Flat Earth or round sphere: misconceptions of the shape of the Earth and the fifteenth-century transformation of the world
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I. Introduction

For over 150 years, historians have battled over the question of whether or not people in the Middle Ages and in the Renaissance, the years before Columbus set sail, believed that the Earth was flat. While historians debated, a popular perception developed, claiming that people living in the so-called 'Dark Ages' were so ignorant that they believed the Earth was flat and, if not for the heroic bravery of Christopher Columbus, we might well have continued in this ignorance. Thus, flat-Earth beliefs have become synonymous with stupidity and ignorance and discussions of Medieval and Renaissance concepts of the shape of the Earth have become so deeply imbued with ideological undercurrents that it becomes almost impossible to find the reality of Medieval geographical understanding. Given the rancor of this debate, it is not possible to ignore it and search only for historical truth. Rather, this article will take on a double task: first, to examine Medieval beliefs concerning the shape of the Earth; and second, to explain modern misconceptions about those beliefs.

There are two periods in the millennium we call the Middle Ages that have held the interest of those looking for flat-Earth beliefs, the 'Dark Ages', roughly from AD 500–900, and 100 years directly preceding Columbus, often considered the beginning of the Renaissance. Thus, this article will stress these periods in order to answer the question: did people in the Middle Ages think that the world was flat? Simply put, they did not. They did not have a unified understanding of the size and composition of the earthly sphere, but they were united in their conviction that it was a sphere. This answer leads to the second part of my analysis, an ultimately more interesting question. Why has this misconception persisted in the popular consciousness? Indeed, philosophers of science still commonly assume a flat-Earth belief and point...
to the breakthroughs of Columbus and Copernicus as the first great paradigmatic shift in world view. There are three inter-related causes of this historical fallacy. First, this issue became a battleground for pro- and anti-Catholic forces in the nineteenth century and continues as a test of modernity for pro- and anti-Medievalists. Second, hagiographic treatments of Columbus in the nineteenth century have seriously prejudiced pictures of pre-Columbian knowledge to this day. Finally, and most importantly, this fallacy comes from a faulty understanding of Medieval cartography. Nineteenth- and twentieth-century historians have looked at Medieval maps from the period before the reintroduction of Ptolemy's *Geographia* in AD 1410 and have seen the representation of a flat Earth. This is a fundamental misconception, based on a belief on the objective reality of map information. Maps always tell us as much about the society that produces them as about the proposed construction of the globe. Thus, the change from T-O maps to Ptolemaic projections does not demonstrate the discovery that the world was in fact round, but rather represents a fundamental change in the relationship between human beings and the Earth, as well as the increased status afforded to geometry and 'objectivity' in the fifteenth and sixteenth centuries.

II. Did people in the Middle Ages think the world was flat?

From the fifth century BC, the Pythagoreans had developed a spherical model of the Earth and the heavens. Every major Greek geographical thinker, including Aristotle (384–322 BC), Eratosthenes (276–194 BC) and Ptolemy (AD 127–160), based their geographical and astronomical work on the theory that the Earth was a sphere. Likewise, all of the major Roman commentators, including Pliny the Elder (AD 23/4–79), Pomponius Mela (c. AD 40) and Macrobius (fourth century AD) agreed that the Earth must be round. Their conclusions were in part philosophical, but also based on mathematical and astronomical reasoning.

Did this knowledge disappear in the Middle Ages? Certainly reputable historians have claimed that it did, at least for a time, during the 'Dark Ages' from the fall of Rome until Greek knowledge was reintroduced through the Arabs. For example, Boies Penrose reported:

> With the decline of Rome and the advent of the Dark Ages, geography as a science went into hibernation, from which the early Church did little to rouse it. . . . Strict Biblical interpretations plus unbending patristic bigotry resulted in the theory of a flat earth with Jerusalem in its center, and the Garden of Eden somewhere up country, from which flowed the four Rivers of Paradise.

Leaving aside this interesting construction of a world centred on Jerusalem, to which I will return, this paints a rather grim picture of the state of geographical knowledge and seems to lend credence to a flat-Earth theory, at least during the early Middle Ages.

But if we examine the work of even early Medieval writers, we find that with a few exceptions they espoused a spherical-Earth theory, even if this theory was based more on the authority of the ancients than on personal geographical understanding. Among the early Church fathers, Augustine (d. AD 430), Jerome (c. AD 346–420) and Ambrose (d. AD 397) all agreed that the Earth was a sphere. Only Lactantius

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(d. AD 325) provided a dissenting opinion, but since he rejected all pagan learning as a deterrent to salvation we must take his denial of sphericity with a grain of salt. The Venerable Bede (AD 673–735), in a book intended as a teaching text, described clearly and unambiguously the round nature of the Earth.

The cause of the unequal length of the days is the globular shape of the earth, for it is not without reason that the Sacred Scriptures and secular letters speak of the earth as an ‘orb’, for it is a fact that the earth is placed in the center of the universe not only in latitude, as if it were round like a shield, but also in every direction, like a playground ball, no matter what way it is turned. Likewise, Martianus Capella’s extremely popular neo-Platonic text, *De nuptiis philosophiae et mercurii* (late fifth century) supported the notion of a spherical Earth. From the seventh to the fourteenth century, every important Medieval thinker concerned about the natural world stated more or less explicitly that the world was a round globe. John Scottus, in the ninth century, held this belief, as did Adam of Bremen in the eleventh. All of the great thirteenth-century natural philosophers were agreed on this point, not surprising since they all incorporated Ptolemy’s astronomy and Aristotle’s physics into their work. Thomas Aquinas (c. AD 1227–74) followed Aristotle’s proof, demonstrating that the changing positions of the constellations as one moved about on the Earth’s surface indicated the spherical shape of the Earth. Roger Bacon, in his *Opus majus* (c. AD 1270), stated that the world was round, that the southern antipodes were inhabited, and explained the effect on the climates of different parts of the world caused by the sun’s passage along the line of the ecliptic. Albertus Magnus (AD 1200–80) agreed with Bacon’s findings, while Michael Scot (c. AD 1190–1291) ‘compared the earth, surrounded by water, to the yolk of an egg and the spheres of the universe to the layers of an onion’. Many other Medieval natural philosophers and encyclopaedists shared this belief in a spherical Earth; to name them all would expand this article unnecessarily. Perhaps the most influential were Jean de Sacrobosco (John Holywood; fl. AD 1230), whose *De Sphaera*, following Al-Farghani, demonstrated that the Earth was a globe, and Pierre d’Ailly (Petrus de Aliaco), Archbishop of Cambrai (AD 1380–1420), whose *Imago Mundi* (written in AD 1410), influenced by Roger Bacon, discussed the sphericity of the Earth and the five climatic zones. The latter was closely read by Columbus and so provides a link between Medieval ideas concerning the shape of the Earth and those of the ‘age of exploration’.

The one Medieval author whose work has sometimes been interpreted to demonstrate a disc-shaped rather than spherical Earth is Isidore of Seville (AD 570–636). Isidore was an important and prolific encyclopaedist and natural philosopher, best known for his collections of general information and interpretations for Christian life. Although he was quite explicit about the spherical shape of the universe (*De natura rerum* 10, *Etymologiae* III 47), historians have remained divided on his portrayal of the shape of the Earth itself. He claimed that everyone experienced the size and heat of the sun in the same manner, which could be interpreted to mean that the sunrise was seen at the same moment by all the Earth’s inhabitants and that therefore the Earth was flat, but is more likely to imply that the sun’s shape did not alter as it progressed around the Earth. Isidore also stated that the Earth was round like a wheel, and misinterpreted the Greek concept of the five climates, drawing them as
five petals on a flat flower, but much of his physics and astronomy can only be understood to depend on a spherical Earth, as does his interpretation of lunar eclipses. While it is not necessary to insist on absolute consistency, and indeed to do so claims a false machine-like quality for human rationality, I would agree with Charles Jones that '[Isidore's] cosmology, insofar as it has any consistency, is only consistent with a globular earth'.

As well as these learned natural philosophers and theologians, many popular vernacular writers in the Middle Ages supported the idea of a round Earth. Jean de Mandeville's *Travels to the Holy Land and to the Earthly Paradise* beyond, written in about AD 1370, was one of the most widely read books in Europe from the fourteenth to the sixteenth century. Mandeville was quite explicit in stating that the world was round and navigable: 'And therefore I say sickerly that a man myght go all the world about, both above and beneath, and come again to his own country... And alway he should find men, lands, isles and cities and towns, as are in their countries'. Likewise, Dante described the world as a sphere several times in the *Divine Comedy*, claiming that the Southern Hemisphere was covered with a vast sea. He also placed the Mountain of Paradise in the south, leading to an image which appeared more pear-shaped than round. As well, in 'The franklin's tale', Chaucer spoke of 'This wyde world, which that men seye is round', assuming that his audience knew of this theory. On the other hand, Jill Tattersall's analysis of twelfth- and thirteenth-century French vernacular literature paints a more muted picture concerning the understanding of the shape of the Earth than can be gleaned from the aforementioned authors. Although Old French vernacular non-fiction followed the Latin tradition closely and therefore reported a spherical Earth, fictional sources leave the matter in doubt. Tattersall claims that the lack of precision in Old French for terms such as round (*roond* or *roondece*) or Earth (*monde* or *terre*) means that we cannot say with any degree of certainty whether these people believed in a disc-shaped or spherical Earth. This ambiguity, as well as that concerning Isidore of Seville's concepts, warns us of the complexity of the issue. Neither the French vernacular texts nor Isidore's texts, however, discuss an explicitly flat Earth. Perhaps the question of the sphericity of the Earth was not the highest priority for these writers, or for their audiences. We must guard against assuming our preoccupations were shared by past generations.

The one Medieval writer explicitly to deny the sphericity of the Earth was Cosmas Indicopleustes, a sixth-century Byzantine monk who developed a scripturally based cosmology, with the Earth as a tableland, placed at the bottom of the universe. This cosmos is usually described by historians of Medieval geography, despite the fact that only two copies of this treatise are extant, one of which may have been Cosmas' personal copy, and that only one man in the Middle Ages is known to have read his work, Photius of Constantinople, known to have been the most widely read man of his age.

Thus, with the exceptions of Lactantius and Cosmas, who did not seem to have been very influential, all major scholars and many vernacular writers interested in the physical shape of the Earth, from the fall of Rome to the years before Columbus, articulated the theory that the Earth was round. Of course many scholars were more concerned with salvation than with geography and vernacular writers were more interested in the human condition than in philosophical questions. People living in...
this period perhaps did not anticipate that their opinions concerning the shape of the Earth would become a litmus test of modernity for modern historians and so concentrated on issues of more concern to themselves and their societies. Still, although not all writers stated that the world was spherical, no one except Cosmas stated that it was not. There was simply no viable dissenting movement claiming that the world was flat.

III. Important Medieval questions concerning the Earth

There were, of course, a number of important controversies concerning the Earth which were the subject of heated discussion in the centuries before Columbus. All were based on the premise that the world was a sphere, but all had different ideas as to how much of this sphere was inhabitable and inhabited.

1.

The first controversy stemmed from Plato’s discussion of creation in the *Timaeus* and from Aristotle’s cosmology concerning the elemental spheres. Aristotle had claimed that the four elements were arranged in four concentric spheres, with the Earthly sphere, as the heaviest, in the centre of the universe, covered by the watery sphere, by the sphere of the air and finally by that of fire (Figure 1). Now, if this were true, why was there any land above the surface of the water? Part of the answer came from the fact that the Earth was imperfect (as opposed to the supra-lunar spheres) and therefore that the element Earth, the most imperfect of the elements, had mixed with others. Thus, the Earth that was visible above the water was in fact not the elemental Earth, but rather that Earth mixed with water and air, which made it lighter than water and therefore able to exist above the watery sphere. For early Christian commentators, it was also clear that God, on the Third Day, had moved the waters so as to uncover dry land for human habitation. Still, neither of these explanations was entirely satisfactory, since they would indicate that in the first instance the dry land should be sinking and in the second that God could take away the dry land (as He had done once before).

Sacrobosco, in his extremely popular *De Sphera* (c. AD 1250, 25 published editions before AD 1500), explained the existence and placement of Aristotle’s four elemental spheres and claimed, therefore, that most of the surface of the globe was covered with water, with only one small section of dry and, therefore, habitable land, the *oechemene* (*terra firma* in Latin). Jean Buridan (c. AD 1300–58), Nicole Oresme (AD 1320/5–82), and Paul de Burgos (c. AD 1350–1435) offered an explanation of the presence of dry land. They argued that the centre of the Earthly sphere was not congruent with that of the watery sphere (Figure 2). The two spheres over-

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Figure 2 ~ Non-centric spheres of Earth and water. The larger sphere is the watery sphere and the smaller that of the earthly element. (A) is the centre of gravity for the combination sphere, (B) the geometrical centre, and (C) the centre of the earthly sphere. From Gregor Reisch, *Margarita Philosophica* (Strasbourg, 1504).

lapped but were not concentric. In other words, the *oechemene* was that part of the Earthly sphere that obtruded from the watery sphere, making the centre of the Earth's gravity (heaviness) different from either the geometrical centre or the centre of the Earthly elemental centre. Based on the articulation of this eccentric model, historian W.G.L. Randles has claimed that Medieval geographers combined an understanding of a round globe (the elemental spheres) with a belief in a flat inhabited Earth (the *oechemene*). This is a useful corrective to modern historians' attempts to force a single narrative of explanation on people with multiple explanations; ultimately, however, the elemental spheres were at the base of this model of the Earth.

2.

This discussion led directly to the second great controversy of pre-exploration geography, the question of just how much of the world was inhabitable and inhabited, sometimes called the problem of the antipodes. From Aristotle and Ptolemy, the majority view was that there was simply one *oechemene* that consisted of the known world. For Ptolemy, of course, this *oechemene* was quite large, from the prime meridian, passing through the Blessed Isles or the Canaries – the furthest west civilization existed – to 180°E; and from 63°N to 16°25'S. This encompassed the civilized world as Ptolemy knew it and he implied that there could be no other, that the world and its map were complete. Sacrobosco, Buridan, Oresme and Gregor Reisch, with his *Margarita Philosophica* (AD 1504), all followed this schema, which of course implied that there could not be other lands or other peoples not part of this *terra firma*.

Crates of Mallos (second century BC) had proposed an alternate theory that was followed by another group of Medieval geographers. Crates claimed that rather than one major landmass, there existed four, one in each hemisphere. This idea was taken up by Pomponius Mela and Macrobius in the Roman world, and by Jean de Mandeville in the fourteenth century. It was an enticing theory, since it implied the existence of other peoples, especially in the antipodes, and other sources of wonder and wealth. The major drawback was the belief that the tropics were uninhabitable.

3.

The question of the peopling of the globe was the third major point of discussion in pre-Columbian geographical circles. From the Alexandrian Parmenides came the theory of the five climatic zones (which Ptolemy also used); the two polar zones were too cold to inhabit and the torrid zone was likewise uninhabitable, leaving only the two temperate zones for human occupation (Figure 3). Since human beings had begun in the northern temperate zone (a belief even stronger after the advent of

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Christianity) and could not pass the tropics, there could only be human beings in the northern temperate zone. Thus, even for those who held the theory of the four oekemene, there was doubt as to whether anyone else would be found in the world. Both Michael Scot and Robertus Anglius, commentators on Sacrobosco, were adamant that there could be no inhabitants in the south. Roger Bacon and Albertus Magnus disagreed, but theirs was a minority opinion.  

4.

The final controversy of Medieval geography was the question of the size of the globe and the size of the oekemene thereon. There had, of course, been a number of different estimates of the size of the Earth, dating back to antiquity. Eratosthenes had established a measurement close to modern numbers, while Posidonius, whom Ptolemy followed, had a rather smaller estimate.  

Because of this, Ptolemy, and later Roger Bacon and Pierre d’Ailly, claimed that the distance from the Canary Isles to the easternmost part of China was not prohibitively far, especially given Ptolemy’s estimated size of China, about a third larger than present claims. Christopher Columbus read Pierre d’Ailly’s Imago Mundi (AD 1410) very carefully, taking great care to annotate extensively (especially the sections on the fabulous wealth of the Indies) and followed this lead by sailing west. Thus, we can see Columbus as the last of the great Medieval travellers, following d’Ailly who relied heavily on Roger Bacon, rather than as the first of the great renaissance explorers.

All of these geographical and cosmographical debates should convince us that the sphericity of the Earth was not at issue. Rather, these thinkers were dealing with much more complex and important questions which would, of course, have huge significance for the ability of Europeans to begin exploring and exploiting the world around them. Questions about the size of the globe, the ability to cross the equatorial divide and the chance of finding other lands if they did so were the burning issues, beside which the simple question of whether or not the world was round pales into insignificance.
IV. Did Columbus prove the world was round?

The modern assault on Medieval knowledge of the sphericity of the Earth deals not only with the early Middle Ages, but also with the Renaissance. Popular textbooks continue to inform us that Christopher Columbus, that intrepid explorer and man-before-his-time, was unable to persuade the council of scholastics at Salamanca in 1486, nor at first Ferdinand and Isabella, that the Earth was round. Thus, it was only due to the magnanimity and sympathy of Isabella that Columbus was finally allowed to undertake his quest and to prove that his description of the Earth had been true. As John Dyson explained, in a recent popular account: 'They [the council at Salamanca] agreed that in his Epistle to the Hebrews, St. Paul ... compared the heavens to a tent extending over the earth. Therefore, on Biblical authority, it could be nothing other than flat.'31 But clearly this was not so. Columbus' proposal, that the distance from Spain to China was not prohibitively great and that therefore a voyage west was shorter and safer than that around Africa, was definitely met with incredulity by the group of scholars informally assembled to advise the king and queen of Spain. There are no extant records of that meeting and so we must rely on reports written by Columbus' son, Fernando, and by Bartolome de las Casas, some years after the fact.

... the replies and reports that the geographers gave their Highnesses were as varied as their grasp of the subject and their opinions. Some argued in this way: In all the thousands of years since God created the world, those lands had remained unknown to innumerable learned men and experts in navigation; and it was most unlikely that the Admiral should know more than all other men, past and present. Others, who based themselves on geography, claimed the world was so large that to reach the end of Asia, whither the Admiral wished to sail, would take more than three years. ... To this they added that of this inferior sphere of land and water only a small belt or cap was inhabited, all the rest being sea that could be navigated only near the coasts and shores. And even if learned men admitted that one could reach the end of Asia, they did not say that one could go from the end of Spain to the extreme West. Others argued ... that if one were to set out and travel due west, as the Admiral proposed, one would not be able to return to Spain because the world was round. These men were absolutely certain that one who left the hemisphere known to Ptolemy would be going downhill and so could not return; for that would be like sailing a ship to the top of a mountain: a thing that ships could not do even with the aid of the strongest wind.32

In other words, these learned men at Salamanca were aware of the current debates about the size of the Earth, the problem of the antipodes, and climatic theories. They challenged Columbus on his claim to knowledge superior to the ancients and on his ability to do what he proposed. They did not, however, deny that the Earth was spherical, but rather used its sphericity in their arguments.33

This can be seen further in the laudatory preface to Decades of the newe worlde first printed in AD 1511, in which Peter Martyr praised the achievements of Columbus and those who have followed him:

Come therefore moste noble Prince elected of God, and enjoy that hyghe estate of thynges not yet understode to men. We offer unto yowe the Equinoctiall line
hetherto unknowen and burnte by the furious heate of the soone and unhabitable after the opinion of the owlide wryters a fewe excepted: But nowe founde to bee most replenished with people, faire, fruitful, and moste fortunate, with a thousande Ilandes crownd with golde and bewtifull perles, besyde that greate portion of earth supposed to bee parte of the firme land, excedyng in quantitie three Europes.54

Peter Martyr was quick to point out that Columbus had proven the equator was pass-able and that there were indeed peoples and lands in those parts of the globe once thought to have been covered with water. Nowhere, however, does he mention any proof of the sphericity of the Earth. If Columbus had indeed proven this to doubting scholars, Peter Martyr would have been sure to have included it.

Those who want to maintain Columbus as an icon for the historic moment when the world became round and possibilities infinite might reply to the previous pages that the issue was not what the scholars believed but what the common people thought. Weren’t Columbus’ sailors afraid of falling off the end of the Earth? Didn’t Columbus on his return need to inform his vernacular readers that he had proven that the world was round?

Neither of these assumptions is valid. According to Columbus’ diary, as later transcribed by Bartolemé de las Casas, the sailors did complain about two specific things. First, they were concerned that the voyage was taking longer than Columbus had promised (which was true and perhaps exacerbated by the fact that Columbus was reporting to the crew shorter distances travelled each day than he had in fact calculated).35 Second, they were frightened that the wind seemed to blow constantly due west and thus they would be unable to return against this prevailing wind.36

Likewise, Columbus’ Letter, published immediately on his return to Spain and translated from Spanish into German, Italian and Latin within the year, contained nothing about the shape of the Earth. Rather, it concentrated on the people and islands of the Indies, clearly a propaganda and fund-raising vehicle.37 Had he considered that proving the roundity of the Earth had been important, Columbus, never one to hide his light under a bushel, would have been the first to proclaim it.

Columbus thus did not prove that the world was round, since this was a perception shared by all learned and practical men for the two centuries at least before Columbus set sail. Indeed, most of Columbus’ views of the world, far from visionary, were based on old and minority opinions. He thought that the world was much smaller than many ancient and Renaissance estimates would allow and he was far more influenced by the tales of wonder in Marco Polo’s and d’Ailly’s accounts than by scientific theories. Indeed, at least once during his description of his voyage he harkened back to the view articulated by Peter Lombard and later Dante, that the world was pear-shaped rather than strictly round.38 This was caused by Paradise being situated on a steep mountain, thus maintaining a position close to heaven and avoiding the great deluge. When Columbus, during his third voyage, approached the mouth of the Orinoco river and felt the current of the great river pushing against the boat, he thought that he was beginning to sail uphill and that perhaps he had reached the source of one of the four rivers issuing from Paradise, located at the far east of Asia (an identification to which we will return).

For [Columbus] sayth, that he hereby coniectured, that the earth is not perfecty rownde: But that when it was created, there was a certeyne heape reysed theron,
much hygher then the other partes of the same. So that (as he saith) it is not rownde after the forme of an apple or a bal (as other thynke) but rather lyke a peare as it hangeth on the tree: And the Paria is the Region which possesseth the supereminente or hyghest parte thereof nereste unto heaven. In soo mucche that he ernestly contendseth, the earthly Paradyse to bee situate in the toppes of those three hylles, which wee sayde beeefore, that the watche man sawe owte of the topppe castell of the shippe: And that the outrageous streames of the freshe waters whiche soo violentlye isshewe owte of the sayde goulfes and stryve soo with the salte water, faule headlonge from the toppes of the sayde mountaynes.

Columbus was a man firmly rooted in his time, engaging in the scholarly and pragmatic debates of the age, and imbued with the same myths and desires. Like many of the people we have examined, he may not have had the same image of the world at each moment in his life. Consistency is a virtue created by modern interpreters, rather than sought by Medieval and renaissance thinkers. People of the thirteenth through fifteenth centuries thought of the Earth as round - when they thought of it at all – but it did not prevent them from considering problems of equal weight having to do with salvation and wealth and day-to-day living.

V. Why the misconception?

Since it is indeed the case that Medieval and renaissance geographical knowledge included the concept of a spherical Earth, why has this myth persisted that in the Middle Ages and in the years before Columbus people believed the world was flat? There are three separate but related causes for the development and continuation of this story. First, the scientific beliefs of the Middle Ages became in the nineteenth century the battleground for pro- and anti-Catholic forces, and the rotundity of the Earth became the measure of modernity for condemning or praising these Medieval churchmen. Second, nineteenth-century hagiographic treatments of Christopher Columbus, especially by such writers as Washington Irving, attempted to portray him as a visionary, a man ahead of his time, and again a spherical Earth became the touchstone of modern ideas. Finally, and I would argue most importantly, nineteenth- and twentieth-century interpreters of Medieval cartography have misunderstood the basic message of the Medieval mappaemundi (maps of the world) and have believed them to represent a flat or disc-shaped Earth.

The first creation of the myth developed in the struggle for the control of Truth between Church and science in the nineteenth century. William Whewell, an important British philosopher of science and a man who believed that science must be released from any superstitious trappings in order to flourish, declared in his History of the inductive sciences (first edition, 1837) that thinkers in the Middle Ages, limited by Catholic dogma, doubted the globular nature of the Earth. He cited as representative Lactantius and Cosmas, as well as the reprimand of Virgil, Bishop of Salzburg, by Pope Zachary for believing in the habitation of the antipodes. John Draper followed suit, with his rather inflammatory History of the conflict between religion and science (1875).

In Christendom, the greater part of this long period [Ptolemy to Copernicus] was consumed in disputes respecting the nature of God, and in struggles for ecclesias-
tical power. The authority of the Fathers, and the prevailing belief that the Scriptures contain the sum of all knowledge, discouraged any investigation of Nature. This indifference continued until the close of the fifteenth century. Even then there was no scientific inducement. The inciting motives were altogether of a different kind. They originated in commercial rivalries, and the question of the shape of the earth was finally settled by three sailors, Columbus, Da Gama, and above all, by Ferdinand Magellan.42

In other words, the evil church (typified for Draper by our old friend Cosmas) had kept people from understanding their world, but proto-capitalists had finally brought progress. Russell argues that much of the blame for this myth can be laid at the feet of Comtian positivism and Hegelian anti-Romanticism. These ideological concerns with the power of science and rationality and the belief in the continuing progress of human knowledge and understanding were an important component in the development of the myth of Medieval Planterreans and certainly influenced Whewell and Draper. Equally as important, however, were sociological concerns. Protestant philosophers of science, particularly those of Anglo-American origin, had nationalistic and economic motives behind their desire to claim the superiority of Protestantism and enlightened rationality. They wished to obtain the ear and pocket of government, especially as the infant British and American Associations for the Advancement of Science were attempting to establish their position as arbiters of scientific knowledge.

The Catholic forces fought back, with M. Schneid (1877) and Fr. Francis Betten (1923) both claiming that churchmen existed throughout the Middle Ages who had witnessed to the fact that the Earth was round. More recent historians have picked up on this theme and depending on their view of the modernity of the Middle Ages, they give greater or lesser credence to Lactantius and Cosmas. Ultimately this battle tells us more about modern notions of rationality and priorities than it does about those in the centuries before Columbus and impedes rather than aids us in an understanding of that period.

The literature about Columbus is as equally heavily burdened with ideological concerns as that written about Medieval progress. Washington Irving began the nineteenth-century movement (culminating in the 400th anniversary of the first voyage to America) to portray Columbus as a visionary, as 'modern man', challenging old perceptions and beginning the creation of a new country, America, which by the nineteenth century would stand poised to take its rightful prominence in the world. Irving began the legend (based on no contemporary evidence) that the council at Salamanca rejected the Earth's sphericity. So powerful has this image remained that every recent historian of Columbus has felt obligated to deny the story. As we have seen, Columbus was definitely a man of his time, engaged in many of the controversies over the size and make-up of the Earth. But because the sphericity of the Earth has such a powerful ideological function (as well as being one of the few things about which he was right!), it has continued as a prime measure of Columbus' special insight. Indeed, the popular image of Columbus has inappropriately taken him out of history and has emphasized instead his iconographic role as the 'other', either positively as the man of action who defined the forces of ignorance, or more recently negatively as the European imperialist destroyer of peoples and cultures.
These two facets of myth-creation were very important, but are not in themselves sufficient to explain the flat-Earth phenomenon. Pictures are often interpreted as objective and neutral, and thus I would argue that even more fundamentally this ongoing confusion about the Medieval mind stems from an inability to deconstruct Medieval *mappaemundi*.

In modern Western society Mercator projections and their various cousins are treated as if they represent unmediated reality; we assume that the geometrical projections represent the way the world looks and we do not question the conventions of these maps, which privilege political barriers, highways and large towns, at the expense of countryside and natural phenomena. The largely unquestioned assumption that these conventions depict reality has led us to assume a similar fit between representation and the real world for Medieval maps. This is a problematic position, to say the least. The conventions that allow us to imagine we are seeing a three-dimensional representation on a flat surface do not apply to maps constructed before the reintroduction of Ptolemy in the fifteenth century. Likewise, the values and goals we assume for modern maps cannot be attributed to Medieval exempla. Historians have often ignored this basic fact and have therefore looked at Medieval *mappaemundi*, especially those in the T-O form, and seen a flat Earth. But to read maps in this way is to ignore how and why these maps were constructed. Medieval T-O maps are an artifact created by a specific society, or more correctly several specific societies, since this form developed over a millennium. These societies did not believe that to measure was to understand or that power and control came through imposing names and order. These societies looked for signatures and symbols and so these maps must be seen as iconographic rather than representational, demonstrating to viewers their place in an organic world rather than their control over an objectified one.

VI. T-O maps

The *mappaemundi* of the Middle Ages demonstrate that non-Ptolemaic representations of the world were constructed with very different criteria in mind from those of the more recognizable Ptolemaic or even Mercator depictions. *Mappaemundi* were of various types, with more than half in the tripartite form often known as the T-O map (Figure 4). These wheel maps, with Jerusalem often in the centre (especially after the Crusades had begun), the Earthly Paradise at the top (east) and the Don River, the Nile and the Mediterranean forming the ‘T’ that divided the world into three continents, were not intended to be even crudely representational. Rather their purpose was to indicate the larger significance of the world as a subjective and organic whole. They demonstrated the inherent order of God’s plan, as well as the relationship between the microcosm of man and the macrocosm of the universe. They were drawn consciously to create symbolic space for the inner and spiritual life of human beings and their salvation. Hugh of Saint Victor, in describing how to draw a map of the world, is thus creating a space of iconic and real salvational import:

... the perfect ark is circumscribed with an oblong circle, which touches each of its corners, and the space the circumference includes represents the earth. In this space, a world map is depicted in this fashion: the front of the ark faces the east, and the rear faces the west... In the apex to the east formed between the circle
and the head of the ark is paradise... In the other apex, which puts out to the west, is the Last Judgement, with the chosen to the right and the reprobates to the left. In the northern corner of this apex is hell, where the damned are thrown with the apostate spirits. Around this above-mentioned circle is drawn one a little wider so that the zones may be effectively seen; the atmosphere is in this space. In this second space, the four parts of the earth and the four seasons are represented: spring to the east, summer to the south, autumn to the west, and winter to the north.52

*Mappaemundi* were pictorial representations of important historical, exegetic, or spiritual aspects of the Medieval world as a whole and of the inner world of those who viewed them.53 Many contained the central theme of salvation, showing the Creation, Passion and Last Judgement of the Earth and its inhabitants.54 The Creation was represented by the division of the world into three parts, often divided among Noah's three sons. The Passion was inherent in the T-structure of the division, representing the cross. Indeed, at times Christ's body was superimposed on these maps, showing the inherent connection between Christ and the world, both in terms of punishment and sin and in terms of final salvation (Figure 5). Christ in Glory at the head of the maps foreshadowed the final Day of Judgement. In the later maps, Jerusalem was often depicted in the centre because it was the focus of every good Christian's life (as well as the Crusades); the Earthly Paradise was on the periphery, nearest God in the east, because human beings by the fall had been driven far away.55 Essentially, these Medieval maps were a real and symbolic reminder of the organic interconnection between individuals, the natural world, and their saviour.

No European would have used such a map to travel to Jerusalem, let alone to the next town, for this was not the function of these maps. In order to travel to a new town or territory, one asked directions or employed a guide. Maps, which we now take for granted as a clear indication of our route, would have confused the Medieval traveller, concerned as he or she was with personal experience and specific encounters. In a world based on a subjective identification between individuals and the world around them, the simplification and reification inherent in geometrical map-making would strip such a map of any real meaning. Map conventions such as we would take for granted require cultural agreement and a common set of assumptions based on a high value placed on abstraction and geometric simplicity. These values were only created in the fifteenth century and so did not affect Medieval consciousness or the construction of Medieval *mappaemundi.*
Figure 5 ~ The Ebstorf map. This map, destroyed during the Second World War, shows the body of Christ superimposed on the map of the world. Note Christ's head at the top, his hands on each side, and his feet at the bottom of the map.

Medieval cartographers did not draw their maps to suggest that the Earth was flat; rather, they drew them to indicate their spiritual connection with that Earth. These maps appeared in texts that explicitly described the sphericity of the Earth and were clearly designed to supplement rather than to contradict the written word. The worlds represented on these maps were self-sufficient and often did not have room for new peoples or discoveries, but they were not flat.

VII. The true innovation of the fifteenth century

The geographical consciousness of Europeans did begin to alter drastically in the century after AD 1400. This was not because they came to believe that the world was round. Rather, the transformation of geographical thought in the fifteenth century was caused by the imposition of mathematical rules on global representation combined with the increased value placed on 'objective' measurement and emplace-
This change, from subjective and vitalistic to objective and mathematical, began fundamentally to alter the attitude of Europeans to their world and their ability to control and exploit it.

The Western world after AD 1400 was a different place from the world of the T-O map. Historians of cartography might point to the reintroduction of Ptolemy’s *Geographia* in AD 1400 (which had not been translated with the rest of the Ptolemaic corpus in the twelfth century) as the turning point from concepts of the world based on myth, hearsay and superstition, to those employing the values of objectivity, realism and geometrical accuracy. However, the reintroduction of this work itself needs explaining, since it could have been translated two centuries earlier and was not. The interest in this geometrical emplacement of the world was a result of a new emphasis in the European *mentality* that affected every aspect of intellectual life – the new importance placed on the mathematical science of geometry.

The introduction and acceptance of geometry changed many aspects of European life. The development of artillery, becoming more essential with new political struggles for power, needed some reliable objective underpinning, as can be seen in the work of such men as Tartaglia, Guido Ubaldo and Galileo. Likewise, fortification designers like Leonardo da Vinci used geometrical axioms to great effect. In art, perspective developed as the most important new technique of the age, partly as a *ludus mathematicus* and partly because of a new interest in the psychology of vision, which translated the objective world, now seen as existing separately from human beings and therefore as an objective reality, into a subjective and yet representational picture. In fact, this geometrization of world view could equally be called the objectification of the world. The natural world was increasingly viewed as separate from humanity. The relationship between human beings and their world ceased to be symbiotic and became that of exploiter and exploited. This allowed the growth of the individual, since each person was no longer an inseparable part of the organic whole, but existed separately and therefore could now reorder the world to suit his (or occasionally her) purpose. This attitude also encouraged the exploitation of natural resources, since this would no longer be viewed as mutilation of the self. It did, however, cast people adrift in a world not of their making or nature, forcing them tortuously to fit this world into an abstract construction.

This change did not occur overnight. Many natural philosophers clung to a belief in the interconnections between microcosm and macrocosm and the vitality of the world soul. The magical mentalities of the sixteenth and seventeenth centuries were a fruitful attempt to hold back the objectification of the world. Yet even these magi were influenced by mathematical ideas, learning to measure even as they sought occult connections. In this drive to develop a measurable world, the *Geographia* was extremely important. Ptolemy provided an artificial, mathematical, man-made framework that reduced the world into a knowable, objective, inert entity (Figure 6). Gone was Jerusalem as the navel of the world. In its place was set a rigid grid, like Alberti’s, through which the world could be viewed, though not touched. This was God’s view of the world, rather than the human view that the Medieval maps had portrayed. Thus, with Ptolemy’s scheme, human beings could not share that omnipotent attitude to the world, and therefore could have the right to exploit it for their now personally divine ends.

The success of Ptolemy’s conquest can be judged by the rapidity with which his
method and world picture were assimilated into geographical explanations. The Geographia itself was published in Latin in AD 1462, 1475, 1478, 1482, 1486 and 1490. Pierre d’Ailly incorporated Ptolemaic techniques and maps into his Compendium Cosmographiae (AD 1413) and his later versions of Imago Mundi. The Nuremberg chronicles, first published in AD 1493, contained among its beautiful woodcut illustrations a Ptolemaic map. And perhaps the most popular authors of the early sixteenth century, Peter Apian and Sebastian Munster, owed their concept of the world as well as their techniques for evaluating it to Ptolemy. Apian’s Cosmographia, first published in AD 1524, was essentially a popularization of Ptolemy, containing Ptolemy’s method and theory of map projection and astronomical observation, and charts of longitude and latitude, as well as maps of the world, inspired by Ptolemy’s work. Likewise, Munster’s immensely popular Cosmographia (AD 1544) began with Ptolemaic maps of the old world, following them with more recent maps of the new (based, of course, on Ptolemy’s technique). In fact, by the mid-sixteenth century, all major geographical treatises explicitly began with Ptolemy, and though they often scoffed at Ptolemy’s lack of particular knowledge and demonstrated how much more modern men knew of the globe than the ancients, they all subscribed unquestionably to the objective and geometrical framework established by Ptolemy.

The conversion of world view from organic, subjective and iconic, to mathematical, objective and representational, encouraged people to push back the bound-

Figure 6 ~ Ptolemy’s map of the world. Although the particulars of this map look very different to modern observers, the gridicule of latitude and longitude co-ordinates is instantly recognizable. Here is a world bounded by its own geometry, yet viewed from a god-like perspective. From Ptolemy Geographia (Ulm, 1482).
aries of the world, to fill in both mental and material maps the spaces marked *terra incognita*. After the acceptance of the Ptolemaic world in the fifteenth century, the rapid exploration of the world could be understood in terms of this mathematical grid of longitude and latitude co-ordinates. People knew where they had been because they could plot it on a globe. They understood the world because they could translate it into an abstract concept. Just as Galileo could claim that he understood the nature of free fall because he could measure it, could develop a mathematical formula with which he could plot it, so Renaissance explorers and geographers could claim to understand the globe because they could map it. Of course, important considerations of purpose and of human being's place in this scheme were lost. There is always a price to pay for objectivity and exactness. The world after Ptolemy, or at least after his reintroduction and acceptance in the fifteenth century, was fundamentally different (although to our modern ideas instantly recognizable) from the organic, personal world of the T-O maps. Mathematics and objectivity had begun their conquest of the human psyche.

**VIII. Conclusion**

The concept of the flat Earth, then, exists more in the mind of the nineteenth-century historians and twentieth-century members of the Flat Earth Society than it did in the geographical consciousness of Medieval and renaissance thinkers. And yet, their conception of the world was as different from ours as that of a flat Earth could be. For they saw the inherent connections between the world, themselves and their salvation; they looked for symbolic confirmation of their integral role in their world. They saw God in their world and their constant connection with Him through the world. The distance from this subjective, organic, inclusive world view, to the mathematical, objective, and controllable structure of the sixteenth century and beyond, is far greater than that from the Fortunate Isles to the Earthly Paradise. It was a journey that necessitated the jettisoning of value and connection in order to collect power and a god-like vision. This change that I have been charting is far more important, as well as more ambiguous in its implications, than any positivist progression from flat Earth to terraqueous globe could hope to be.

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**Notes**

1 Jeffrey Burton Russell, in his recent book *Inventing the flat earth. Columbus and modern historians* (New York, Praeger, 1991), argues that the 'Flat Earth Error' was caused by Comtian pro-Darwinian nineteenth-century historians and scientists. While I agree that this is part of the answer, it does not delve deeply enough into questions of how we conceptualize the globe or what values we place on it.

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Penrose, Travel, p. 7. These proofs were articulated by Aristotle in De Caelo ii, 14. First, physical laws required the Earth to be spherical since all heavy bodies seek the centre of the universe. Second, the shadow which the Earth casts on the moon during an eclipse indicates that it must be a globe. Finally, travellers moving from north to south see new constellations appear about the southern horizon, just as those travelling from west to east find that constellations rise sooner as they travel. This indicates the curvature of the Earth.


Augustine, De civitate dei, 16, 9; Gen. ad litt 1.10; Quaest. evang. 2. 14. Jerome, Com. in eccles. Ambrose, Hexaemeron 1.3. Lactantius, Divinarium institutionem libri septem Lib. 3, ch. 24. ‘Is anybody so foolish as to believe that there are men who have their feet above their heads? that grain and trees grow downward? that rain and snow fall upward?’ These authors are discussed in Charles W. Jones, ‘The flat earth’, Thought 9 (1934), pp. 296-307. Wright, Geographical lore, claims that the early eastern Church Fathers tended to favour Lactantius in distrusting pagan authors, citing Giovanni Marinelli, ‘La geografia e i padri della chiesa’, Bollettino della società geografica Italiana 19 (1882), reprinted in Scritti minori di Giovanni Marinelli, i (Florence, 1908), pp. 281-383. I can find no evidence to support this.

Bede, De temporum ratione, ch. 32. As quoted in Jones, ‘Flat Earth’, p. 301. Of course, Newton, Travel and travellers, p. 2, claims that Bede is the best of a bad lot.

Wright, Geographical lore, p. 54. Martianus Capella, in F. Eyssenhardt, ed., De nuptii philogie et mercurii (Leipzig, 1866).

John Scottus, De divisione naturae 3.32-33, cited by Jones, ‘Flat Earth’, p. 303. Adam of Bremen ‘clearly grasped the sphericity of the earth and refers to the axis around which the globe revolves’. Newton, Travel and travellers, p. 7. Francis S. Betten, S.J., ‘The knowledge of the sphericity of the earth during the earlier middle ages’, Catholic Historical Review NS 3 (1923-4), pp. 74-90, makes the claim that Medieval thinkers had sorted out the question of sphericity long before contact with the Arabs reintroduced Greek learning (and introduced Arab learning).


Penrose, Travel, p. 8; Newton, Travel and travellers, p. 11.

Albertus Magnus, Liber cosmographicus de natura locorum (1260). Penrose, Travel, p. 8; Newton, Travel and travellers, p. 10. For Michael Scot, see Wright, Geographical lore, p. 151.

‘Holywood gave some of the commonsense proofs of the curvature of the earth, and quoted an ancient estimate for its circumference, 252,000 stadia.’ Oakeshott, ‘Classical ideas’, p. 251. Wright, Geographical lore, p. 152. For d’Ailly, see Newton, Travel and travellers, p. 14.


Charles W. Jones, Bedae opera de temporibus (Cambridge, MA, The Mediaeval Academy of America, 1943) p. 367. Most historians of Medieval geography claim that Isidore believed the world was spherical: Woodward, ‘Medieval mappaemundi’, pp. 320-21; Stevens, ‘Figure’, pp. 268-77; Jones, ‘Flat Earth’, p. 303; Betten, ‘Sphericity’, pp. 84-85. Wright, Geographical lore, p. 54, claims Isidore sees spherical heavens and a flat Earth: ‘It seems certain that Isidore, or at any rate his interpreters, had no clear conception of the world as a sphere.’ Oakeshott, ‘Classical ideas’, p. 248.

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1, p. 129 (section on round Earth, pp. 126–32). Mandeville uses the rising and setting of the Pole Stars to prove his point and explains the physics of people living 'beneath our feet'.

16 Dante discusses geography many times in Divine comedy, e.g., Paradiso, Canto 9, 84, Inferno, Canto 26. The discussion of a pear-shaped world occurs in Inferno, Canto 34, 124ff. For a further discussion, see Edward Moore, Studies in Dante. Third series (Oxford, Clarendon Press, 1903), pp. 109–143. This description of a spherical Earth appears in another, interesting context. In an ecstasy Alpis (or Alpāis) of Cudor, 'was said to have seen the entire world in the form of a globe, compact and united. The sun was larger than the earth, and the latter was suspended in the midst of the air like an egg surrounded by water on all sides'. From Histoire littéraire de la France (1750), ix p. 155, cited in Wright, Geographical lore, p. 425. Likewise, the 'Vision of St. Benedict', painted by Giovanni del Biondo (c. AD 1356–98) shows St Benedict envisaging the world as a tripartite globe, so small in comparison with heaven that he looks forward to the afterlife. I owe this reference to David McTavish, Queen's University, Canada.


19 Most surveys of Medieval science, e.g. David C. Lindberg, ed., Science in the Middle Ages (Chicago, University of Chicago Press, 1978), do not mention geography. J.L.E. Dreyer, History of the planetary systems, (Cambridge, Cambridge University Press, 1906), pp. 214–19 stressed Cosmas' importance, as did John H. Randall, Jr., The making of the modern mind: a survey of the intellectual background of the present age (Boston, MA, Houghton Mifflin, 1926), p. 23, and Penrose, Travel, p. 7, who adds the caveat that 'it is only fair to state that not all writers of the Dark Ages were as blind as Cosmas, for St. Augustine and the Venerable Bede upheld the sphericity of the earth, and both Isidore of Seville and Orosius included geographical sections in their writings, which are not wholly without value'. Jones, 'Flat Earth', p. 305, demonstrates the marginality of Cosmas, stating that even Photius says, 'The style is poor and the arrangement hardly up to the ordinary standard. He relates much that is incredible from an historical point of view, so that he may fairly be regarded as a fabulist rather than a trustworthy authority. The views on which he lays special stress are: that neither the sky nor the earth is spherical, but that the former is a kind of vault, and the latter a rectangular plane'. Woodward, 'Medieval mappaemundi', p. 319, concurs with Jones.

20 Russell, Flat Earth, ch. 2 briefly discusses some of these spherical ideas, from those directly preceding Columbus moving backwards to the Greeks.

21 Eduard Jeaneau, Recherches sur l'école de Chartres (Amsterdam, 1973) discusses Medieval commentaries on the Timaeus.


24 Sacroboso, De sphaera (Venice, 1st edn, 1498). Randles, De la terra, p. 11.

25 Jean Buridan, in E.A. Moody, ed., Quaestiones super libris quattuor de caelo et mundo, (Cambridge, MA, 1942), p. 159; Nicole Oresme, The 'Questiones super de celo' of Nicole Oresme (2 vols., [New Haven: s.n.], 1965). Randles, De la terre, p. 43. Randle explains how this argument was used against Columbus by the academics of Salamanca in 'The evaluation of Columbus' “India” project by Portuguese and Spanish cosmographers in the light of the geographical science of the period', Imago Mundi 42 (1990), pp. 51–53.


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29 Aristotle estimated the circumference of the Earth to be 400 000 stades, Erastosthenes claimed 252 000 stades, and Posidonius (adopted by Ptolemy) 180 000 stades. Whether the stade used by [Erastosthenes] was 157.5 or 168 metres, as different modern scholars contend, the circumference according to his estimate would be 39,375 or 42,336 kilometres, close to the modern estimate of 40 000 km. Wright, *Geographical lore*, pp. 16–17.


31 John Dyson, *Columbus. For gold and glory* (Toronto, Penguin Books, Ltd, 1991), p. 81. Although this account has been challenged by more serious Columbus scholars, e.g., W. Phillips and C. Phillips, *The worlds of Christopher Columbus* (Cambridge, Cambridge University Press, 1992) and below, popular books continue to repeat the same myths.

32 Fernando Colon, *The life of the Admiral Christopher Columbus by his son Ferdinand*, trans. and annotated by Benjamin Keen (Westport, CT, Greenwood Press, 1959), p. 39. Bartolomé de las Casas relates practically the same story in *History of the Indies*, ed. and trans. Andrée Collard (New York, Torchbook Library, 1971), pp. 27–28 adding ‘There were other reasons not worth recording, and there were those contrary minds who contradict everything, no matter how clear and good the reasons.’

33 Randies, ‘Evaluation’, discusses some of the scientific arguments used against Columbus’ foolhardy scheme.


35 De las Casas claimed (ever the apologist) that Columbus did this to disguise just how far they had travelled from the crew. Instead, Columbus might have been converting one type of mile into another. In either case, there is more than a possibility that the crew knew something odd was going on. There were, after all, pilots on the two other vessels. This is discussed in Phillips, *Worlds*.


38 Peter Lombard (d. AD 1160) says Paradise ‘was situated on a height touching the circle of the moon’s orbit, whence it came about that the waters of the Deluge could not penetrate thither’. *Sententiae ii*, 17,5. Translated by Wright, *Geographical lore*, p. 262. Hildegard of Bingen (d. AD 1180) said that in a vision she pictured the Earth rising into an immense mountain in the north: Wright, *Geographical lore*, p. 192. Mandeville, *Mandeville’s travels*, p. 130, talked about walking uphill to Jerusalem, since the world was round and Jerusalem was in the centre point. This could be interpreted as a pear-shaped earth, but this was probably not his intention.
This need for consistency seems to pervade much literature on this topic. For example, Randles, *De la terre*, p. 26, claims that Pius II in his *Historia rerum* does not seem to see the incompatibility of the various theories of the Earth which he discusses, 'si evidentia pour nous'.


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It is outside the scope of this work to describe the changes that took place for maps in the millennium known as the Middle Ages. They were certainly not static images and, as David Woodward has shown, incorporated different ideas and information, depending on the period and the individual map. Indeed, much more work needs to be done on individual maps in order to see the real diversity and to understand their particular place in the world view of Medieval people. For the beginning of this work, see Woodward, 'medieval mappaemundi'.


There is much speculation as to how widespread the dissemination of these maps was. P.D.A. Harvey claims that the Medieval period produced relatively few maps. See P.D.A. Harvey, 'Medieval maps: an introduction', in J.B. Harley and David Woodward, eds, The history of cartography. Vol. i. Cartography in prehistoric, ancient, and Medieval Europe and the Mediterranea (Chicago University of Chicago Press, 1987), p. 283. Woodward, 'Medieval mappaemundi', p. 324, suggests that large mappaemundi may have been displayed in churches, which would have allowed a relatively large number of people to view them.

For a more detailed description of the symbolic aspects of Medieval maps, see Woodward's 'Medieval mappaemundi', pp. 334-41.

Randles, De la terre, p. 17.

200 examples of T-O maps have been found in copies of Isidore's Etymologiae and De natura rerum; 60 manuscripts of Sallustius' De bello jugurthino have such maps, as do manuscripts of the writing of Bede, Raban Maur and others. See Woodward, 'Medieval mappaemundi', pp. 359-67, for a list of the location of all major mappaemundi known to have existed between AD 300 and 1460.

David Woodward, 'Roger Bacon's terrestrial coordinate system', Annals of the Association of American Geographers 80 (1990), pp. 109-22, demonstrates that the co-ordinate system of map projection existed, at least in the thirteenth-century work of Roger Bacon, but that it did not gain popularity until the explorations of the fifteenth and sixteenth centuries. In Woodward’s 'Maps and the rationalization of geographic space', in Circa 1492: Art in the age of exploration (New Haven, Yale University Press, 1991), pp. 83-87, he sees this exploration as the impetus for a geometrization of the world map. I will argue that the geometry made the exploration (or at least its incorporation into a European world view) possible.

Thomas Goldstein, 'The renaissance concept of the earth in its influence upon Copernicus', Terra incognitae 4 (1972), pp. 19-51, traces another extremely important change which took place in this period, the development of a holistic picture of a terraqueous globe. When Copernicus argued in Book 1, Chapter 3, that the Earth was round and therefore subject to the same rules of physics as the round universe (that is that it should share the circular movement of the universe), he was referring to a different spherical Earth than Sacrobosco had envisaged. Gone were the separate spheres of Earth and water and in their place one unified terraqueous globe. This change, I believe, operated side by side with the mathematical development I am tracing to create a new vision of the Earth and its place in the universe (and therefore 'man's' place in that universe).

Many authors have discussed this development. See, for example, Edgerton, 'From mental matrix'; Paul Rose, Italian renaissance of mathematics (Geneva, Droz, 1975); Mario Biagioli,


Edgerton argues throughout ‘From mental matrix’ that perspective was the sole reason for Ptolemy’s acceptance. Svetlana Alpers The art of describing: Dutch art in the seventeenth century (Chicago, University of Chicago Press, 1983), provides a thought-provoking analysis of the development of the concept of seeing as believing in the seventeenth century.


Petrus Apianus, Cosmographia (Antwerp, 1564).

Sebastian Munster, Cosmographia universalis (Basel, 1559).