Of Schoolmen and a Flat Earth

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I distinctly remember a lesson in Primary School. The teacher told me that Christopher Columbus got money for ships from Isabella, Queen of Spain. In 1492 he said he sailed off westwards from Portugal with three small boats hoping to get to India. The story in the book was that he had to hijack his crews off the streets because the Spanish thought the world was flat so they would fall off the edge and couldn't get to India that way.

The first parts of the story were true enough, but the last sentence was not. The crews thought they were sailing to certain death but not because the earth was flat. Columbus himself chose maps that showed the earth to be smaller than it is. If he hadn't done that he could not have taken enough food for the expected journey. Spare a thought for those sailors. No phones, no GPS, no reliable maps, no weather reports, no fresh food: afraid of scurvy, of ghosts, of floggings, and being out of sight of land for months. They had a lot to be upset about. Sadly, at the time, I believed what I was told: the flat-earth bit and the stupid bit.

The shape of the earth

Two thousand five hundred years ago Greek scholars knew the earth was round and **Eratosthenes** (a Greek who lived in Egypt) calculated the circumference and radius to within a few percent in 240 BC. The Romans ruled most of Western Europe until about 400 AD. They knew. After the collapse of Rome only priests and scholars in the scattered remnants of the Roman Church could read and write. They wrote in clumsy Latin and argued about religion, but they never lost the knowledge of a spherical earth.

The silly story about the Spanish believing the Earth was flat was made up hundreds of years later by people who were trying to make fun of the Catholic Church.

For the details see:

https://en.wikipedia.org/wiki/Myth_of_the_flat_Earth

An illustration from a manuscript of *Vox Clamantis*, showing Gower shooting the world ca. 1400.

Aristotle had declared in 300 BC that the earth must be spherical because (as he said) all heavy things move towards their natural place of rest: the centre of the earth that corresponds to the centre of the 'universe'… so the earth, made of heavy things, must be spherical. Water is heavy and it too seeks its natural place of rest, so the surface of the oceans must be spherical.

The Medieval Schoolmen added their own curious opinions. The propositions below (in simplified form) are by the German, Albert of Saxony, who was rector of the University of Paris from 1353.

> *Verticals will diverge and meet at the centre of the earth.*
>
> *If two vertical towers are built the tops will be further apart than the bottoms.*
>
> *If a well is dug with a plumb-line it will be larger at the opening than at the bottom.*
>
> *When a man walks on a flat road his head moves faster than his feet. One can imagine a man so tall that his head moves twice as fast as his feet.*

And another one from Pierre d'Áilly, high master of the College of Navarre in 1384.

> *A flat bottomed pool will be deeper in the centre than at the sides.*

True enough, but unhelpful in modern terms. The schoolmen were not calculators or experimentalists. They paid attention to things that could not be measured. Their ideas might have been clever but they made no contribution to bettering people's lives.

The importance of approximation

It is important to pay attention to things that *can* be measured, and to understand that physics is the art of approximation. I remember a discussion with a school-boy in New Zealand some years ago. He was eight at the time and had been sent to me to ask questions about science. He wanted to know whether the shadows of rugby goal posts in sunlight were parallel as the book claimed. He thought (rightly) that they would diverge. He was in this respect at the stage of the best minds in Europe a thousand years ago. Unwilling to accept that approximations can and should be made when deviations cannot be measured.

The schoolmen's insistence that the verticals diverge made the calculation of the trajectory of a cannon ball too difficult. It was not until Galileo simplified the problem, separated the horizontal constant velocity from the vertical accelerated motion, and showed that the path is a simple parabola *if the verticals are taken as being parallel*, that progress was made and physics as we know it got started.

Of further interest:

Dugas, Rene. A History of Mechanics (Routledge 1955). *On the web as a .pdf file.*
Carl Segan on the measurement of R_E … https://www.youtube.com/watch?v=vzImgJCgUkg
Early illustrations … https://commons.wikimedia.org/wiki/Spherical_Earth#Medieval_images