The problem with flat maps

Why every attempt to flatten a round world must choose which kind of error to accept.

A Every world map is, in a sense, a lie, and it cannot be otherwise. The Earth is very nearly a sphere, and a sphere cannot be spread out flat without tearing, stretching or squeezing some part of it. A mapmaker who wants a neat rectangle of paper or screen must therefore accept a distortion somewhere; the only real choice is which one. This is not a failing of skill or care. It is a mathematical certainty, and every flat map ever drawn is simply a particular answer to the same impossible problem.

B The impossibility has a precise basis in mathematics. A sphere and a flat plane have different curvatures, and in the nineteenth century Carl Friedrich Gauss proved that no method exists for turning one into the other while keeping every distance unchanged. Something must give. A projection, as such a method is called, can preserve area, or shape, or direction, or the scale along certain lines, but it can never preserve all of them at once. To gain one property is to give up another, and the mapmaker's real task is the choosing of a loss.

C The most famous answer is the projection published by Gerardus Mercator in 1569, and it was built for a single purpose: navigation. On a Mercator map a course of constant compass bearing appears as a straight line, so a sailor could rule a line between two ports and read off the heading to steer. For crossing an open ocean by compass this was invaluable, and for four centuries it made the projection the natural choice for sea charts. Within the job it was designed to do, it is close to perfect.

D That usefulness comes at a steep price in area. To keep directions true, Mercator stretches the map more and more towards the poles, so that lands far from the equator swell well beyond their true size. Greenland, on such a map, looks about as large as Africa, although Africa is in reality some fourteen times larger. Because the projection was for generations the one hung on classroom walls, critics have argued that it quietly taught a distorted picture of the world, inflating the northern latitudes where the wealthier nations happen to lie.

E The obvious remedy is a projection that keeps areas honest, and several exist. Equal-area maps such as the Mollweide, or the Gall–Peters that was once promoted as a corrective to Mercator, show every country at its true relative size. But the trade-off returns in a new form: to fix the areas, these maps must distort shapes, so continents appear stretched or squashed in ways that look wrong to an eye trained on Mercator. Neither map is more correct than the other. Each simply keeps the one promise it has chosen to make.

F Between the extremes sit the compromise projections, which try to be moderately wrong about everything rather than exactly right about one thing. The Robinson and the Winkel Tripel spread the unavoidable error across the whole map, so that no single property is perfect but none is badly betrayed. The result pleases the eye, which is why atlases tend to favour them for general world maps. The deeper lesson is that there is no true map, only a map fit for a purpose: one projection for navigation, another for comparing the sizes of nations, a third simply for a pleasant overview.

G The story has a modern twist. When online maps arrived, their designers revived Mercator, not out of nostalgia but for a technical convenience: the projection turns the world into a neat square grid that can be sliced into tiles and zoomed smoothly at any scale, and it keeps small shapes locally accurate, which matters when you are looking at a single street. So the very projection once criticised for misrepresenting the globe is now the one that billions of people see every day on their screens. The old compromise has not been solved. It has simply moved to a new home.

ANSWER THE QUESTIONS

Questions 1–5 · True / False / Not Given

Do the following statements agree with the information in the passage? Write True, False, or Not Given.

1 A flat map can represent the Earth's surface with no distortion at all.

2 Gauss proved that distances cannot all be preserved when a sphere is flattened.

3 The Mercator projection was designed mainly for use at sea.

4 Mercator maps were officially banned from schools.

5 Equal-area projections manage to avoid distortion completely.

Questions 6–9 · Multiple choice

Choose the correct answer, A, B, C or D.

6 According to the writer, the central difficulty of mapmaking is that

- **A** the Earth is not a perfect sphere
- **B** a sphere cannot be flattened without some distortion
- **C** maps must be drawn by hand
- **D** paper and screens are rectangular

7 The Mercator projection is especially useful for navigation because

- **A** it shows the areas of countries accurately
- **B** it is always centred on the equator
- **C** a constant compass bearing appears as a straight line
- **D** it divides the world into a square grid

8 According to paragraph D, one criticism of the Mercator projection is that it

- **A** is too difficult for sailors to use
- **B** cannot represent the poles at all
- **C** distorts compass directions
- **D** exaggerates the size of the northern regions

9 The writer says that compromise projections such as Robinson

- **A** remove distortion altogether
- **B** spread the unavoidable error across the whole map
- **C** are used mainly for sea charts
- **D** preserve the areas of countries exactly

Questions 10–11 · Sentence completion

Complete each sentence using no more than two words from the passage.

10 A projection can preserve area, shape, direction or the along certain lines, but never all at once.

11 Online maps favour Mercator partly because it turns the world into a square that can be sliced into tiles.

Questions 12–14 · Matching information

The passage has seven paragraphs, A–G. Which paragraph contains the following information? Choose the correct letter.

12 a comparison between the apparent and the real size of two land masses

13 the mathematical basis for the impossibility of a perfect flat map

14 the reason a much-criticised projection is now seen by billions of people

ANSWER KEY

1. FALSE
2. TRUE
3. TRUE
4. NOT GIVEN
5. FALSE
6. B
7. C
8. D
9. B
10. scale
11. grid
12. D
13. B
14. G