

SKEPTIC *investigates*

Is the Earth Flat?

Flat Earthers Are Back—You Know the Earth Is Round, But How do You Best Make the Argument?

BY DANIEL LOXTON

RECENT NEWS STORIES,¹ CELEBRITY ENDORSEMENTS, and Google search trends² have highlighted an apparently growing conspiracy theory belief that the Earth is not a globe, but instead a flat disc. According to believers, government forces promote a completely fictitious model of the cosmos in order to conceal the true nature of the Earth. Are these claims true?

No. The Earth is Round

The evidence for a spherical Earth is overwhelming.³ Most obviously, there are many thousands of images and videos of the Earth from space, including a continually changing live stream view of the globe from the International Space Station—not to mention all the astronauts who have personally seen the Earth from orbit. Flat Earthers claim that all images of the globe are fraudulent inventions, and all testimony from astronauts is false. It is unreasonable to dismiss all of the evidence from the entire history of space exploration, especially when there is zero evidence for a decades long “globularist” conspiracy. However, we do not need to rely on evidence from modern space agencies to confirm the roundness of the Earth for ourselves.

The globe has been clearly understood for thousands of years. Indeed, this was one of the first cosmic facts to be worked out correctly by ancient people because evidence of a spherical Earth is visible to the naked eye.

By the time of the philosopher Socrates and his student Plato, many Greeks understood that the Earth could only be a sphere. Sailors would have noticed that the sails of approaching ships appeared be-

fore the hulls of the ships became visible because the surface of the sea is slightly curved, like the surface of an enormous ball.⁴ When you sail toward a ship, island, or lighthouse, their tallest points are the first thing to peek up over the curve of the horizon.

Plato's student Aristotle offered further “evidence of the senses” to support his own conclusion that the Earth “must necessarily be spherical.” First, there was the evidence of lunar eclipses. When the Moon passes through the shadow of the Earth, that shadow is always the circular shadow of a sphere. Also, Aristotle argued, “our observations of the stars” make it clear “not only that the Earth is circular, but also that it is a circle of no great size.” He pointed out that “quite a small change of position to south or north” significantly changes “the stars which are overhead, and the stars seen are different, as one moves northward or southward.” Just as ships can be hidden from view by the curvature of the horizon, so too can the stars.⁵

The debate about the shape of the Earth has been settled for over two thousand years. An ancient scholar named Eratosthenes—the head of the famous library of Alexandria in Egypt—even correctly approximated the circumference of the Earth using experimental measurements of shadows in two cities and some geometry.⁶ (Figure 1)

Despite modern legends about Medieval backwardness, there never was a time when educated people went back to thinking the Earth was flat. Once discovered, the true shape of the globe was too simple and useful a fact to be forgotten. Sailors were reminded of the planet's roundness every time they climbed a mast to see further over the horizon

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SKEPTIC INVESTIGATES

or looked to the stars to determine their position. By the time of Columbus, his crew and even his critics understood that our world is a globe.⁷ It had been an established fact for centuries. For example, here's a passage from the popular astronomy textbook *On the Sphere of the World* (Figure 2), published over 250 years before Columbus sailed:

That the earth, too, is round is shown thus. The... stars do not rise and set the same for all men everywhere but rise and set sooner for those in the east than for those in the west; and of this there is no other cause than the bulge of the Earth.⁸

The Nature of Flat Earth Beliefs

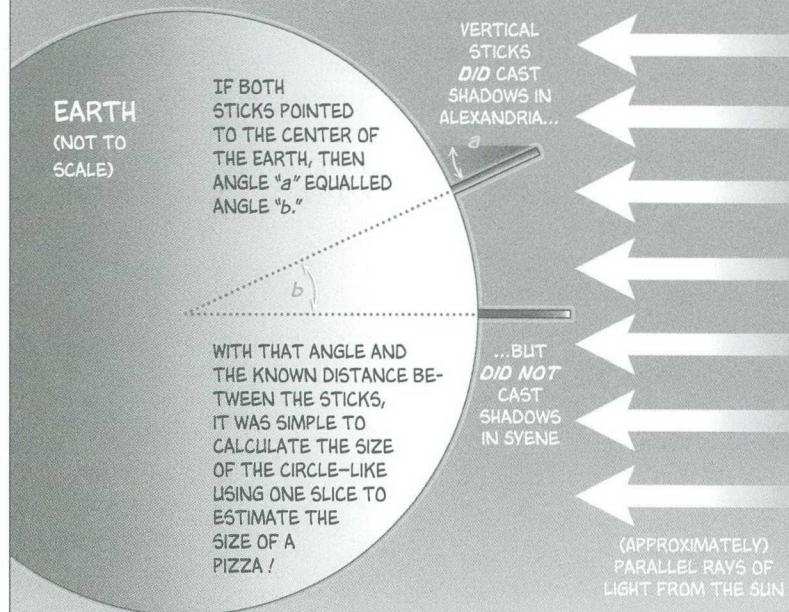
Flat Earth beliefs vary, but usually involve a large disc-shaped world with a relatively tiny Sun and Moon circling above it like lamps above a table. Flat Earth maps rearrange the continents and seas to radiate outward from the North Pole, which is imagined to be at the center of the disc. Everything we think of as the Southern Hemisphere is spread out around the outer circumference. It is usually claimed that Antarctica does not exist at all. Instead, the entire disc is encircled by a vast wall of ice that we mistake for a frozen southern continent.⁹ (Figures 3 and 4)

The people who make these claims are not always sincere. There is a long tradition of humorous trolling by people who merely pretend to think the Earth is flat.¹⁰ However, genuine, passionate Flat Earth believers certainly do exist. They typically base their beliefs on two things: intuition and fundamentalist religious faith. The world seems pretty flat when we go about our daily lives. The Bible also contains passages that suggest that our world could be a flat surface covered by a dome (the "Firmament").¹¹ (Figure 5)

Throughout the 19th and 20th centuries, Flat Eartherism was primarily motivated by Biblical literalism.¹² Believers saw the globe and astronomy as threats to faith. "No one can believe a single doctrine or dogma of modern astronomy and accept Scriptures as divine revelation," argued 19th century Flat Earth author John Hampden.¹³

This idea remains the position of many Flat Earthers today (although the Internet apparently also fosters a new, more secular¹⁴ conspiracy theory strain alongside traditional Christian Flat Eartherism). Flat Earth believers have long occupied a fringe within the Christian creationism movement, and have been a source of embarrassment for other creationists. For example, the creationist ministry Answers in Genesis has published several articles

Figure 1—The Earth Was Known to be Round More Than 2000 Years Ago



While Aristotle reported that mathematicians in his day had tried to calculate the circumference of the Earth, he didn't mention which methods they used. A century later, Eratosthenes, head of the famous library of Alexandria in Egypt, read that on the first day of summer in Syene (a town in the south of Egypt), a staff held upright would cast no shadow at noon. The sun in Syene at that moment was positioned so directly overhead that it even shone straight down into deep wells and reflected off the water. Eratosthenes tested a vertical stick on the summer solstice at noon to see if it would cast a shadow in his own town of Alexandria, some 500 miles (800 km) to the North. It did! He used the length of that shadow, the known distance between the two towns, and the rules of geometry to calculate a circumference for the Earth of around 250,000 stadia. Astronomer Carl Sagan marvelled:

Eratosthenes' only tools were sticks, eyes, feet and brains, plus a taste for experiment. With them he deduced the circumference of the Earth with an error of only a few percent, a remarkable achievement for 2,200 years ago.

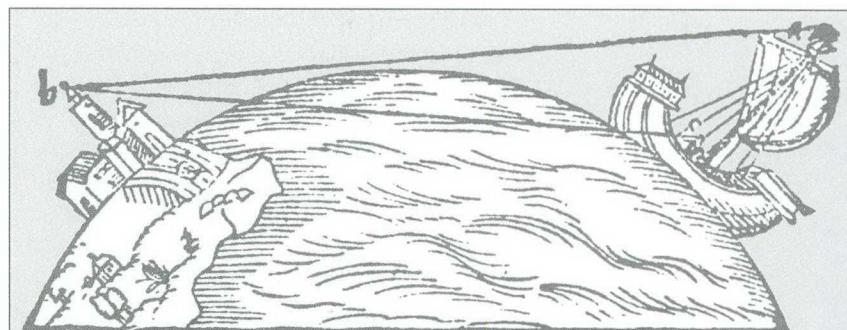


Figure 2—A diagram from a later edition of the early 13th century text *On the Sphere of the World* indicates that individuals of the time understood the curvature of the Earth.



Figure 3—Flat Earth illustration by Daniel Loxton. The Sun and Moon are shown much larger than imagined by Flat Earthers. Most believe that the Sun and Moon are around 32 miles across, which would make them tiny pinpoints of light relative to the size of the disk they circle over.

correctly debunking Flat Earth beliefs,¹⁵ only to be accused of hypocrisy for accepting astronomy while rejecting geology and biology. “The Flat Earth position is first based upon Scripture,” shot back one Christian Flat Earther.¹⁶

Flat Earth beliefs almost require creationist faith because the Flat Earth could not be a natural object. If such a world existed, it could only be an artificial environment constructed on purpose and maintained by forces we do not understand. Left to itself, a disc-world would collapse under its own gravity, forming a sphere like other planets, large moons, and stars.

Since the dawn of the Space Age, Flat Earth beliefs have necessarily also entailed believing that a vast conspiracy deceives us about the nature of the world.¹⁷ “The space program is a scientific plot to hoodwink the public,” claimed Charles and Mar-

jory Johnson,¹⁸ the most prominent Flat Earth advocates during the 1970s, 80s, and 90s.¹⁹ If they were correct about the shape of the Earth, it would follow that a conspiracy must exist to falsify evidence of Moon landings and images of the Earth from space.

However, this claim of a worldwide conspiracy suffers from the same serious flaws as other similar grand conspiracy narratives (such as the “chemtrails” conspiracy theory that aircraft contrails are actually part of a secret global spraying program designed to poison the Earth). First, there is no evidence that any such conspiracy exists. Second, it is implausible to suppose that a conspiracy could exist at that scale for decades without any of the countless thousands of conspirators ever leaking the truth. Third, if a conspiracy was so powerful as to hide itself successfully forever, it would

SKEPTIC INVESTIGATES

surely also be able to stop Flat Earthers from constantly blabbing about it on the Internet, newspapers, and television. Finally, it is unclear what could possibly motivate the sustained worldwide effort and expense necessary to conceal the shape of the Earth.

Christian Flat Earthers consider the conspiracy Satanic, which again places Flat Earth beliefs firmly within the sphere of religious fundamentalism. The assumed goal of the round Earth conspiracy is to lead believers astray from their salvation. This has a certain internal logic given their prior assumptions (on faith) of a Flat Earth, a conspiracy, and ongoing spiritual warfare between God and Satan. A round Earth conspiracy seems difficult to justify in secular terms. Why bother pretending the Earth is one shape rather than another? It stretches credibility to accept the motivation that one Flat Earth organization proposes: space agencies are “most likely motivated by greed...and using only some of their funding to continue to fake space travel saves a lot of money to embezzle for themselves.”²⁰

Flat Earth Ideas Make No Sense and Explain Nothing

Like other creationists, Flat Earthers base their arguments on perceived flaws in mainstream science while ignoring major problems with their own claims. They do not provide scientific evidence for their radical alternative model. Nor do Flat Earth models explain the broad range of natural phenomena that are well explained by the modern scientific understanding of the globe and its place in our solar system: planetary formation, volcanoes, tides, seasonal changes, the phases of the Moon, plate tectonics, earthquakes, the coldness of the poles, the magnetic field that compasses rely upon, auroras, and so on.

The Flat Earth model fundamentally conflicts with the things we see in nature. For example, why would the southern hemisphere’s stars be visible from the opposite edges of a Flat Earth, while people in the central region of the disc instead see the constellations of the northern hemisphere? Shouldn’t the same stars hang over everyone on a Flat Earth like a ceiling hangs over a kitchen table?

Why do the Sun and Moon and stars appear to rise and set? Most Flat Earthers believe that the Sun and Moon are fairly close objects, each just a few miles across, which always hang above the Flat Earth. Supposedly both objects circle around the North Pole on a plane parallel to the Earth’s flat surface while shining down like lamps to illuminate

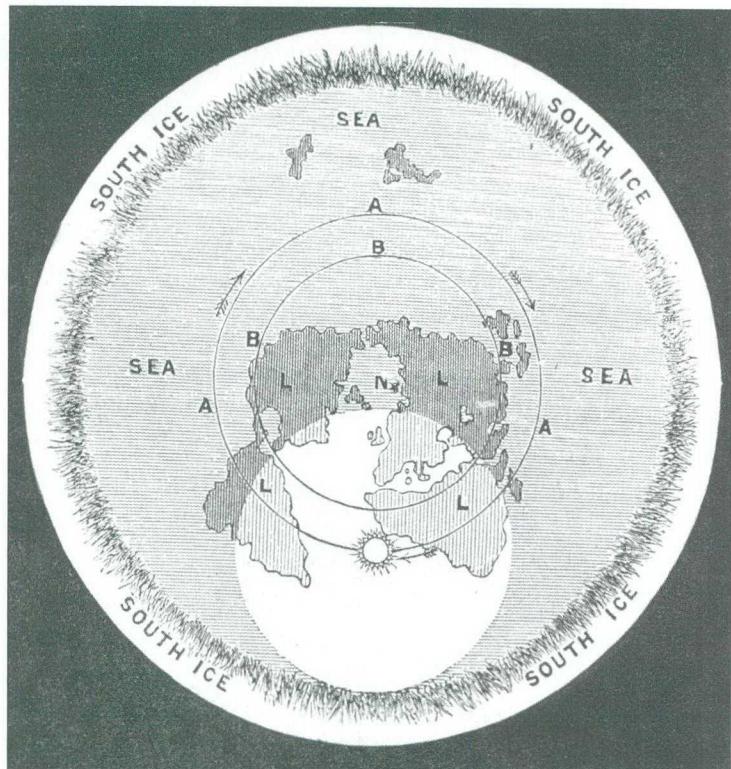


Figure 4—A Flat Earth map from Samuel Birley Rowbotham’s book *Zetetic Astronomy* (1865).

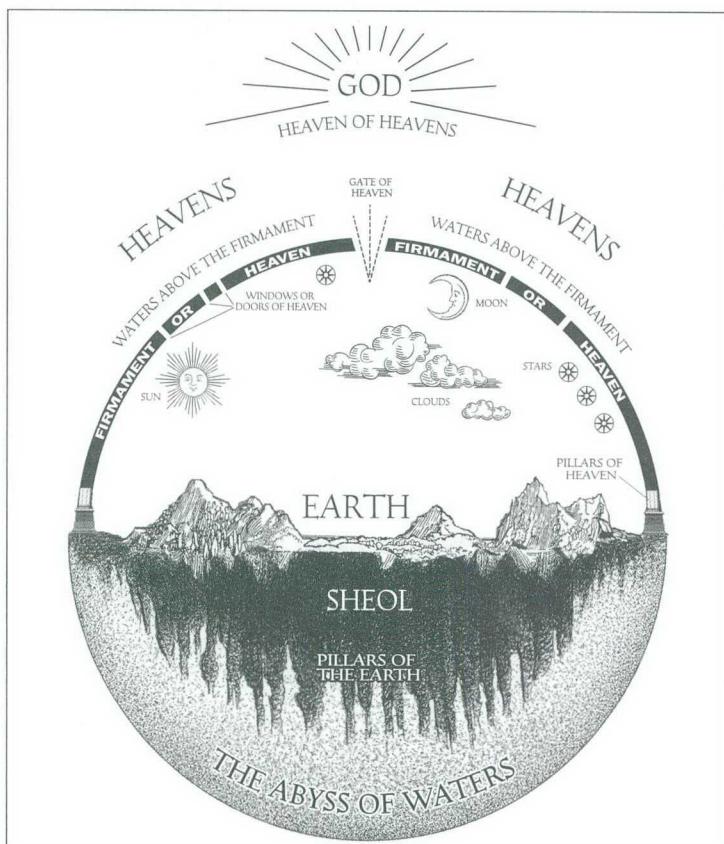


Figure 5—The ancient Hebrew concept of the cosmos.

different parts of the disc. (The Sun and Moon they argue are illuminated and kept moving by unknown forces; neither object orbits anything.) If so, the Sun and Moon should be visible all the time from every part of the Earth's surface. How could such a world ever experience a sunset? We never see the Sun grow noticeably dimmer or smaller with distance as we would in this Flat Earth model; instead, as the globe turns, the Sun passes out of view over the curvature of the horizon.

Flattening the globe also would severely distort the shapes of oceans and continents and the distances between them. Most notably, all proposed Flat Earth maps greatly expand the distances between southern landmasses. Countries that are relatively close together on a globe would be repositioned many times further away on opposite sides of a flat disc-world. In reality, for example, the distance between the northern countries of China and the USA is similar to the distance between the southern countries of Australia and South Africa—and so are the flight times to travel between them. That would not be true if Flat Earth maps were accurate.

All routes for planes and ships would be different on a Flat Earth, especially in the Southern Hemisphere. According to many Flat Earth maps, the shortest flight route between South America and Australia would cross over the North Pole!²¹ A conspiracy to conceal the flatness of the Earth would therefore have to include hundreds of thousands of airline pilots and ship captains as well as governments, space agencies, mapmakers, and Antarctic explorers.

Gravity, Handwaving, and the Supernatural

Flat Earth advocates rely upon made-up excuses and invented forces to explain away the problems of their model. They claim that light, perspective, and gravity work differently from what we understand from the evidence of science and our senses. Many claim that gravity does not exist at all. This claim is necessary because everyone on every part of the Earth's surface feels a roughly equal gravitational pull straight down toward their feet, which only makes sense on a globe: gravity pulls everyone down toward the planet's center of mass. Gravity would feel very different on a Flat Earth. A disc-world's center of mass would not be located straight down from most parts of the surface. People standing at the central North Pole would feel a vertical downward pull, but everyone further from the center of the disc would feel gravity pull at an angle. At the edges of the disc, the pull of gravity

would be almost horizontal. This would pull the oceans and atmosphere inward toward the center of the disc, drowning the center and leaving the outer edges airless and uninhabitable. Standard gravity would also pull down the Flat Earth model's tiny nearby Sun and Moon to crash into the North Pole. Since none of these things happen, we know the world is not flat.

Rather than confront the problem of gravity, Flat Earthers respond by dismissing gravity altogether. If the "traditional theory of gravitation" is "incompatible with the Flat Earth Model," then gravity must be weak or nonexistent.²² But if that were the case, wouldn't you be floating out of your chair right now? Why would objects fall when you drop them? According to one common Flat Earth claim, objects fall because the Earth "is constantly accelerating up at a rate of 32 feet per second squared (or 9.8 meters per second squared). This constant acceleration causes what you think of as gravity."²³ This handwaving explanation doesn't work. If our world is accelerating upward, why doesn't the Flat Earth crash into the tiny Sun and Moon above us? What force could cause the Flat Earth—an entire world—to constantly accelerate at a perfectly even rate? How would the flat surface remain perfectly oriented with the direction of acceleration without ever tumbling (or even slightly wobbling)?

There are no coherent natural explanations for anything in the Flat Earth model. Even when presented in secular language, Flat Earth claims describe an impossible and necessarily artificial world created and maintained through unexplainable miracles. A Flat Earth could only exist through supernatural or technological forces beyond our comprehension.

The Bottom Line

Believing that the Earth is flat requires not only a worldwide conspiracy to fake decades of space exploration, but also the wholesale denial of many branches of science and the evidence of our senses. It requires the invention of new forces and laws of nature without evidence, and implicitly relies upon the actions of a deity-like being or beings.

Despite the rising prominence of Flat Earth ideas, there has never been evidence to suggest that the world could be flat. Advocates simply assume the "obvious truth" of a Flat Earth on the basis of religious faith, intuition, or humor, and then invent a reality to match.²⁴ Although surprisingly frustrating, the rhetoric of Flat Earthers does nothing to change the simple fact, definitively proven for centuries: we live on the surface of a globe. ■

SKEPTIC INVESTIGATES

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