

## VISUAL ESSAY

# Anamorphosis: The geography of physicians, and mortality

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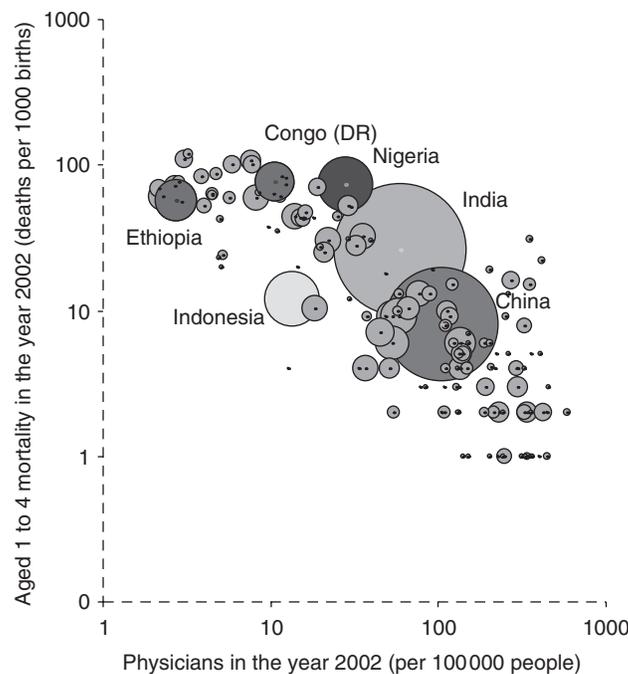
Visual images can have an impact that is different and often more immediate than the written argument or reported statistical effect. Photographs are especially effective and, hence, the photo essay.<sup>1</sup> But serendipitous intuition can also be fostered with schematic diagrams. However, we quickly become immune to the distortion of some forms of graphic; for instance, oblivious to distorted scaling of traditional maps,<sup>2</sup> or to the ubiquity of the log scaling required to squeeze all extremes of life within one inequitable planet onto the square of the graph; dispassionate to the implications of moving an inch to the left or up graphs such as that shown in Figure 1.

The five figures that follow take the same data as shown in Figure 1 but show parts of it—recombined in different ways.<sup>3</sup> They illustrate how simply showing the absolute numbers the rates are based on (Figures 2 and 3), reveals information not

apparent from the rates (compare with Figures 4 and 5); and how showing both the absolute numbers and the rates makes visible yet more despite the geography being lost (Figures 6 and 7).

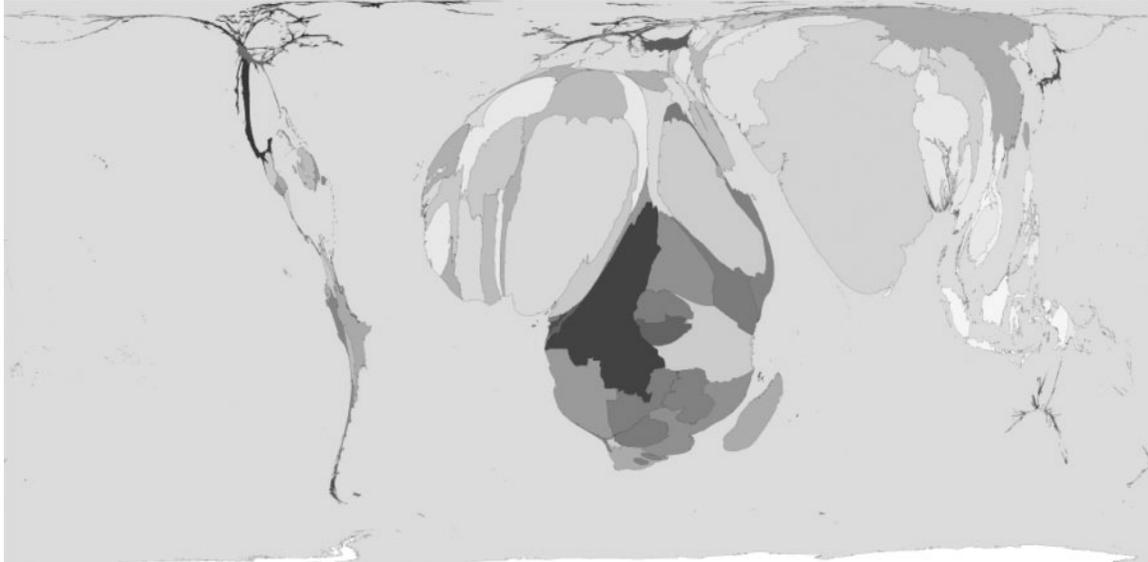
Images have a long history in medicine and politics, as does both deliberate and hidden distortion, hidden meanings and signs (Figure 8). In the end is shown (Figure 9) how simply turning off one of the most common distortions—the log option—and re-scaling again...reveals a very different image again—an anamorphosis: ‘an unconventional way of seeing’<sup>4</sup>:

We prefer an ordered world, regular patterns, familiar forms, and when flaws or distortions occur, provided they are not too gross, our mind’s eye tidies them up. We see what we want or expect to see...<sup>5</sup>



**Figure 1** Territories of the world drawn as circles with area in proportion to births (in log space)

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**Figure 2** Territories of the world drawn with area in proportion to death at ages 1–4<sup>6</sup>

*There are more nurses from Malawi in Manchester than in Malawi and more Ethiopian doctors in Chicago than Ethiopia<sup>7</sup>*



**Figure 3** Territories of the world drawn with area in proportion to physicians 1–4<sup>8</sup>

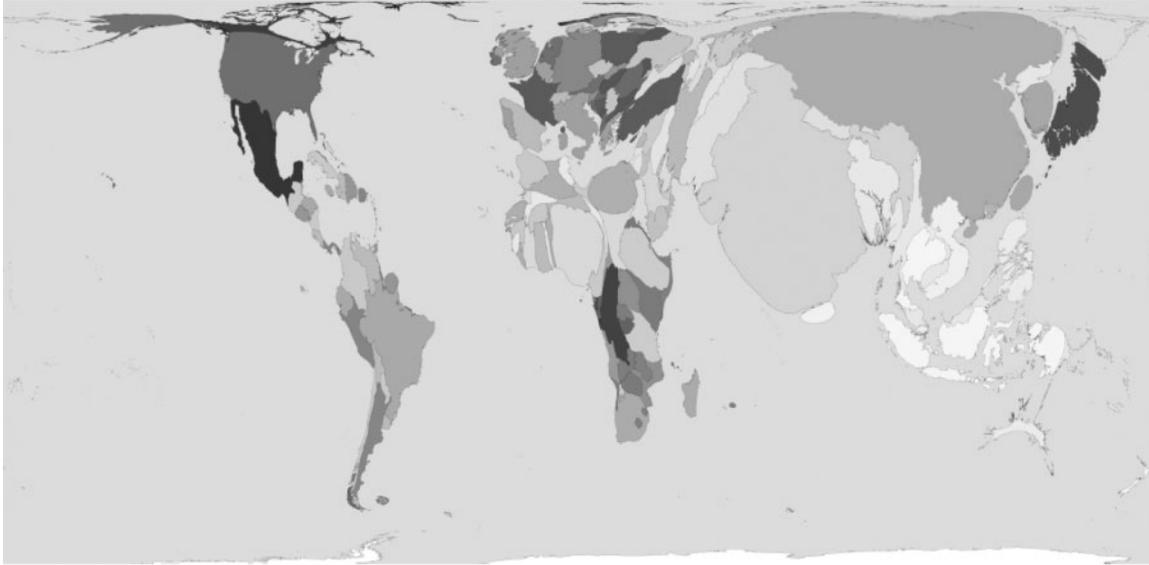


Figure 4 Territories of the world drawn with area in proportion to population<sup>9</sup>

*Africa's population density of 249 people per 1,000 hectares is well below the world average of 442<sup>10</sup>*

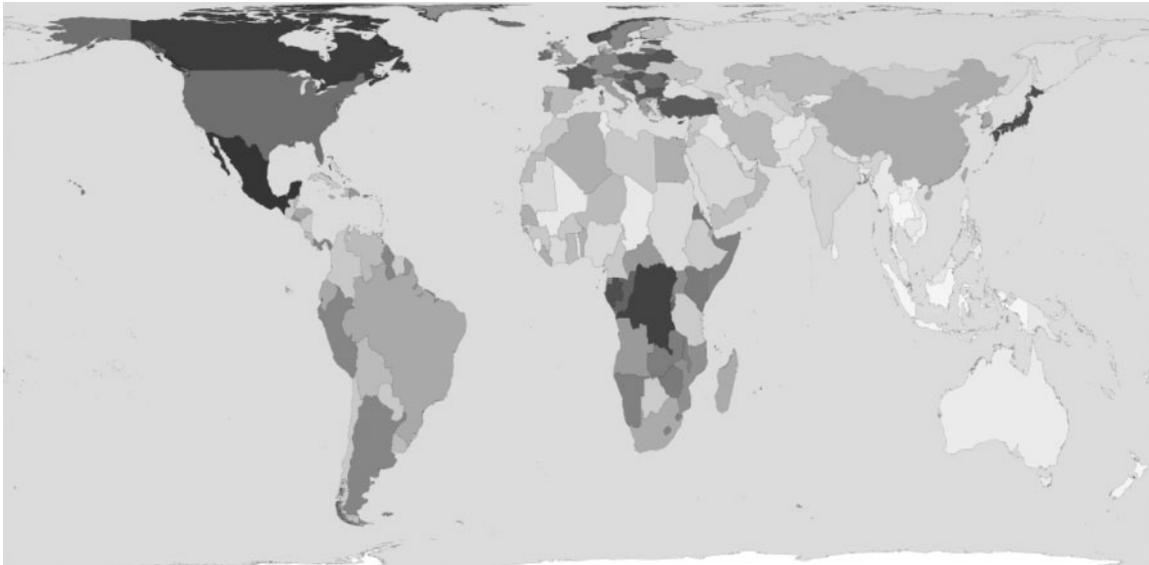


Figure 5 Territories of the world drawn with area in proportion to land area<sup>11</sup>

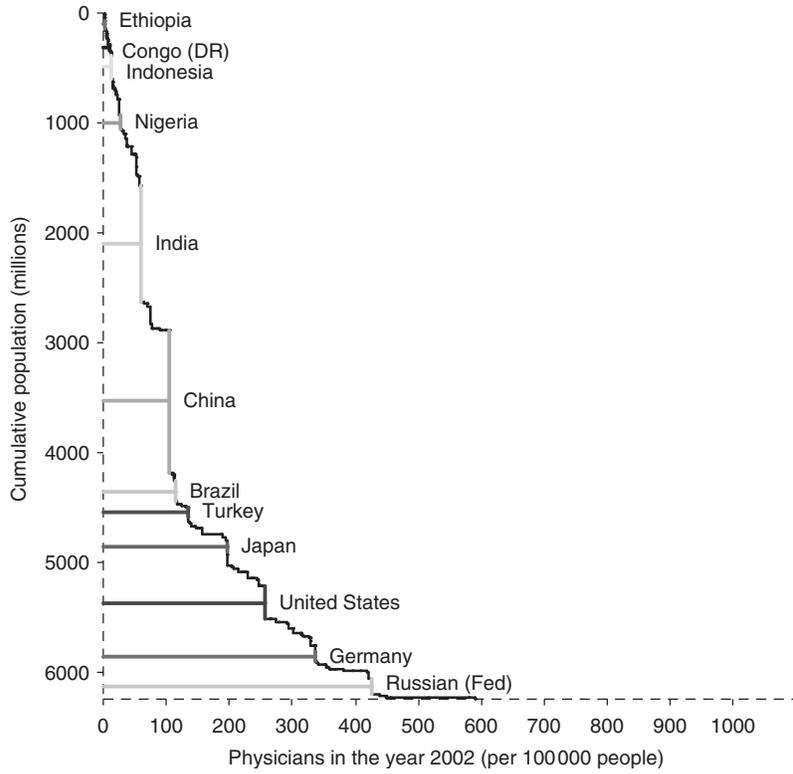


Figure 6 Territories of the world drawn with area in proportion to physicians<sup>12</sup>

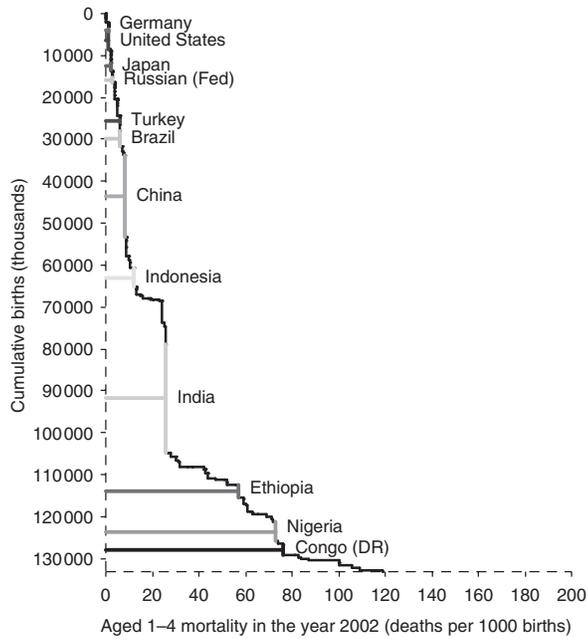


Figure 7 Territories of the world drawn with area in proportion to death at ages 1-4<sup>13</sup>

*It is difficult to escape the conclusion that this loss of infant life is in some way related to the social life of the people<sup>14</sup>*

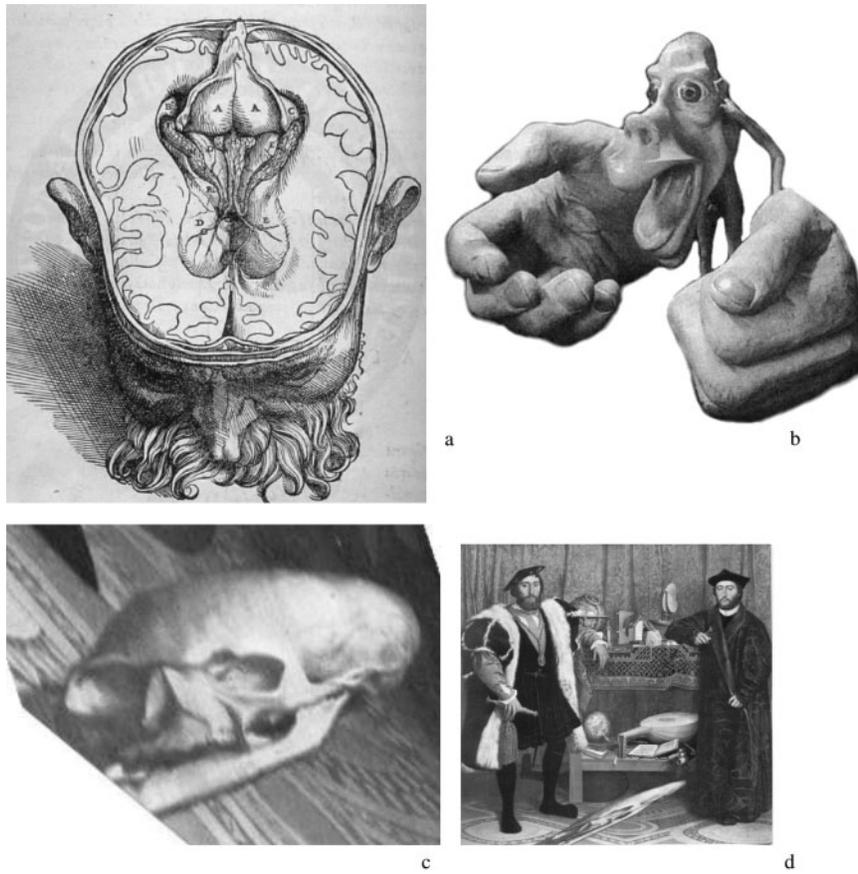


Figure 8 Anamorphosis in medicine and politics<sup>15</sup>

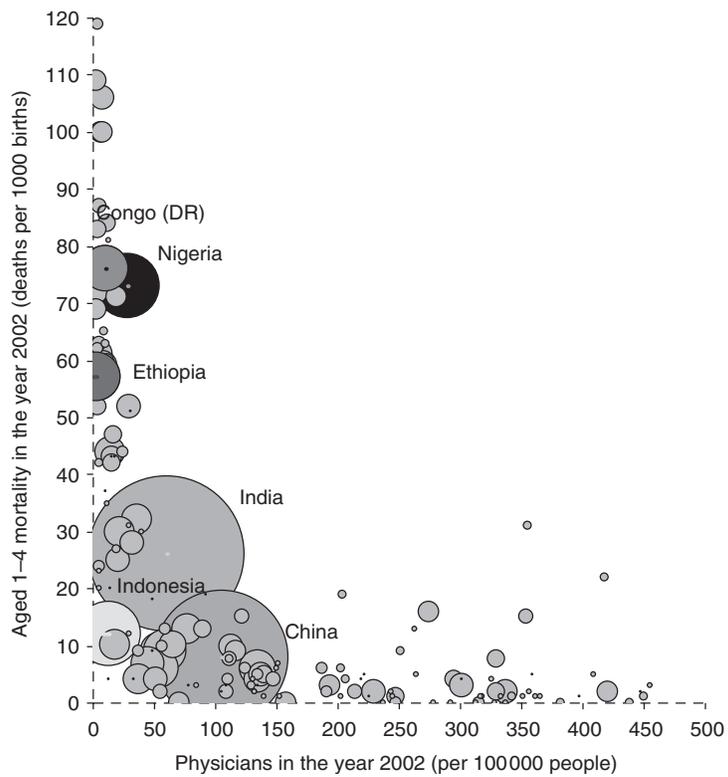


Figure 9 Territories of the world drawn as circles with area in proportion to births<sup>16</sup> (euclidean space)

The final graphic (above) is identical to the first (Figure 1) other than that the scales used to place the circle representing each territory on the page are no longer log-based. There no longer appears to be a simple relationship between physicians per person and the very premature deaths of young children when the world is looked at like this.<sup>17</sup>

## References

- <sup>1</sup> Darwell J. Photoessay, Legacy: inside the Chernobyl exclusion zone. *Int J Epidemiol* 2006;**35**:827–31.
- <sup>2</sup> Dorling D (2007) Worldmapper: The Human Anatomy of a Small Planet. *PLoS Med* 4(1): e1 doi:10.1371/journal.pmed.0040001 (Published: January 30, 2007).
- <sup>3</sup> All these graphics save the last are taken from spreadsheets and images made available on the website [www.worldmapper.org](http://www.worldmapper.org) (the last is the same as the first without the log scaling and was derived from them). More than three hundred related distributions are depicted in graphical and map form there also and over one hundred maps of death attributable to different causes will appear there early in 2007.
- <sup>4</sup> An image that is painted in a way that makes it appear distorted unless viewed from a specific viewpoint or using a cylindrical or conical mirror, or a different world view. See also <http://www.anamorphosis.com>
- <sup>5</sup> Wright L. *Perspective in Perspective*. London: Routledge and Kegan Paul Books Ltd, 1983;27; unread and referenced in turn at end of page on: <http://www.anamorphosis.com>
- <sup>6</sup> This image is of the world as shaped when drawn in proportion to the more than 3 million children who die each year aged between 1 and 4 (inclusive) almost all from superficially easily preventable causes. In most cases their death is not simply due to the lack of intervention of a trained physician.
- <sup>7</sup> Kinnock G, April 4, 2006, Strasbourg: [http://www.welshlabourmeps.org.uk/gk/gk\\_press/healthbudget04.04.06.htm](http://www.welshlabourmeps.org.uk/gk/gk_press/healthbudget04.04.06.htm).
- <sup>8</sup> There are more than two working physicians for every child that dies aged 1–4 worldwide each year. A traditional map in which territories are shaded according to the ratio of the population to physicians gives the reader little real impression of just how geographically concentrated physicians are: most into just a few territories worldwide. Instead a cartogram, often also termed an 'anamorphosis', is needed. The proof that a map of this kind could be drawn was made in 1975 when A.K. Sen published 'A theorem related to cartograms (in *American Mathematics Monthly*, **82**:382–385). The first fully working practical realisation of that proof did not emerge until 30 years later and the latest version at time of writing is: Newman M (2006) Cart: Computer software for making cartograms [online]. University of Michigan. Available from: <http://www-personal.umich.edu/%7Eemejn/cart/> [Accessed July 5, 2006].
- <sup>9</sup> Here (and in Figures 2, 3 and 5 also) some 200 territories of the world are coloured according to which of 12 contiguous regions they lie in. Twelve rainbow shades from red in central Africa to violet for Japan are used, with regions ranked according to their populations' weighed average score on the United Nation's Development Programme's Human Development Index for 2002. This is also the year from which the world population is drawn that is used to scale each territory in area. Within regions four shades of each hue are used to allow territories to be differentiated and identified.
- <sup>10</sup> The quote continues 'However, a great deal of the total destruction of the natural environment is occurring in the region. Poverty is a major cause and consequence'. The area of Africa on the population cartogram is roughly half what the continent is on the equal land area map as a result of population density across Africa being almost half the world average. (Quote Source: United Nations Population Fund, The State of the World Population 2001; Chapter 2: Environmental Trends: <http://www.unfpa.org/swp/2001/english/ch02.html>).
- <sup>11</sup> This equal area projection appears very similar to that re-produced by Arno Peters and adopted by many parts of the United Nations as a more equitable projection than traditional world maps used. Note, however, that this and Peter's projection give most prominence to where there is most land—not most people.
- <sup>12</sup> On this graph the area of each territory is proportional to the number of physicians who work there, as also in Figure 3, but here information on geographical location is lost so that territories can be ordered by rates. The area to the left of the line is thus proportional to absolute numbers. The graph is as much an anamorphosis itself as any other image shown here.
- <sup>13</sup> All territories of the world are shown in this image and thus there is a minute space to the left of the line to represent the death of each child aged 1–4 that occurred in this one year. Some dozen territories that are home to over half the world's population have been labelled as, unlike on a map, it is far from obvious where places are on a graph.
- <sup>14</sup> This observation was not made of the graphs shown here but of very similar rates of infant mortality found within England almost exactly a century ago. Source: Newman G. *Infant Mortality: A Social Problem*. London: Methuen and Co., 1906;vi.
- <sup>15</sup> Sources: (a) Dissecting the cortex: taken from Vesalius' *De humani corporis fabrica*, 1543 [On the Fabric of the Human Body] now published online: <http://vesalius.northwestern.edu/> This image sourced from: <http://pages.slc.edu/~cbj/iminds01/notes/L1-Descartes-bats/s8-vesalius.html> (b) Homunculus; taken from [http://wwwppeda.free.fr/progressions/3/homunc\\_sens\\_grand.jpg](http://wwwppeda.free.fr/progressions/3/homunc_sens_grand.jpg) (c) Detail, transformed with photo software and derived from Holbein's 'The Ambassadors' (d) from <http://www.dodedans.com/Eholbein.htm> accessed October 26, 2006.
- <sup>16</sup> Cuba is the most easterly circle, Sierra Leone the most northerly, and the most prominent circle to the south west extreme of the distribution: Malaysia.
- <sup>17</sup> Only two territories of the world have been promoted out of the poorer groups into a richer category in the last three decades: Malta by geographical inevitability and South Korea by invitation (Babones SJ. The country-level income structure of the world-economy. *J World-Syst Res* 2005;XI(1):29–56). Millions of skulls are hidden beneath the illusion of development.