathematics also paralleled Erasmus' insistence upon making the Scripture available to all in the vernacular. The temptation to draw a connection between Recorde and other indigenous developments such as the Lollards or other heretical groups, however, would prove futile. Recorde was a humanist and his concern for mass education was humanistic in nature. He regarded mathematics, as Erasmus regarded the Scriptures, to be the key to the good life and the way to worship God.


\textsuperscript{11}Erasmus was "a mentor of teachers rather than a teacher himself." Caspari, pp. 34-36.
Although he shared many of Erasmus' ideas on education and Scripture, Recorde's emphasis upon mathematics was not Erasmian; in this area, Vives showed a far greater impact. As distrustful as he was of what science might do to man, Vives was willing to concede the necessity of the subject. Warning that too much concern with mathematical abstractions might "withdraw the mind from the practical concerns of life and render it less fit to face concrete and mundane realities," Vives also pointed out the usefulness of mathematics in everyday life.\(^{12}\) His emphasis on scientific study was rooted in its utility, and he considered it detrimental to pursue such study beyond that point. Nevertheless, Vives' arguments for and against science paved the way for the inclusion of science as a part of humanistic knowledge.

The most influential of Vives' ideas was that humanist scholars should not spend all their time in bookish pursuits. All learning was empty if it was not connected to the welfare of the common man. Students were told that they should not only observe nature, but should seek advice and learn from gardeners, husbandmen, etc., and "enter shops and factories, and to ask questions from craftsmen."\(^{13}\) Only in this way could they ensure that their knowledge was

\(^{12}\)Simon, p. 119. \(^{13}\)Ibid., p. 120.
based on reality and, in turn, could be made useful in this world.

The development of Reorde's views during the early 1530s suggested that Vives' advice has a profound effect on him. His personal need to infuse mathematics with a concept of usefulness was evident in all his works. The titles of his first two works are cases in point: The Grounde of Artes Teachyng the worke and practise of Arithmatike and The Pathway to Knowledg, containing the first principles of Geometrie, as they may moste aptly be applied unto practise, bothe for vse of instrumentes Gemoetricall, and Astronomicall and also for proiection of plattes in euerye kinde, and therefore much necessary for all sortes of men.

The contents of the texts corresponded with their titles. Throughout The Grounde and The Whetstone, "whiche is the seconde parte of Arithmetike," the discussion always centered around the various uses of arithmetic in trade and measurements. In The Grounde in particular Recorde urged that "all men vse . . . [arithmetic] and employ the same to [their] most profyte. . . ."15 To make "profyte," one had to be able to handle money. In the section on

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14See p. 17 in this text.

division, when the student asked for the reason why anyone should learn such a difficult art, Recorde replied: "for by Dyuisyon pens are tourned into shillynges, and shyllynges into pounds: as for example of 120.5 it maketh 6.Ł2. . . . [Student] . . . when I knowe the vse of the worke, therefore now woulde I gladdely learne that."16

As a mathematician and a Pythagorean, however, Recorde refused to restrict his art to mundane usefulness. In The Castle of Knowledge, he could not resist adding a mystical element to the supposedly worldly humanistic literature. The ability to accurately read the stars was hailed as an incalculable advantage of mathematical knowledge. Anyone "who can skyll of their natures, and coniecture rightlye the effect of them and their menaeyncynges, shall be able not only to auoide many unconueniences, but also to atchiue many vnlikelye attempts: and in conclusuon be a gouernour and rulare of the stars accordyne to that vulgare sentence gathered of Ptolemy:

The wise by prudence, and good skyll Maye rule the starres to serue his will."17

Recorde himself appeared to be the first person to benefit from this ability. By pointing out the utility of mathematics in the outer realm and its relation to this world,

16Ibid., p. b.vii.

Recorde was able to integrate the humanist demand for practical knowledge with the idealism of his tradition. With this magical touch, the purity of mathematical knowledge was preserved, the humanist calling for useful knowledge was served, and all these ends were achieved without leading minds away from reality to abstraction as Vives had feared.

The difference between humanist pragmatism and Pythagorean idealism indicated by Recorde's work should not be over-emphasized. They coexisted with few apparent distinctions. In general, as Fritz Caspari comments, "if the appeal of the humanistic postulates was so successful because it was practical, the motivation of the humanists was essentially idealistic."\(^1\)\(^8\) It was not the utility of knowledge to which the humanists were committed; it was the concept of utilitarianism that fascinated them and induced them into preaching that ideal. Recorde's consideration for practical mathematics was formed in exactly the same vein. His humanism required that he measure all knowledge in terms of the usefulness it would provide, and he was more than delighted to comply. His mathematics was already ideally practical, which made it supremely suitable for everyone. There was no reason why something as perfect as mathematics could not be

\(^1\)\(^8\)Caspari, p. 10.
classical, useful, and thus humanistic knowledge at the same time.

How seriously Recorde embraced the idea of mathematics as a legitimate branch of studia humanitatis could be seen in the way he attempted to popularize it. He was not satisfied with any randomly selected texts; rather, all of his works were the result of deliberate planning, and they were all published in the order in which he intended them to be studied. Beginning from the introductory work on arithmetic (The Grounde) in 1543, he proceeded to geometry (The Pathway) in 1551, to astronomy (The Castle) in 1556, and finally to algebra (The Whetstone) in 1557. At each successive step all students were told that they should master the earlier works before they progressed to the more advanced subjects. After examining Recorde's instructional methods and his ability to blend the applicable aspects of mathematics into his writings, Francis R. Johnson and Sandord V. Karley conclude that "The size and superiority of the school of practical mathematical scientists in England can therefore be attributed to the movement initiated by Robert Recorde, and the points in which the English excelled corresponded to the most significant features of his system of teaching."19

The success Recorde had in establishing the English school of practical mathematics was clearly as humanistic as it was scientific. Beyond his insistence that mathematics must be useful, Recorde also responded to the summons of humanists like Erasmus and Vives for vernacular writing. Although the study of classical languages remained the heart and soul of the humanistic program, there was always a danger that the mastery of those languages could be achieved solely for the sake of elegance, which would lead humanist scholars away from their strength. It was better, wrote Vives, to "write in the vernacular, in which the great mass of the people were themselves authorities, teachers, judges." The public could thus readily comprehend the content of the works written and the humanists could avoid the elitist trap that had befallen the scholastics.

To write a mathematical text for the first time in any language other than those in which such texts were originally developed was an immense undertaking. Due to the highly technical nature of the subject, it was probably more difficult than any normal translation of other classical topics. Mathematical terminology was not easily

\footnote{Simon, p. 114.}

\footnote{A clear example of this can be seen in the writing of Ralph Lever's The Arte of Reason, rightly termed, Witchcraft (1573). Lever fancied himself to be a genius with words and attempted to write a book on logic in English.}
rendered into foreign languages. Facing this challenge, Recorde was forced to choose among three alternatives: first, to take over the technical foreign terms unchanged; second, to create new ones in their stead; or, third, to find English equivalents for them. Of the three possibilities, the last one was obviously the best course to take if a writer was honestly concerned with the public. The use of the equivalents would enable beginning learners to establish reference points within their own cultural context without having to bother to memorize additional strange new terms.

It has always been known that Recorde "made a special effort to find English equivalents for Latin and Greek technical terms..." But not all of the classical technical terms had English equivalents, as the mathematical language of present-day English testifies. Recorde himself admitted the impossibility of writing his works completely in the English language. This apparent

Along with the word "wicraft," he coined several other new terms, but none of them caught on and his book was a miserable failure. See Wilbur Samuel Howell, Logic and Rhetoric in England, 1500-1700 (Princeton, New Jersey, Princeton University Press, 1956), pp. 57-63.


contradiction raised the critical question of how "special" Recorde's "special effort" was, especially when no satisfactory equivalents existed. To determine the answer to this perplexing question, an examination of Recorde's vernacular writing and usage is in order.

In the list below, all of the new words introduced by Recorde in the writing of all his extant mathematical texts are presented alphabetically. They are the result of cross-reference checking between The Oxford English Dictionary (OED) and A Chronological English Dictionary (CED).

<table>
<thead>
<tr>
<th>Grounde (1543)</th>
<th>Pathway (1551)</th>
<th>Castle (1556)</th>
<th>Whetstone (1557)</th>
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<td>arithmematical*</td>
<td>artsman+</td>
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(1) (10) (10) (14)

+Words did not appear in mathematical contexts.
*Words appeared elsewhere in other forms.
/Word that Recorde mistook to be a common English word; see note 25 below.

24 In checking for new words in The Grounde, all three dates--1540, 1542, and 1543--have been used.
Although the appearance of these words suggests Recorde's failure to completely anglicize his mathematical texts on the one hand, the small number of these new words also reveals the extent of his desire to produce vernacular works on the other. Altogether he introduced only thirty-five new words to his readers. Discounting the words that were not used in mathematical contexts and those that had previously appeared in other forms in someone else's writings, the actual number of new technical terms Recorde was forced to employ for all his writings totaled only twenty-five. This was a remarkable achievement in view of the gigantic task of laying down the whole foundation of mathematics in a new language.

Recorde's ability to find and exploit existing English terms for his works undoubtedly helped to minimize the difficulty of the subject somewhat for his readers. But, given the nature of mathematics, it was not nearly enough. To make his texts more attractive, Recorde also adopted the dialogue form as a means of instruction. As if afraid that other mathematicians might accuse him of demeaning such a holy art with vulgar expression, he was

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25Easton reported that Recorde introduced a few other words than those appearing in the OED/CED. Among them are "cinkeangle" for pentagon and "siseangle" for hexagon, but these words did not appear to be "new" for Recorde. They probably show "the residual French influence in what Recorde took for sound English words." See Joy B. Easton, "The Tudor Euclid," Scripta Mathematica, XXVII (Winter, 1966), 344.
quick to point out the benefits of this method: "Because I judge that to be the easiest way of instruction, when the scholar maie aske every doubt orderly, and the mayster maie aunswere to his question plainly." But the dialogue format should not lead one to look upon Recorde's works as frivolous oversimplifications; the form of the presentation was insignificant compared to the content. Everything Recorde did in writing his books he did for the sake of the common readers; if these "simple ignoraunte" could not understand the works, all his efforts would have been in vain.

The most successful aspect of Recorde's vernacular writing was probably his ability to articulate his abstract knowledge in clear and simple English prose. All his desire to search for existing English equivalents and his technique of adding a personal touch with the use of dialogue would still have proven sterile if the works themselves had not been as accurate as they were simple to understand. When a single word was not adequate to convey the intended meaning, Recorde coupled two words together. The best illustration of his lucidity and accuracy was his definition of a "poynt":

\[\text{Recorde, Grounde, p. [xiii].}\]

\[\text{"Coupling" of words was a common practice for translating classical works during this period. No other works, however, dealt with mathematics or were written as well as}\]
A Poynt or a Pryke, is named of Geometricians that small and unsensible shape, which hath in it no parts, that is to say: nother length, bredth nor depth. But as this exactness on definition is more meeter for onlye Theorike speculacion, then for practise and outward worke. (considering that myne intente is to apply all these whole principles to wooke) I thynke meeter for this purpose, to call a poynt or pryke, that small printe of penne, pencyle, or other instrumente, which is not moue, nor drawn from his fyrst touche, and therefore hath no notable length nor bredth: as this example do declare . . .

The Pythagorean's preoccupation with precision and the humanist's requirement for useful knowledge were neatly juxtaposed together into the making of this "poynt." Because of this type of writing, Anthony à Wood, a seventeenth-century biographer, praised Recorde for "render[ing] all the mathematical texts to clear and obvious to capacities, that none ever did the like before him in the memory of man."29


29 Anthony à Wood, Anthaenae Oxonienses: An Exact History of All the Writers and Bishops Who have had their Education in the University of Oxford, 3rd edition with additions by Philip Bliss (London, T. Bensley, 1813; facsimile edition, Hildesheim, West Germany, Georg Olms Verlagsbuchhandlung, 1969), I, 255.
Few Renaissance humanists had taken the call for mass education as seriously as Recorde and even fewer had received such high praise for their vernacular efforts as he did. This was especially true of humanist mathematicians. A renowned humanist such as Melanchthon did not care to mix his theological and classical concerns with mathematics and did not venture beyond the first two subjects in his public teaching. His material grandfather, Johannes Reuchlin, "the most erudite" of the German humanists, the "defender of Christian truth," was far worse.  

It was bad enough that he did not write any of his scientific treatises in his own language, but he also extolled "Pythagoras's use of symbols to confuse and flaunt the common crowd, those cheapjacks and hecklers." With the exception of Peter Ramus, who was not a mathematician and "frequently (non raro) make mistakes with the abacus . . . and get into tangles he could not get out of," Recorde stood alone as a sixteenth-century mathematician who actually wrote his mathematical texts specifically with the masses in mind.

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31 Ibid., p. 77.

The absence of mathematical treatises in the vernacular in Europe at this time, apart from Recorde's, suggested that, despite their desire to educate the public, the humanists either saw no practical value in popularizing mathematics or lacked the knowledge to do so. Recorde could have been the only person who was convinced of the desirability of disseminating mathematical knowledge among the masses and possessed enough training to do it. His actions, indeed his determination, in this direction further suggested that his intention was much more complex than a simple response to his early humanistic education. The central position that mathematics occupied in his mind exhibited itself again and again in all of his works. Like all humanists, Recorde conceded that the importance of grammar was the most vital key to all knowledge, but he also never failed to point out that grammar itself must be based on the knowledge of mathematics. "And yf you take away number from grammar," he pronounced, "then is all the quantitee of syllables lost" and the whole structure of classical languages would crumble.\textsuperscript{33} In fact, he categorically gave the reasons as to why mathematics should be studied before all else and concluded that

\[
\dot{\ldots} \text{for humaine knowledge thys I boldly say, that who soeuer wyll attain true judgment therin, must also before al other arts, taste of the mathematical}
\]

\textsuperscript{33}\text{Recorde, \textit{Grounde}, p. b.iii.}
sciences, specially Arithmetike and Geometry, without which it is not possible to attayn full knowledg in any art.\textsuperscript{34}

The studies of law, philosophy, medicine, and especially theology all came under the domain of mathematics. In this regard, mathematics, for Recorde, was more than just an external research tool, as grammar was viewed by humanists such as Erasmus and Vives; it influenced the quality of the mind itself. Once a mind had been touched by the power of mathematics, it would soon change to become just as absolute and as pervasive, and thus all-perceptive, as mathematics itself. Claiming that all scholars agreed with him in this general belief, Recorde triumphantly declared: "It is confessed amongste all men, that knowe what learnyng meaneth, that beside the Mathematycalle artes, there is noe vnfallible knowledge, exepte it bee borrowed of them."\textsuperscript{35} Anyone who disagreed with Recorde on this point simply betrayed his own ignorance. Such individuals were among those who did not "knowe what learnyng meaneth," and therefore did not deserve to be heard.

R. T. Gunther was partially right to suggest that, besides being the first popularizer of mathematics, Recorde was also the first vernacular author who "insisted on the

\textsuperscript{34}Recorde, Pathway, p. j.i.

\textsuperscript{35}Recorde, Whetstone, p. b.i.
advantage of pure mathematics as a training of the mind."  

Gunther, however, failed to see that Recorde regarded mathematics as something much more important than a mere wit-sharpening stone. Many animals, as Recorde himself pointed out, were naturally more clever than men and "excel in manner all men, as it is dailly scene."  

Man could not hope to match his wit against these animals regardless of how sharp that wit might be. The superiority of man lay elsewhere. More than wit, man also possessed an ability to reason that raised him above any animal. The balance between wit and reason enables man, and no other creature, to comprehend mathematics. It was singularly this ability of man "that separaieth manne from bestases."  

Since mathematics made man human, anyone who "contemne noumbre," Recorde concluded, "be declareth hym selfe as brutishe as beaste, and vnworthy to be counted in the fellowshyp of menn."  

No Renaissance humanist would go so far as to proclaim his grammar as the one knowledge that differentiated men from beasts. The humanists' idea of knowledge was to give man informed choices, not to dictate them. Recorde's mathematics was much more authoritarian. It was a religious

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37 Recorde, Grounde, p. a.iii.  
38 Ibid.  
39 Ibid.
dogma that benefited anyone who followed it and damned anyone who did not. Even the concept of humanist "reason" was twisted to suit his view. His "reason" was not God-given intelligence for man to solve problems in this world, but the vehicle which enabled man to soar above his temporal concerns. In one of his lyrical moods, Recorde wrote,

If reasons reache transcende the Skye,  
Why shoulde it then to earthe be bounde?  
The witte is wronged and deadde awrye,  
If mynde be maried to the grounde.\

It was not a simple case of wastefulness, as a humanist like Vives would view it, if man did not cultivate his reasoning ability and wit in the art of mathematics; it was also "wronged and deadde awrye" for minds to be restricted to this earth. They had to be allowed to reach out to the spiritual realm with the aid of mathematics. Man, in short, could not be man without mathematics, and his mind would be tormented if it were not permitted to develop to the higher level that mathematics was sure to open to him.

Recorde reiterated this spiritual aspect of mathematics over and over again in all of his works. He always acknowledged that he had stated all these points before, but he never failed to repeat them again. He himself, he claimed, was not responsible for this apparent tautology.

\[^{49}\text{Ibid.}\]
It was "that .7.," he insisted, that "will not permitte me to passe it with silence."\(^1\) This magical number "contained, not onely the secretes of the creation of all thynges: and the consummation of the whole worlde . . . But also by it is the Sabbothes reste, and therby the full life and conversation of godlie persones. . . ."\(^2\) Recorde could not avoid making such statements any more than he could stop reciting the words of the Scripture. These were God's words, the omnipotent truths that all men should know and accept. Those who remained ignorant of them should be instructed in order that they could come to recognize the truths as such. It was the chief duty of all Christians to perform this service of teaching others.

Recorde's desire to combat the evil of ignorance and to educate the masses represented a happy marriage between the humanistic concern for the welfare of man and the Pythagorean conviction of the magical power of mathematics. Nothing could be more agreeable to Recorde's ancient mystical tradition than the humanist critical method and its optimistic view of the impending rebirth of new learning. But by adopting the humanist methodology, he had to accept its religiosity. It would indeed be impossible to carry on the humanist battlecry of going back to the source without returning to the Scriptures.

\(^1\)Recorde, *Castle*, p. a.iiiij.

To employ the Scriptures as the fulcrum of all "humaine knowledge," Recorde could not avoid universalizing and humanizing his mathematics. In effect, mathematics in this sense became a God-given weapon for man to combat the evil of ignorance in this world as well as a vehicle to achieve union with the Creator.

The extent to which Recorde committed himself to the tasks of popularizing mathematics in his own language further indicated that his attempt was domestically developed. While claiming that his works were written "for all menne," he also added that they were especially for "soche of my countrie menne, that vnderstand nothyng but Englishe." Since English was a little-known language in the sixteenth century, it is difficult to imagine how individuals of other nationalities were to benefit from his writings. The time period when the works themselves appeared confirm this suspicion. In August, 1536, Thomas Cromwell issued an injunction encouraging parents, masters, and governors to help eradicate the social evil of idleness by setting their children and servants "even from their childhood, either to learning or to some other honest exercise, occupation or husbandry"; if these young people remained idle for the lack of skill or trade, Cromwell declared, they would "fall to begging, stealing or some other

"Ibid., p. [b.iii].
unthriftness." This particular injunction and several others that immediately followed, as James K. McConica points out, were very clearly inspired by Erasmian reform and attracted wide support among English intellectuals.

Recorde could very well have been one of the scholars who responded to this urge for civic responsibility. All of his mathematical texts were perceived as "a forte against ignorance," and his concept of ignorance closely resembled Cromwell's. The root of his commitment to his program, nevertheless, went deeper. As a scholar, he was also concerned with the state of learning in England in general. The visits of eminent continental figures such as Erasmus and Vives must have been a constant reminder to him of how backward his country was in terms of academic excellence. The introduction of his first book, The Grounde (1543), revealed as much:

Sore oftentymes haue I lamented with my self the infortunat conditio of England, seyng so many great clerkes to aryse in sundry other partes of the worlde, and so few to apere in this our nation.

There was no good reason for this sorry state of affairs to continue. Few nations, Recorde believed, excelled or equalled the English for their "excellencye of naturall wytte." The only thing that kept the country backward

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was that, despite their intelligence, the English "[sur]-
passe all menne in wyne pleasure, to whyche they maye at-
tayne without greate payne or laboure . . . "

There was not much hope for this sort of men, but "yet all menne are not of that sorte. . . . " The other "sorte" of men not only took the "peyne to attayne learnyng, but also with as greate study and paine to communicat their learnyng to other, and make all Englande (yf it mought bee) partakers of the same . . . " It was to this second group of men that Recorde considered himself to belong and with whom he wished to "communicat."

These statements by Recorde were brimming with patriotism. In his belief, the love of one's country superseded all other considerations. Knowledge alone was useless unless it was shared with one's own countrymen, and only through knowledge could England be equal to other European nations. Antonia McLean is right on target when she points out that Recorde "believed that the way to national greatness lay through technical knowledge, and he wrote to educate his countrymen." Recorde himself further promised that he "wyll not cease dayly" to produce as many treatises as he could for their use.

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46 Ibid. 49 Ibid.


51 Recorde, Grounde, p. a.iii.
From the beginning, Recorde was concerned by the violation of his mathematical code of secrecy. He further confessed that "a greater cause of [his] lamentation is thys, that when learned men haue taken paynes to do thynges for the ayde of the unlearned, scarce they shall bee allowed fo[r] theyr well dooynge, but derided and scorned, and so bitterly discouraged to take in hand any like enterpryse agayn." Despite these odds, however, Recorde was determined to carry on his self-assigned mission because he had "good hope--that Englande wyll (after she hath take some sure taste of learnynge) not only brynge foorthe the more fauorers of it, but also suche learned men that she shall bee able to compare with any Realme in the world."\(^5\)

Kaplan suggests that Recorde's nationalistic emphasis was closely associated with the sense of a "quasi-religious duty" toward one's nation that was prevalent at the time.\(^5\)\(^3\) There was nothing "quasi-" about Recorde's attitude; his mission was, and always would be, a religious duty to him. The DNB probably was more correct to claim that Recorde was "an active champion of the Protestant reformation," but probably not in the sense in which that claim was originally

\(^5\)Ibid., p. a.ii.

made. All Souls was a hotbed of Protestant ideas at about the time of Recorde's enrollment there. The purging of Lutheran elements from the College in 1528 coincided with the period when Recorde decided to leave that university.\textsuperscript{54} The royal divorce and subsequent break with Rome had made English nationalism inextricable from the religious issue. Duty to one's country was the major Lutheran doctrine that made it particularly appealing to the nationalists in England and distinguished them from the mainstream of metropolitan humanism.\textsuperscript{55} Mathematics, however, was for Recorde the only true calling, and the religiosity that he attached to his discipline was translated into teaching the subject to the English public as a way to achieve national greatness in all of the spiritual sense of the word.

The feeling of "lamentation" that dominated Recorde's first work was not alleviated until the force migration of European scholars to England, as a result of the counter-reformation, and Charles V of Spain's attempt to consolidate the Hapsburg empire over the German territories in the

\textsuperscript{54}See p. 11 in this text.

late 1540s. After congratulating Edward VI for having been "borne in the time of such skilful schoolmaisters & learned teachers," Recorde urged the king to further his nationalist attempt:

I wasperswaded, that suche a wyse prince doothe des-ire to have a wise sorte of subjectes. For it is a kynge's chiefe reioysinge and glory, if his subjectes be riche in substantive, and wytty in knowledge: and contrarye waies nothyng can bee greuouse to a noble kyng, then that his realme should be other beggerly or full of ignoraunce: But as God hath geuen your grace a realme bothe riche in commodities and also full of wyttie artes (wichbe as the whette stones of witte) they muste needes increase more and more in wysedome, and peraduenture finde some thynge toward the ayde of their substantive, wherby your grace shall haue newe occasion to re-joyce, seeing your subjectes to increase in substantive or wisdom or in both.

Not only would the nation benefit from this learning in "wyttie artes," but the king himself, to whom God had given this realm, would gain as well. If Edward was to remain "wyse," as God ordained him to be, there was no other course for him to take but to help banish ignorance from the land by the use of the mathematical art.

Edward was also told that the source of ignorance, the enemy of the realm, was the Roman Church. Once the people became learned in the "Heauenly Knowledg," Recorde predicted:

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56 Chief among these scholarly refugees was "Martin Bucer of Strassburg from whom Calvin learned so much." Simon, p. 221.

57 Recorde, Pathway, pp. j.ii-j.iii.
... the blindnes of errour & superstition is exiled & good hope conceiued that all the sedes & fruts therof, with all kindes of vice & iniquite, whereby vertu is hindered, & iustice defaced, shal be clean extrirped and rooted out of this realm. ...  

The nation would thus be doubly served. The people would gain in worldly wisdom and substance, and the "sedes & fruts" of anti-Christ teaching would be rooted out of the land. England would ultimately gain from the knowledge of mathematics and right teaching would prevail.

By 1557, however, the situation in England had greatly changed. Mary I had been on the throne for four years and all indications suggested that she was jeopardizing England's sovereignty by her Spanish marriage. After a brief period of reconciliation for the sake of publishing his work, Recorde abandoned the position he had taken under her only a year before. In The Whetstone, he condemned those who did not join him in his patriotic deed "for fear of tauntes, and barking of eueres"; those people should realize that "their corage is smalle." The nation was in need and no one had a right to place his own personal safety first; everyone was required to do his share. Recorde had done his part of the work, but he reminded those who had yet to do theirs that they should "remember

58Ibid.
59See p. 36 in this text.
60Recorde, Whetstone, p. a.ii.
their duetie to their countrie: and to be a shamed, that their hauynge so greate habilitie, shall be founde moare slacke to aide their coutrie, then he that hath smaller knowledge, and lesse occasion other waitees."\textsuperscript{61} Recorde openly admitted that he could do no more, writing, "I exhorte them that be beste hable, to take from me this chargeable woorke, and to further thair contrie men, as equitie would."\textsuperscript{62}

Recorde was once again correct in his assessment of the situation. Soon after The Whetstone was published, he was imprisoned, and he died in the following year without seeing the fruit of his mission. His attempt to enlist other mathematicians to carry on his work, however, did not prove vain. The seed that he had planted grew to a gigantic tree within a few centuries. His achievement was far greater than he could have imagined; his English descendants, equally possessed by a sense of national pride and belief in the power of science, strode out of their little island to convert the world into an English world. Although they failed to rule the world politically, they were successful in transplanting belief in the practical mathematics and science of Englishmen everywhere around the globe. The sun has yet to set on Recorde's island.

\textsuperscript{61}Ibid. \quad \textsuperscript{62}Ibid.
CONCLUSION

Robert Recorde was a man of multiple affinities. More than a normal case of Renaissance synthesis, he was at once a mathematician, a Christian humanist, a champion of the Protestant Reformation, and an English patriot. As such, he embraced a wide array of philosophical ideals (mathematics, humanism, Protestantism, and patriotism) that occasionally overlapped—but seldom in complete agreement—with one another. Recorde, however, refused to recognize that there could be possible conflict among these ideals and tried to fuse them all together. The result of this fusion was the motivation behind his attempt to popularize mathematics, the success of his attempt, and probably the foundation of the supremacy of mathematics in the modern world.

As a sixteenth-century mathematician, Recorde had a conception of numbers that was as aesthetic and sublime as his attitude toward the ignorant masses was contemptuous and elitist. He regarded mathematics as a divine art concerned with spiritual beauty, but he saw ignorant people as nothing but "blinde wormes" who could never perceive the beauty of mathematics. Mathematics and the ignorant were the antithesis of each other, and a
relationship between them was not only remote but entirely impossible.

There were, however, limiting factors in Recorde's mysticism and elitism. His entire training in mathematics, after all, was conducted at a time when Christian humanism was the most powerful intellectual force in England. The educational ideas of men like Erasmus and Vives permeated all fields of classical scholarship, and mathematics was no exception. The mathematical tradition that Recorde inherited was not purely classical; rather, it was imbued with humanist aspirations, methodology as well as Christian theology.

The first problem Recorde had to deal with was the source of the divine nature of mathematics. Like all other mathematicians of his time, Recorde assumed that the sacredness of number came from God. The Pythagorean-Platonic philosophy itself was founded on the assumption that the Prime Mover invariably manifested Himself in mathematical terms. The conversion of mathematics from pagan to Christian art seemed simple at first glance. All Recorde had to do at the initial stage was to employ classical interpretation of the subject and lightly pronounce that God was the fountain of numbers.

But as a Christian humanist Recorde could not depend solely on Greek authorities for support. He had to use Christian sources to demonstrate that a connection between
mathematics and God actually existed, and this was when complications began. The Christian God was not only a Prime Mover but a Creator Whose creation contained everything in existence—the perfect as well as the imperfect. The corruptible earth was as much the work of God as the eternally perfect stars. If all things were equally close to God and "God was alwaies workinge by Geometrie," for the sake of mathematical consistency, Recorde was compelled to admit that perfection and imperfection were both different aspects of mathematics. This led Recorde to re-examine his traditional view of numbers and conclude that mathematics was not a divine art because it was perfect, but because it was the instrument that God used to create heaven and earth.

Recorde's willingness to admit the existence of mathematical imperfection, paradoxically, was intended not to make mathematics relative, but more absolute. By abandoning the pagan concept of mathematical perfection, Recorde could extend the domain of mathematics to the earth and make numbers the elemental force behind all parts of God's creation. The Pythagoreans had enshrined mathematics in the eternal perfection of the heavens and made the earth a black hole that defied all mathematical perceptions. In the Christian context, however, the earth could not remain a mathematical anomaly, and Recorde wanted to bring it
back into the fold of mathematics. Since his desire was founded on the Christian theology of creation, he was convinced that Genesis had been written especially for him to prove his point: mathematics was universal.

The universalization of mathematics was as necessary as it was desirable for Recorde. Because he was a Christian humanist, his attempt to relate mathematics to God was not enough; mathematics also had to be related to man. Both Erasmus and Vives were particularly insistent on this educational issue. Man's body and mind required simultaneous nourishment, and knowledge was to fulfill both the material and spiritual needs of man. The aesthetic quality of mathematics could satisfy the mind, but it was valueless for the body. In order to be a legitimate humanist knowledge, mathematics had to be practical as well. By universalizing mathematics, Recorde believed he could meet the humanist demand for useful knowledge without sacrificing the divine nature of numbers. Mathematics could be made into an applied science for the body while it retained its full magical potency of the heavens for the mind. The dichotomy of mathematics could accommodate the dual needs of man. To create the earth with less exact mathematics, God intended to leave His less precise instrument for man's uses. Mathematics was God's gift to man.

The utilitarianism of Recorde's mathematics was an ideal, but it was formulated on practical experience. As
a student, he was urged to combine bookish learning with observation of nature and men at work. By this combination, a humanist like Vives believed, scholars could deepen the understanding of their subjects of study and, in turn, be able to provide others with useful knowledge. Beginning in the early 1530s, Recorde worked closely and continuously with various groups of new professional men—printers, navigators, and miners—and from these associations he gained one important insight: as beautiful and appealing as mathematics was, these men were not interested in learning it. They were concerned only with knowledge that was immediately relevant to their life and trades. To persuade them to learn mathematics, Recorde had to convince them of the subject's usefulness. The humanist idea of practical education could not hope for a better confirmation; the experience Recorde had with these craftsmen and artisans revealed clearly to him that practical considerations of number were the essential part of mathematical study.

1The reading public of England at the time had not yet reached a state of being "habitual readers." Most literate individuals read for specific reasons and, because of this, they were often thought of as being "middle class." See Louis B. Wright, Middle Class Culture in Elizabethan England (Chapel Hill, The University of North Carolina Press, 1935), pp. 81-156; and H. S. Bennet, English Books and Readers, 1475-1557 (Cambridge, The University Press, 1969), pp. 26-27.
Recorde could have only paid lip-service to the humanist encouragement of public and practical education, as most of his contemporaries in mathematics did. But negligence in these areas would have lessened the credibility of the connection he had forged between God and mathematics. Because there was no blind spot in God's grace and some men did possess the knowledge of mathematics, Recorde was convinced that God wished all men to know mathematics and that no group of individuals could legitimately claim that mathematics was for their exclusive use and enjoyment. Mathematics was for everyone, and every man was potentially educable in the mathematical arts. The only reason why mathematicians could readily absorb the abstractions of numerical relations, Recorde insisted, was because God had entrusted them to teach the public for Him. There were certainly "blinde wormes" in existence, but no mathematicians needed to trouble their minds about them; these beings were not men but beasts and, regardless of how much they tried, they would not be able to understand mathematics. All mathematicians should rest assured in carrying out God's mission of teaching those who wished to learn to the best of their abilities.

Since teaching the public mathematics was the mathematician's reason for existence, the public had a Christian duty to learn from him. Only through the knowledge of mathematics could man understand the glory of God and,
at the same time, improve his own lot on earth. In ignoring mathematics, man was not only ignoring his own opportunity for improvement but the wish of God as well. Anyone who refused to comply with the wish of God deserved to call himself neither a Christian nor a man.

The intensity of Recorde's conviction in the need of man to learn mathematics went beyond Renaissance humanism to the religious fervor of formative Protestantism. The humanist assumption that any knowledge gave man the free will to make an informed choice was totally discarded; there was no element of choice in Recorde's mathematics. In his own definition, man was a mathematical being; God had created him thus, and he had a duty to realize the full potential of his own being. Man either had to learn mathematics or prepare to be damned for his ignorance.

No Christian humanist, with the exception of Luther, was willing to make such righteous statements. Merely to learn was not enough; one had to learn the right kind of knowledge. Besides the Scripture, Recorde believed, mathematics was that right knowledge, and its rightness indicated that it was the unwritten part of the Scripture. One had to have faith to be able to perceive this truth, and theologians who dared to believe otherwise were not true, but "scrupulous devines."

From this combination of total trust in the power of mathematics and a deep sense of religious duty, Recorde
plunged himself completely into the humanist task of teaching his countrymen mathematics when Henry VIII broke with Rome. A responsibility to one's nation and fellow citizens was no less holy than one's obligation to God. As Luther pointed out, a nation was designed by God to be man's unit on earth, and the king was His ordained representative. In opposing the wishes of the king, the Roman Church defied the sovereignty of the nation and the sacredness that the king represented. As a citizen, Recorde felt the need to popularize mathematics as a measure of support for his king and country. Only in this way, he believed, could England become prosperous and enlightened enough to purge herself of the Roman influence. Armed with the knowledge of mathematics, the most powerful gift God had given man, Englishmen could gain in "substance or wisdom or in both" and "blindnes of errour & superstition . . . shall be clean extrirped and rooted out of [the] realm."

Unlike any other types of knowledge, Recorde came to believe, mathematics was an instrument that united the power of heaven and earth. On a physical level, mathematics was the useful knowledge that helped man to obtain all the riches he desired; on a spiritual level, it became the magical Spear of Longinus that helped man conquer the evil of ignorance and brought him enlightenment. There was no good reason why the spirituality of mathematics
should be emphasized at the expense of its practicality; they were simply two manifestations of numbers, and they were of equal importance. Mathematics was the union of beauty and function, as man embodied the union of body and soul. With mathematics, man could improve himself spiritually as well as materially. The metaphorical relationship between mathematics and man helped convince Recorde that he had found the all-important key to man's salvation, and that key was mathematics.

If Recorde had kept his finding a well-guarded secret, it is unlikely that mathematics would have become the most dynamic force in the modern world. The strength of Recorde's convictions, however, did not permit him to keep silence about them. To serve God and country, Recorde made his mathematical doctrine public knowledge and, to get his countrymen started along the right course, he composed elementary mathematical texts to accompany his message. To do anything less would have been for him a violation of God's trust and a failure to fulfill his only mission in life.

Reorde's countrymen did not disappoint him. As well as making his texts the most popular mathematical treatises for two hundred years, they also helped to spread his mathematical gospel. In The Cosmographical Glasse (1559), William Cunningham, a Cambridge scientist
and the first original English writer on geography, implied that Recorde's texts were prerequisites for his work. In a dialogue between himself and a student, Cuningham had the pupil reply to his inquiry into his background knowledge with the statement "Yes sir I haue redde the grounde of Artes, the whetstone of wytte, and the pathway." Over fifty years later, Recorde's message about the necessity of mathematics in the life of man was still closely associated with his name. In 1612, one schoolmaster, who complained that the lack of mathematical knowledge as "a great foule want," urged his students to seek Recorde's works for help.

The significance of Recorde's accomplishment was often overlooked by scientific historians. Recorde's Christian humanist leanings made him appear to be an aberration in the scientific tradition of the sixteenth century and prejudiced his case in their eyes. It is


5J. L. Heilbron, for example, was fully aware that Recorde's career preceded John Dee and that Dee was "guided and inspired by his service to Recorde," but he wrote that
true that there was no quality of purism in Recorde's works, and he was an aberrant to his discipline. But precisely because Recorde was not a "true" mathematician, he was able to make his greatest contribution to man and mathematics alike.

The mathematical conception of the Renaissance was no less perfect and circularly static than the one originally enunciated by the Pythagoreans. For "progress" to occur in the discipline, mathematics first had to be Christianized. Only by replacing the Greek cyclical notion with the Judeo-Christian concept of linear time could the mental and thus physical act of "going forward" become possible. A new beginning was needed, and mathematics, as the basis of all sciences, was required to initiate the move. No properly indoctrinated mathematicians, however, were able to escape the perfect and eternal bondage of their own view toward mathematics. Their mathematics was being, not becoming. The task was left to a Christian humanist like Recorde, whose trust in God was absolute and whose patriotism was total.


Although the Renaissance mathematical study was originally revived by humanists, it soon fell into the hands of mathematicians proper. Humanist contributions to mathematics were usually limited to book collection
Recorde's mathematics was Christian, and it came directly from God. Recorde's God was the very same God that Thomas More, his senior Christian humanist, described in Utopia as the Supreme Being to whom the Utopians "attribute[d] the origin, increase, progress, change, and end of all visible things." As a mathematician, Recorde added to More's passage that the essence of God's visible attribute was mathematics and that it, too, should begin, change, and progress. The elementary texts that he published were designed to do exactly that: to be the foundation upon which all knowledge, including mathematics, could improve and change along with man.

To be sure, there were many other Christian mathematicians better qualified than Recorde to make this point, but there was no one who possessed his vision and deep sense of patriotic duty. A humanist like More, on the other hand, might have had the necessary vision but

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8In addition to being a popularizer of mathematics, Recorde was also the first person who made the idea of progress the central theme of his writings. See Samuel Lilley, "Robert Recorde and the Idea of Progress: A Hypothesis and a Verification," Renaissance and Modern Studies, II (1958), 4-37.
did not know enough mathematics to recognize its potentiality and, as a result, his Utopia was a fantasy without means. To Recorde, mathematics was a God-given instrument for man to achieve utopian ends. Heaven on earth might not be found, but it could be created, and England was chosen to be the first Utopia of all nations. Through mathematics, the country could progress as far as God wished her to go; all she needed was someone to provide her with the required knowledge. When Recorde popularized mathematics, he unleashed a far more profound force than the mere knowledge of numbers; he set forth the idea of what numbers can do for man. Since that time Christians and non-Christians alike have been possessed by this idea and have consumingly pursued Recorde's directive myth of progress through mathematics and science.
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