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Can a Map Change the World?

Danny Dorling

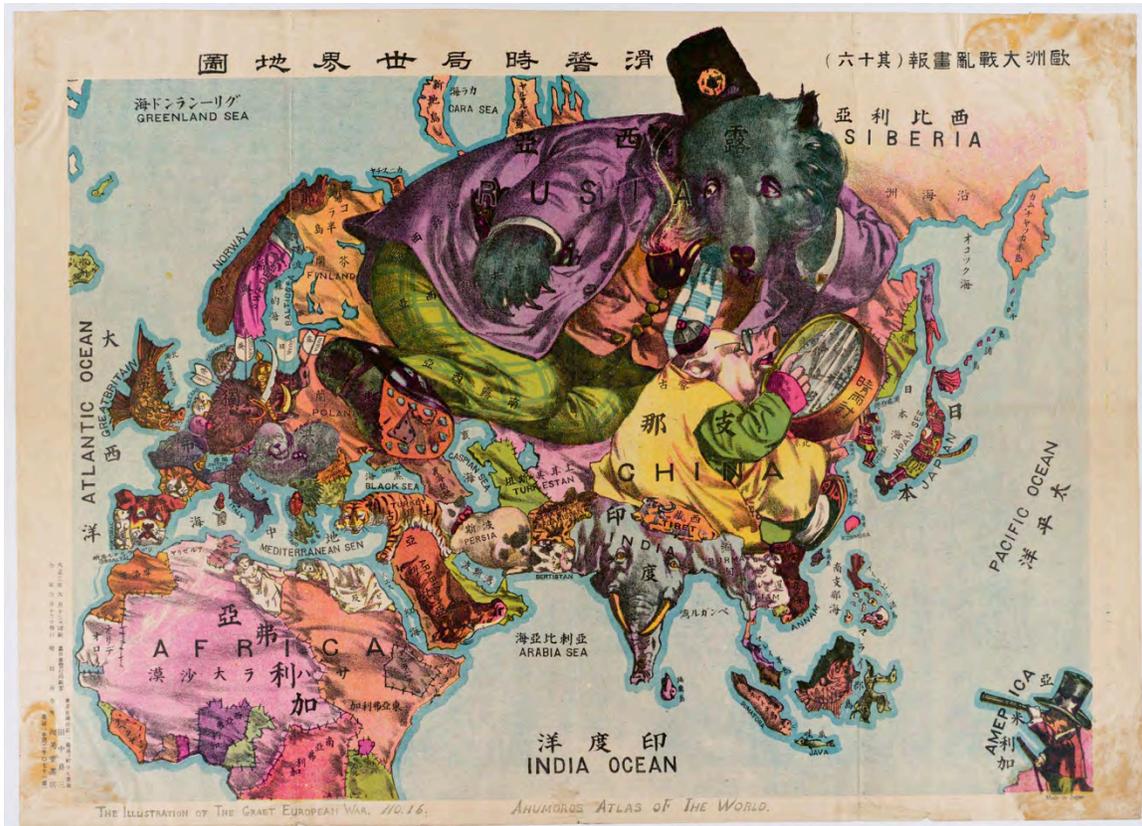
Maps colour in our imaginations.

Maps can change the world because it is through maps that the world is imagined in the minds of those who change it. Change the map and you change how the world is viewed. Change how the world is viewed and you change the prejudices of those who can change the world. Change their prejudices and they will then change the world differently to how they might otherwise have behaved.

All behaviour matters when it comes to the influence of maps. From the smallest aside in a conversation about how people in a particular place are – what you think of them - to a commander moving an army in one direction rather than another because of what he (its almost always he) perceives as opportunities or constraints displayed on a paper map. Maps, from ephemeral 'performance' to hard copy or digital images, colour in our imaginations.

Figure 1 shows a view of the world in which China is represented as a pig, Turkey as a tiger, Spain as a dog, Russia as a sleepy bear and Japan itself as a samurai warrior. The boundaries of colonies being demarked in Africa by imperial powers are shown as being stitched together in ways that may not last. It is one of very many images from the late nineteenth and early twentieth centuries which presented states as if they were species of animal, and as if the boundaries between them were somehow natural and flexible. Dominant above them all was Russia, sometimes as lethargic, as in this image, sometimes as aggressive. Drawn in similar maps Russia has been represented as an octopus about to infiltrate the rest of the continent of Eurasia with its tentacles. The United States is depicted as largely insignificant, placed on the lower right-hand corner, observing from the side-lines.

Figure 1: A humoristic/racist Japanese world map, created September 3rd, 1914



Source: https://upload.wikimedia.org/wikipedia/commons/3/3e/World_around_1900.jpg

Figure 1 was published a few months after the outbreak of World War One, at a time when nobody could have know what the eventual outcome of the conflict would be. These anthropomorphic maps, many produced before the war would contribute to people's perceptions of the protagonists and influence their attitudes. The map focuses on various contemporary stereotypes; Russia as a lazy bear (with its hobnail boot hovering over eastern Europe), China as a fat pig, India as a sleepy elephant, all near or neighbouring Japan represented by a Samurai warrior, located close to Korea (a docile peasant). Few of these images are positive accept Japan, and even Japan appears to be sporting a tiger's tail. All are being eyed up by Uncle Sam from the distant Americas, largely off-stage. With his telescope and top hat Uncle Sam is depicted as a small and insubstantial rodent-like figure.

In the event it would be the United States that invaded Japan just thirty years after this map was drawn. The map was prescient in its depiction of Japan as a small warrior poised to energise its larger and lethargic neighbours into action; this may have been one of a myriad of tiny visual and verbal shoves in the direction of future war. The other tiger in the image represents what is now Turkey, but was then part of the Ottoman Empire; scowling beneath the underbelly of a complacent Europe in which Germany is a hog impaled with many arrows and The United Kingdom is a sea horse.

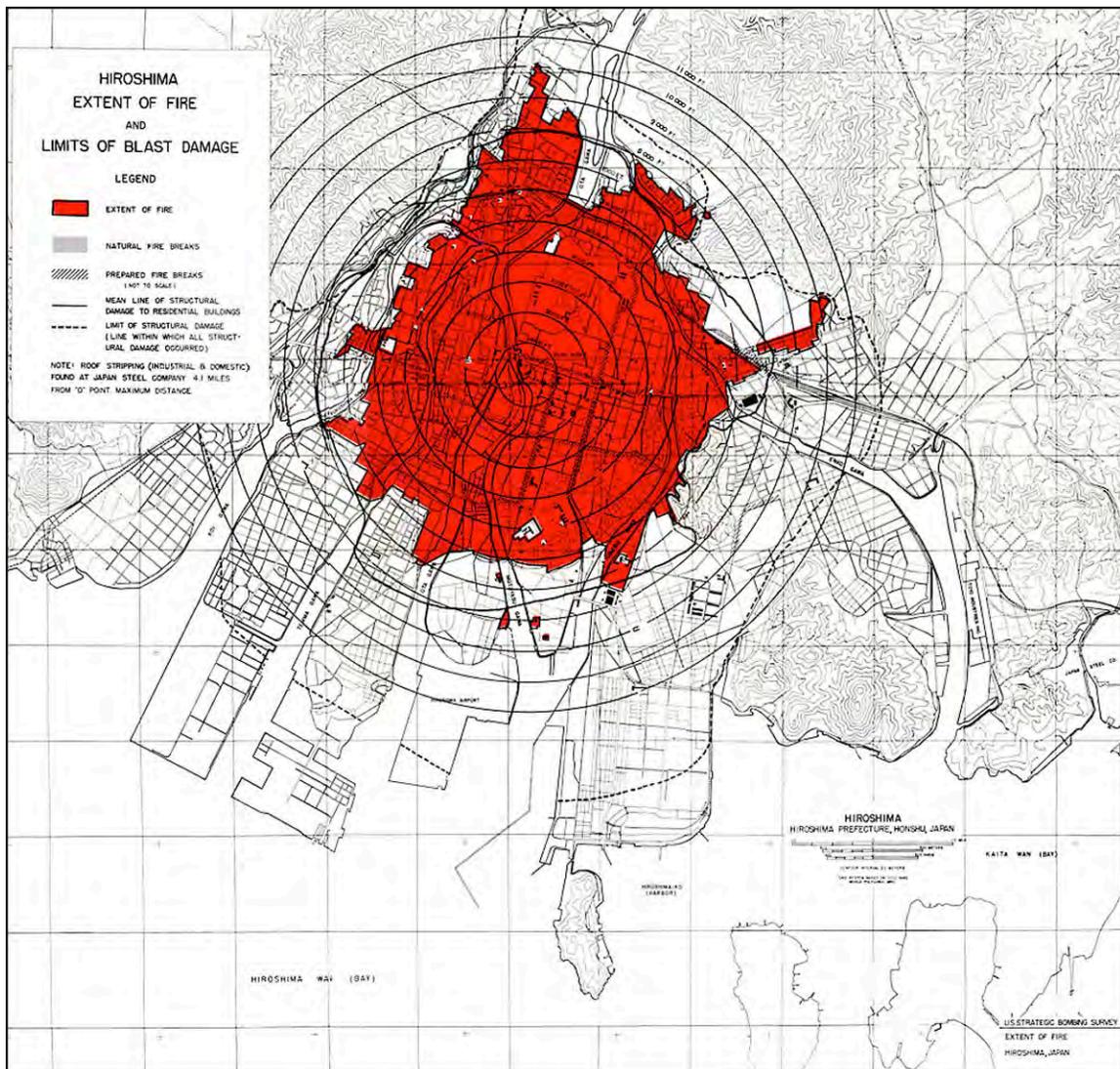
Images such as Figure 1 may appear bizarre to us today. Reifying countries as animals, which each nation-state being presented as if it was a single creature with a particular temperament, is less common a century on, but can be remobilized as circumstances dictate; for example, the visual conceits of the acquisitive octopus or the rampant bear continue to be used today to portray Putin's Russia and its penetration of power into eastern Europe and the middle east (see Vujakovic, 2014). Perhaps in future people will look back at the images we produce today and ask how we could have been so naïve, so stereotyping, so manipulative? And yet we still talk of countries as if each is an object controlled in a singular way by a single mind: Putin's Russia, Obama's America, Cameron's Britain.

Just over thirty years after the 'humourist' (racist) Japanese world map was published the United States military would drop the first of two nuclear bombs on Japanese cities. Figure 2 shows an image of the firestorm that followed the nuclear detonation over Hiroshima on August 6th, 1945. It is an image that needs very little embellishment to still have a menacing effect today.

The red area in Figure 2 shows the extent of the firestorm that killed so many people, those who did not die in the initial blast. Air was sucked in from the surrounding hills after the initial blast, as the heat pored upwards - the inrush of the oxygen turned the central city into vast crematoria. Over 50,000 people died in Hiroshima that day. More than 50,000 others would die within the next few months as a result of their burns, other

injuries, radiation sickness, lack of medical care and starvation. Almost all of the dead were civilians. Nine out of ten doctors in the city were killed or injured that day and an even higher proportion of nurses. No significant help came. If this story is new to you, look again at Figure 2. The single most deadly bomb ever dropped in the history of humanity (Truman, 1946). To what extent stereotyping, cartographic or other, contributed to an 'othering' of the people targeted for destruction can only be conjecture, but when a person or group is constructed as less than human, their fate becomes easier to justify.

Figure 2: The extent of the Firestorm, Hiroshima, Japan, August 6th, 1945



Source: <http://fly.historicwings.com/wp-content/uploads/2012/08/HighFlight-LittleBoy3.jpg>

To me cartography is the means by which we make sense of our world. We have to make sense of our world to be able to change our world. The better a sense we have, the less likely we will do damage in what we try to change. Almost all of the earliest cartographic images were not simply way-finding maps, but contained messages of how human society was ordered at the time and what the threats and opportunities to that society might be, as well as providing messages for how much better things could be; and how much worse – if disaster struck. There is every reason to believe our maps today serve similar purposes but that these are less obvious to us as we tend not to consider our outlook subjective.

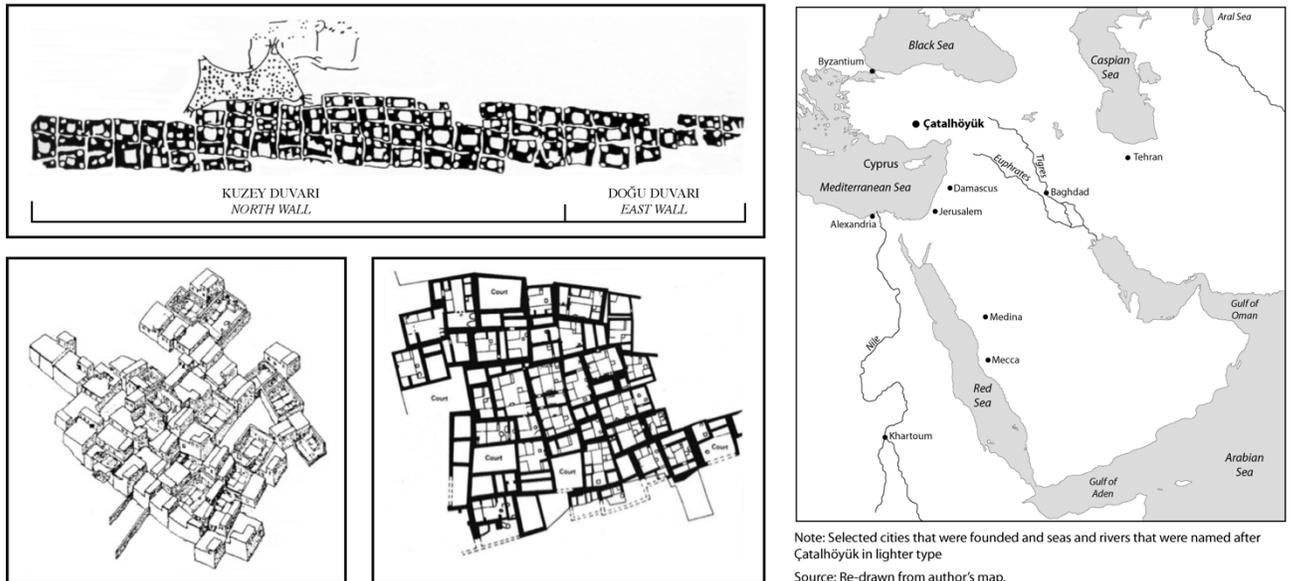
New maps show when the world changes

One of the earliest maps of anywhere in the world is of a city, Çatalhöyük. The map depicts houses built cheek by jowl, with no streets or even alleyways between them and with a threatening Volcano looming over this earliest of human concentrations. Recently archaeologists have suggested that what we see today as a volcano may, in fact, have been a rather lurid leopard skin dress, drawn above the city for some other reason. We may never know if that dot-filled-form is dress or volcano, but we know that this map – revealed on a 9000 year old plaster wall – served a purpose greater than simply being a remarkably accurate depiction of the buildings around it, and which for many thousands of years had been buried and out of sight. The map shows how this ancient people thought that their city and that part of the world was organised.

The original image is augmented in Fig. 3 by two modern day plans. These show how the city without streets might have looked had anyone then been able to fly over it when it first existed at its full extent and how it was laid out in plan form. The houses of Çatalhöyük were denser than those built in Hiroshima, but not much denser. Millennia would pass before the region in which the city existed (now called Turkey) would be depicted as a tiger ready to leap up towards Europe from Arabia. It would take that same amount of time for us to start spacing our cities out more, to be at lower risk from fire.

Figure 3: Çatalhöyük – the world’s first city (without Streets)

Çatalhöyük, the world’s first city (without streets)



Source: Redrawn from many reconstructed images that now appear on the web.

Today we presume that people got to their homes in Çatalhöyük by walking over the roofs of other people's property. Also almost certainly property will have had a different meaning then. There were no countries, as we know them now, and the idea of giving generic names to masses of water, the entire lengths of river networks, and maybe of towns and cities will have all been later inventions – spawned from thoughts that have come to human minds long since Çatalhöyük was first built, along with both the idea of streets and, in some cases a very long time later: sewers.

Modern maps of the world privilege coastlines as being important, almost universally they put north uppermost and leave much space blank. These illustrate how the 'bottleneck' between the great continental landmasses of Africa and Eurasia could have been the place where human innovation flourished, as interaction was maximised, but it might also mislead.

Figure 4: The Manchester sewers imagined beneath the shiny station platform

Figure 2.7: Picture drawn in chalk by Joe Hill, Manchester Piccadilly.



Source: (BBC 2010), Temporary drawing made on the concourse floor. "United Utilities say that Mancunians flush away thousands of incorrect items, such as make up wipes and ear buds, a year, causing sewers to block and toilets and drains to flood."
http://news.bbc.co.uk/local/manchester/hi/people_and_places/newsid_9135000/9135707.stm

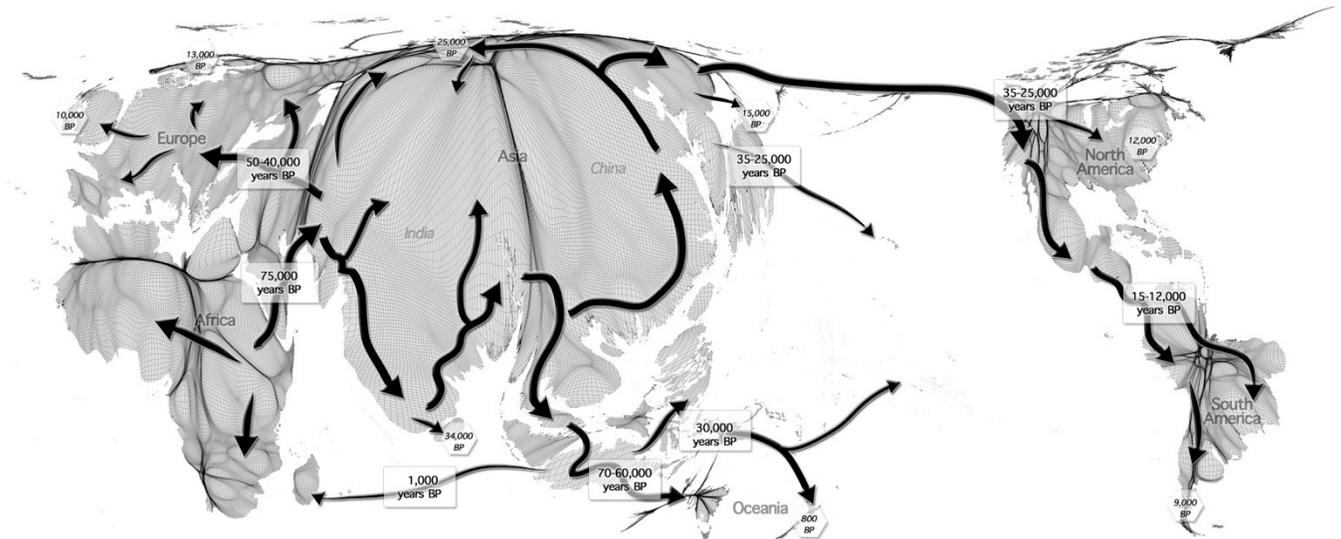
If, in the past, people found moving long distances over water far easier than moving long distances over land, then we would need to turn the map inside-out (in some way) to see the topography and topology that actually led to Çatalhöyük being, for a time, near the centre of things. Cartography can obscure as much as it reveals. Use a modern day map to look at the past, or even look at the present without getting the metric right, and you might not see things as clearly as you could.

Cartography changes as our conception of how we are all connected to each other and how that is changing. We can easily think that how we draw maps today is how they should always have been drawn, if only people in the past had benefited from what we now know (we might think), but that is easy to disprove this as both a fanciful and narrow-minded viewpoint. In many ways the modern mechanisation of map making has held innovation back because computer software mimics what cartographers of a few decades ago regarded as 'good cartography'.

Figure 5 shows one depiction of the migration of humans out of Africa, through what is now Turkey and around the coasts towards Australia; back (much later) to Madagascar; across to the Americas and, at a similar time into cold wet western Asia – later to be christened 'Europe'. We had no idea that such a story of our past was possible just six generations ago. We did not know our origins as a species. Just three generations ago we had no computers and no reliable knowledge of DNA. Most people in the world did not come to accept modern ideas on biological evolution until long after the theory was propounded by Darwin; many still do not accept it.

The projection underlying Figure 5 is too complex to be created by a person working with paper and pen, no matter how long they might have been given to try to draw it. The world is changing because our understanding of it is changing and so our maps of the world are beginning to change very rapidly in response. In maps thousands of year old we painted animals on cave and plaster walls, or Leopard skins maybe. In maps just over a century animals depicted old countries all printed on paper. Maps then became more 'scientific', more accurate but still they were about what we believed was around us in our 'hearts and minds'. Even as the world is being stretched to show where people live, using a scientific algorithm, a political choice is being made – that Africa, India and China needs to be shown with more prominence. Not as a set of borders being stitched up, or as a sleepy elephant and a greedy pig, but as hope to the bulk of humanity.

Figure 5: The migration of people out of Africa on a map sized by the descendants



Source: drawn by the author with help from Benjamin D. Hennig, Carl Lee, and Wikipedia.

Travel time mapping in spacetime

Should you be a teacher here is an exercise you can set your students. Ask them to draw a new map of the world. This is a map they can draw without needing a computer to draw it. They need to take a list of the world's largest modern cities. Many such lists exist; all are to a degree arbitrary. Begin with the largest city, in the case of the list given below I use, Tokyo, and then calculate how long it takes to fly from there to the second largest city in the world. In 2012, when the data used to draw Figure 6 was collected, this was Guangzhou.

Here are the kinds of instructions you can give students for them to try to draw a new world map: "There are many calculators on the web that will give you the shortest travel times between two cities. Use one of these to draw each city as a circle with area in proportion to its population and the distance between each pair of city centres made proportional to that quickest possible travel time between their most central airports. A third and fourth city can be added by taking a pair of compasses and drawing circles from each existing city centre the correct distances away. Where those compass lines intersect

is where the next city down in the hierarchy should be placed. Keep adding cities until it becomes too hard to work out the appropriate location of the next by hand.”

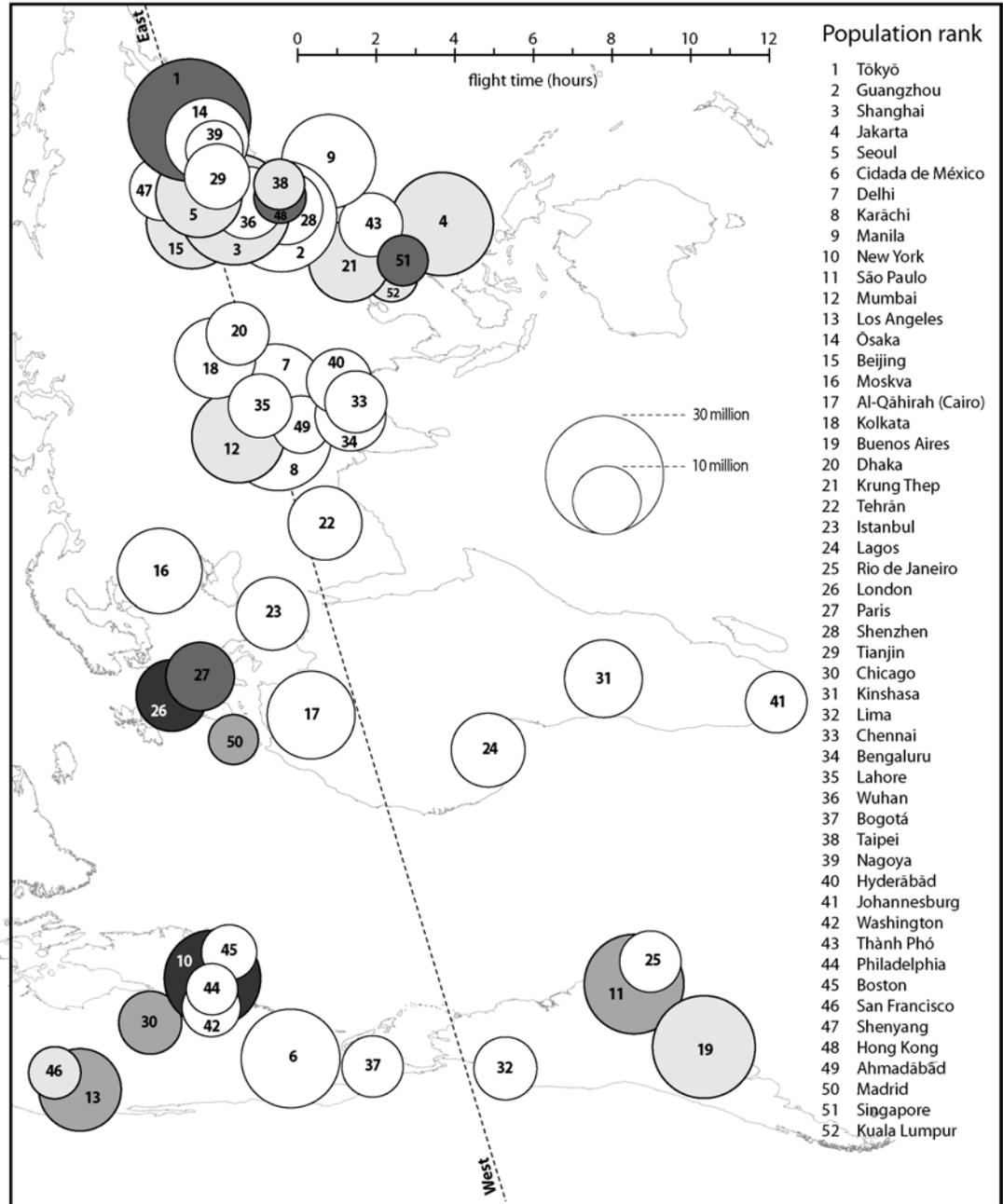
The map below is based on this set of instructions and is just one attempt among many possibilities to create a new world map of the major cities, with each city sized by population, where fastest travel time is the geometry, not traditional over-land and sea distance. What is most remarkable about this map is that the world is flat when it comes to its most populous cities, although it wraps round from top to bottom (if East is put uppermost again as it once was in most ancient maps).

Tokyo is at the top of Figure 6. Now no longer drawn as part of a samurai, but as the largest circle on the map. In many ways it is the world’s most successful city; a place that is home to more people living at a higher standard of living than anywhere else on the planet. It is remarkable to think that in just the space of the last century a part of the world that was one of the later places to be colonized by humans (Figure 5), a proud, but politically marginal state just a century ago (Figure 1), and which suffered so much just over half a century ago (Figure 2) should now be at the centre of the most significant cluster of cities in the world today – which are all now in East Asia.

The second most significant cluster of world cities in Figure 6 lies just beneath the first, but in and around that supposedly sleepy elephant of India. The Greater Indian cluster includes Tehran on its Western border. In contrast, Europe today can only boast three world sized cities within its borders and another three on (or just outside) its borders, including one in Africa which now has four in total; a number unimaginable when that continent was under colonial control and being portrayed as a 'stitch-up' (as in Figure 1). But travel times within the African-European cluster of nine world cities are spread-out, as are their economic fortunes of course. Those nine cities do at least benefit from being in similar time zones, and the same can be said for the thirteen world cities of the Americas which in turn connect more easily to the largest East Asian Grouping than to Greater India. East Asia is now the economic centre of the world.

Figure 6: A map depicted travel times by distance between 52 cities in 2012

The top 52 world cities by population
(Shading is rank in world city hierarchy)



Source: Re-drawn from the author's rough drafts.

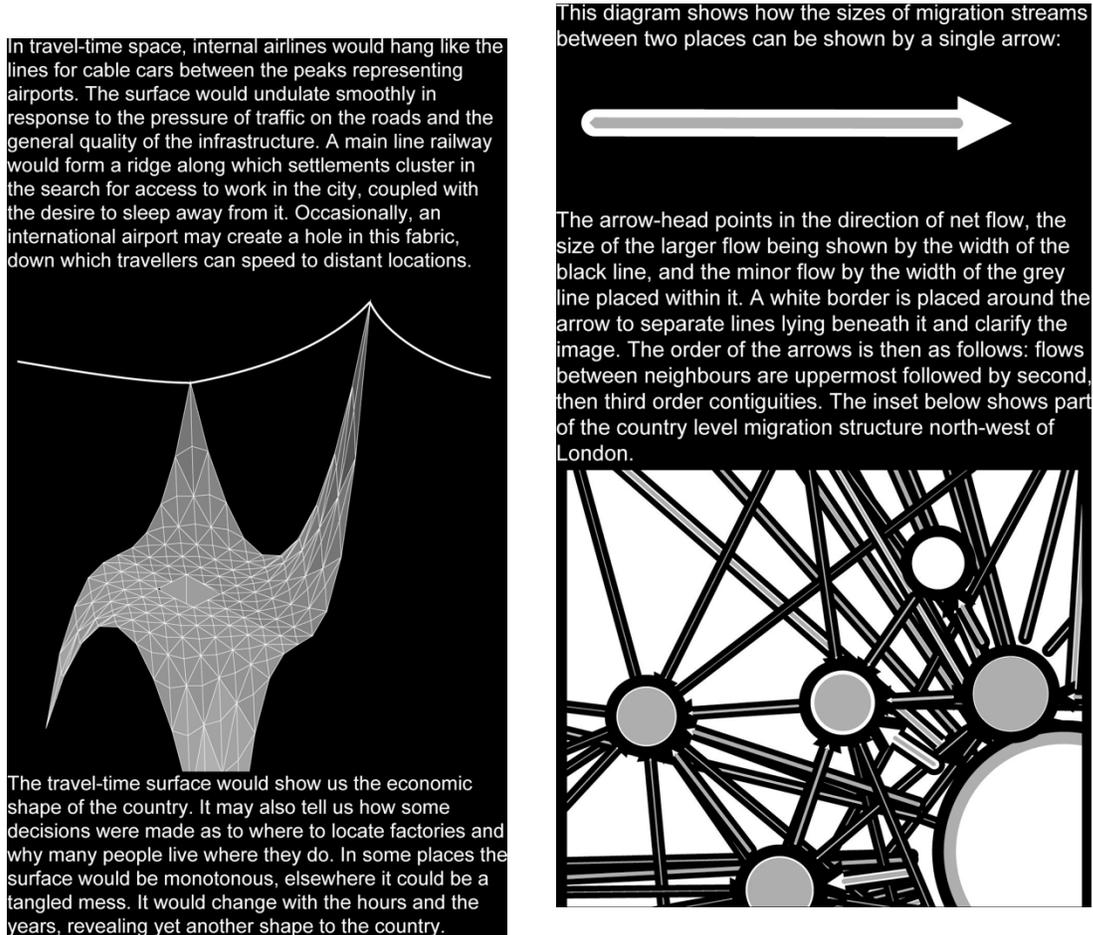
Try to imagine how this map might have looked a century ago when people mostly did not fly. Back then places were connected most quickly by sea and the dominant ordering of cities was very different. Now try to imagine how figure 6 might look in a century's time. World population is now predicted to rise from its current 7.2 billion, by 2, 3, 4 or even 5 billion people in that time – possibly more, or it may shrink to less. No one really knows! In many cities in Asia the average family are having just one child. In China when given the choice to have two, many now chose to have one. Many more cities in Africa will be more populous. And will we still fly as much when we can soon meet as holograms projected across space to sit in meetings as if we were actually there?

Today many aeroplanes fly over the Arctic to connect some of the richest cities in the world but, if you were thinking of designing a London underground style cartogram of the globe, where each station is a mega-city, you might do well to start with the image above and then consider how to separate out the cities at the 'top of the world'; those which now clustered so closely.

The map in Figure 6 is just a rough sketch, in effect drawn by hand. It will contain errors. Tehran is oddly placed, partly due to it being a little harder to fly to, partly due to the author being lazy towards the end of finishing this map. But try to imagine a map that does not yet exist. This is not a map of the future, but a map of 'now' that we cannot see. It is a world map showing travel times by ensuring that each distance shown on the map is very accurately proportional to travel time and not actual distance. It is a 2D map that bends and folds within a three dimensional space – it is what is called a manifold.

As more and more towns and cities are added to a map where distance is made proportional to travel-time, the surface of the map has to become undulated. Hard-to-reach towns need to be drawn on mountaintops, these are of mountains that are only there in our minds and in the “mountains of time” it takes us to travel between places. All this is a new cartography still waiting to be discovered. Figure 7 highlights the key parts of the travel time map idea.

Figure 7: Travel Time surfaces on which millions of flows could be shown



Source: Graphical “Textboxes” 6.3, 7.3 from ‘The Visualisation of Spatial Social Structure’ (Wiley, 2012): <http://www.geog.ox.ac.uk/research/transformations/gis/books/visualisation/material.html#graphics>

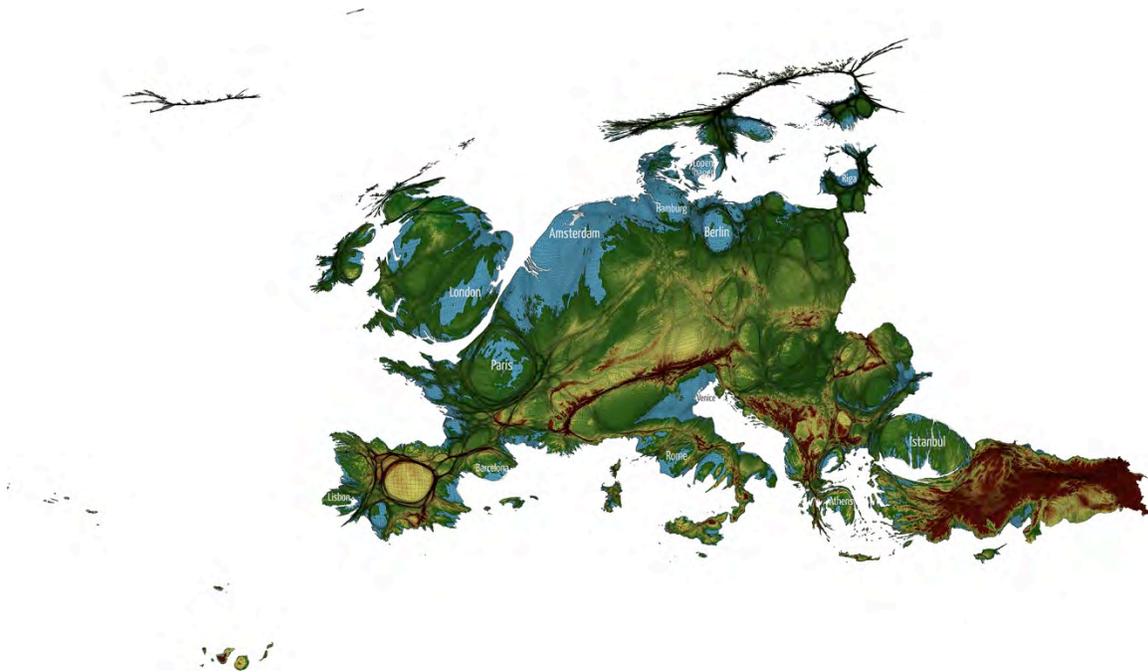
In Figure 7 a surface is shown with two cities drawn upon it as peaks. Between those peaks is drawn a white 'rope'. This rope could be an intercity train line that only has stations within the centres of those cities and the time the train takes to travel is then proportional to the length of that rope. Beneath the two city centres is shown a grid of roads with eight roads meeting at several points. Travel time on the roads slows down as you head towards the city centres and so the length of road segments grow and the city centres become higher and higher peaks. Two other cities are also shown, not connected to the specific city-train-network, and so their peaks are inverted. Two mathematicians a very long time ago showed that this surface could always be drawn. It has not been drawn

yet. So much that is new is possible and that is just what we know of! The remainder of Figure 7 suggests new ways of mapping bidirectional flows upon this kind of a map.

Seeing the world anew

Maps can help us see the world in new and different ways, but until we see a new map it can be hard to imagine that it can tell us much that we did not already know. It is also only by looking back at maps made in the past that we can see most easily understand how such maps were particular distortions designed to propagate a partial point of view (see Figure 1 above). Other maps use distortion more deliberately. Figure 8 below shows how the coastline of Europe might look after sea level rises, flooding and storm surges. The projection used, however, is not a conventional topographic map (as used in many projections of sea level impacts) but is an equal population cartogram that focuses attention on the numbers of people that might be affected.

Figure 8: Equal Population cartogram of Europe showing height above sea-level



Source: Dorling and Hennig 2015.

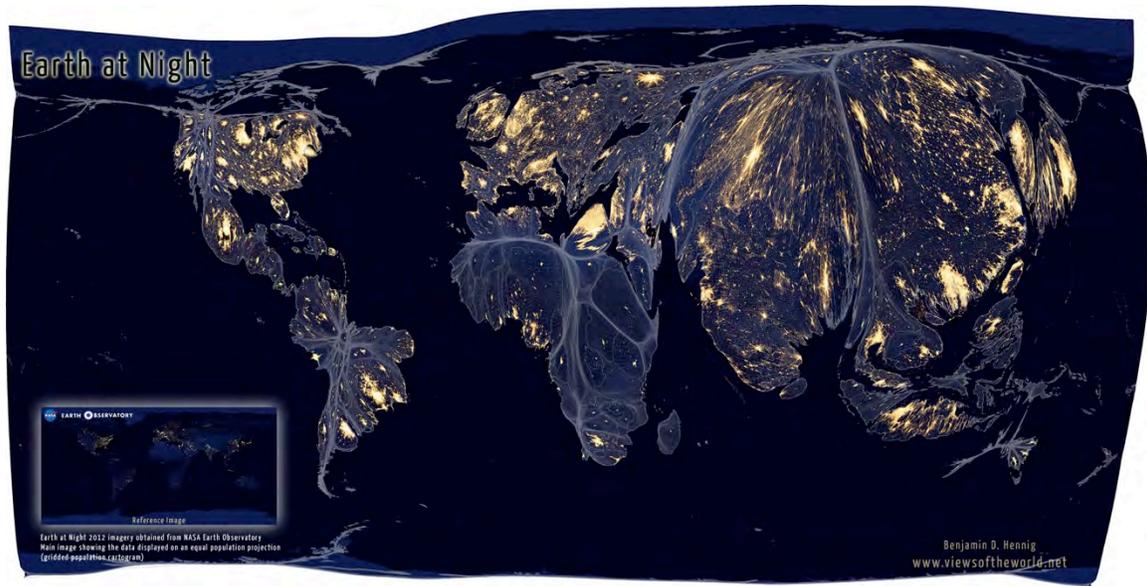
Cartography is about making sense of the world. It can be conducted without conventional images, or simply by painting pictures using words or sounds (drawing a map in others' minds through what you say), but it is so much easier to describe how you believe different elements to be connected when you can use an image that fits your times and new explanations and reach into other's minds through their eyes rather than their ears! Any description of the map in Figure 8 below, in words, can never substitute for the actual map.

Benjamin Hennig drew the map below (Figure 8), and all those that follow. The map in Figure 9 shows the now iconic image of the earth at night, using December 2012 satellite data. It is a map of humanity and who is both best connected and most wasteful. The image is again drawn on an equal area population cartogram, where every very small grid square has its area enlarged or decreased so as to be shown in almost exact proportion to the number of people living in that area. The projection is made using a technique that ensures that all lines of latitude and longitude still meet at approximately 90 degrees. The map is conformal. It approximates the best unique solution.

Cartography should be about innovation (Hennig 2013); it is when we innovate that we most change the world by changing how it is viewed. Begin to depict the world as being a place of inequalities in unnecessary pollution and you begin to suggest how we should change for the better. Figure 9 is a map of the amount of energy we waste by shining light up into the sky. Light generated at huge expense and requiring enormous amounts of carbon pollution in most cases to generate it.

On a standard map of the world the "earth at night" image appears to show where people are and where there are no people, or where there are people shedding little light. On the equal population cartogram of the world there are people everywhere, in exactly equal density. Where there is light it is most often where light is being wasted, shone up to the sky rather than down to a book.

Figure 9: The sky at night drawn over an equal population world cartogram



Source: Hennig 2013

Slight changes to cartography can promote great changes in how we conceive of our society or societies, whether we begin to see ourselves as one mass of seven or eight billion people, or whether we draw ourselves as supposedly more separated than that – we have choices to make.

Cartography is about choices. There is no single correct way to depict the world that we are a part of. How we choose to depict it will alter how we see it and treat others, the land, energy, air travel, how we see the seas of the Mediterranean, the lands of the middle east, how we come to view Asia anew. It will affect whether we see a places as being in the middle, or as being east of somewhere we consider now more central (perhaps the middle east should now be called the middle west), and whether we worry more about volcanoes or the excesses of leopard print clothing, let alone what happens when you first built a city with no streets.

Cartography is both art and science, but also a part of the humanities and of popular culture, of new technology and of ancient history. 'Making maps or charts' is as old as humanity and changes as fast as we change. More new maps and charts will have been made in our lifetimes than over the course of the lives of every human who has ever lived. With new technology it may also be possible for our children to be able to say the same thing again of us (that we say of our parents' and grandparents' cartography), and consign us to part of that strange and obscure history, no longer being at the forefront that we write so much about.

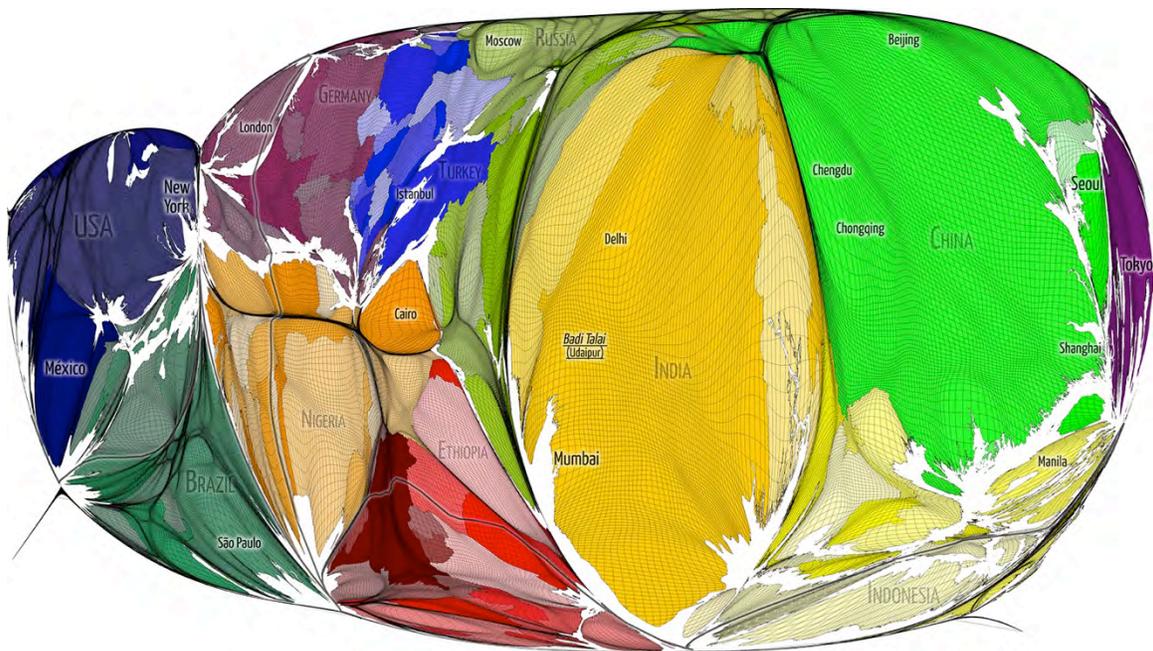
Always, what matters most is whether the sense that is being made of the world does itself make sense. If it does not, then we need new maps, more maps, and better maps. The faster our world is changing the faster our maps will change. The east was deposed from the top of maps, including most Christian maps, when the compass suddenly became king and trade across oceans mattered most. The north had to be at the top when trade became more important than gods.

The Mercator projection became the new world' imagined'; it dominated thinking in the seventeen to twentieth centuries, not just because it was useful at the start of those centuries to get ships to places they planned to visit, but because, as it became less useful as a chart it helped make the USSR (what is now mostly Russia) look like an enormous threat on the map. In between those centuries the Mercator projection was used to pinpoint the embarkation points for hundreds of thousands of African slaves, and to plot the journey of those that survived the passage to the Americas, before the slave ships returned to Europe with sugar and cotton, and then travelled back down to Africa, often half empty.

Africa would be more populous today were it not for four hundred years of slavery, war, colonialism and imperialism. China would be smaller today had not the Opium Wars destroyed traditional Chinese society and led to so much later population growth in China. There was also then much more population growth in India and its neighbours, from the places where the British harvested the opium they demanded the right to sell in

China. Chinese students are taught this part of World History. British students are not. It is perhaps in our omissions, in the gaps left on our maps and the lacunae in our histories, that we create the greatest mis-education. It is not in what we say, but in what we chose not to say. It is not in what we map, but in what we chose not to map, that we most mislead.

Figure 10: the world with the oceans taken out and all people given equal prominence



Source: Dorling, D. and Lee, C. (2016) Geography, London: Profile.

Figure 10 above shows everyone on the planet, but now with the oceans removed. A small village in India is at the centre of this world. The giant new metropolis of Chongqing is clearly visible near the vastly expanded old Sichuan capital of Chengdu. In population space these areas now dominate in the East. Tokyo will soon be shrinking rapidly as its population ages. The threat of Russia boils down to just Moscow on this final new map. London is on the far North West extreme. The USA is now on the edge of the map, as far away from the centre as much of Africa or Indonesia are.

Maps both change the world and show a changing world. Sometime they can do both. We are where we tell ourselves collectively we live. We can aspire to become what we collectively tell ourselves we can be. Images are only images but if they are repeated and reproduced enough times they become new versions of the truth. And the truth is a very powerful thing to create.

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Short biography

Danny Dorling is the Halford Mackinder Professorship in Geography at the University of Oxford. He went to various schools in Oxford and to University in Newcastle upon Tyne. He has worked in Newcastle, Bristol, Leeds and New Zealand. With a group of colleagues he helped create the website www.worldmapper.org which shows who has most and least in the world.

He has published with others more than 25 books on issues related to social inequalities and several hundred journal papers. Hi cartographic work includes, three co-authored texts: "Identity in Britain: A cradle-to-grave atlas", "The Atlas of the Real World: Mapping the way we live" and "Bankrupt Britain: an atlas of social change". One recent book is "Population 10 Billion", from where some of the images used here are taken apart from the final image.

He is currently President of the Society of Cartographers.

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