3. Flow Mapping through the Times

The Transition from Harness to Nazi Propaganda

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Abstract

One of the most commonly used types of maps today are flow maps, which simultaneously depict movement in time, place, and volume on a geographical map, as seen in GPS navigation devices. This type of map-making was invented independently during the 1830-1840s by three railway engineers from the United Kingdom, Belgium, and France. However, as this chapter argues, the growing popularity of the genre had little to do with the intent of the three pioneers. By looking at the context, in which flow maps appeared, rather than the technique used to design them, the chapter shows the importance of culture, politics, and ideology in understanding the changing meanings of flow maps during the nineteenth and twentieth centuries.

Keywords: Flow map; atlases; nineteenth century; colonialism; English cartography; German cartography; American cartography

Introduction

One of the most commonly used types of maps today are flow maps, which simultaneously depict movement in time, place, and volume on a geographical map, as seen in GPS navigation devices. Flow maps were first introduced in 1837 but only became popularized during the second quarter of the twentieth century. Based on the collection of nineteenth- and twentieth-century European and American atlases in the Library of Congress, this chapter examines the developing popularity of flow maps as a graphical method since the mid-nineteenth century.

Historiography of cartography, like historiographies of other sciences and arts, focuses on the innovators and pioneers of the field. However, despite the obvious importance of these trailblazers, they rarely cause the dissemination and popularization of new techniques. I will start by describing the first cartographers, who

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invented flow maps independently in the United Kingdom, Belgium, and France. Yet, flow maps became something completely different from what they initially intended to be. The introduction of flow maps in commercial atlases appeared much later, in places that had little to do with those original innovators, and reflected themes that were radically different from those present in the pioneering flow maps. The history discussed here is not a linear one of scientific progress, but rather an erratic history of changing paradigms, with no single scientific milestone to mark the point of change. Furthermore, I will claim that this development was not an immediate outcome of a new technology, a new set of symbols, or even a conceptual and cultural change, but rather of a growing Western colonialism and nationalism that required new means to depict Western and national global dominance.

Flow maps are cartographic depictions of movement, with an emphasis on its quantitative values. Flow line symbolization is used when the cartographer wants to show the type, volume, and density of movement between two or more places.[1] The symbolization of qualitative data is most often done by varying the direction, colour, or shape of the lines in question in order to reflect differences in values. For the quantitative variety, the widths of the flow lines connecting the places are usually drawn in proportion to the quantity of movement represented. Flow maps are important because of their ability to simultaneously represent multiple variables in such a way that they are 'integrated gently and unobtrusively that viewers are hardly aware that they are looking into a world of four or five dimensions.'[2]

The invention of flow maps

Although '[f]lows – of people, products, or information – often seem to beg for cartographic portrayal,' as stated by Mark Monmonier, this was only realized in the early nineteenth century.[3] The invention of flow maps independently in the United Kingdom, Belgium, and France was part of a larger development in the history of statistical graphing, described as the beginning of modern graphics.[4] However, a more relevant context was the fact that, in 1840, the three states had the longest operating railway systems in Europe.[5] Consequently, the three innovators of flow maps were engineers looking for new ways to visualize the effects of modern transportation and individual movement patterns on their societies, and consequently improve the public transportation infrastructures of their states. The earliest flow maps were

1 Dent, *Cartography*, p. 188.
2 Tufte, *The Visual Display*, p. 40.
3 Monmonier, *Mapping it Out*, p. 189.
4 Friendly, 'Milestones in the History of Data Visualization', p. 37.
5 Mitchel, *International Historical Statistics*, p. 655-656.

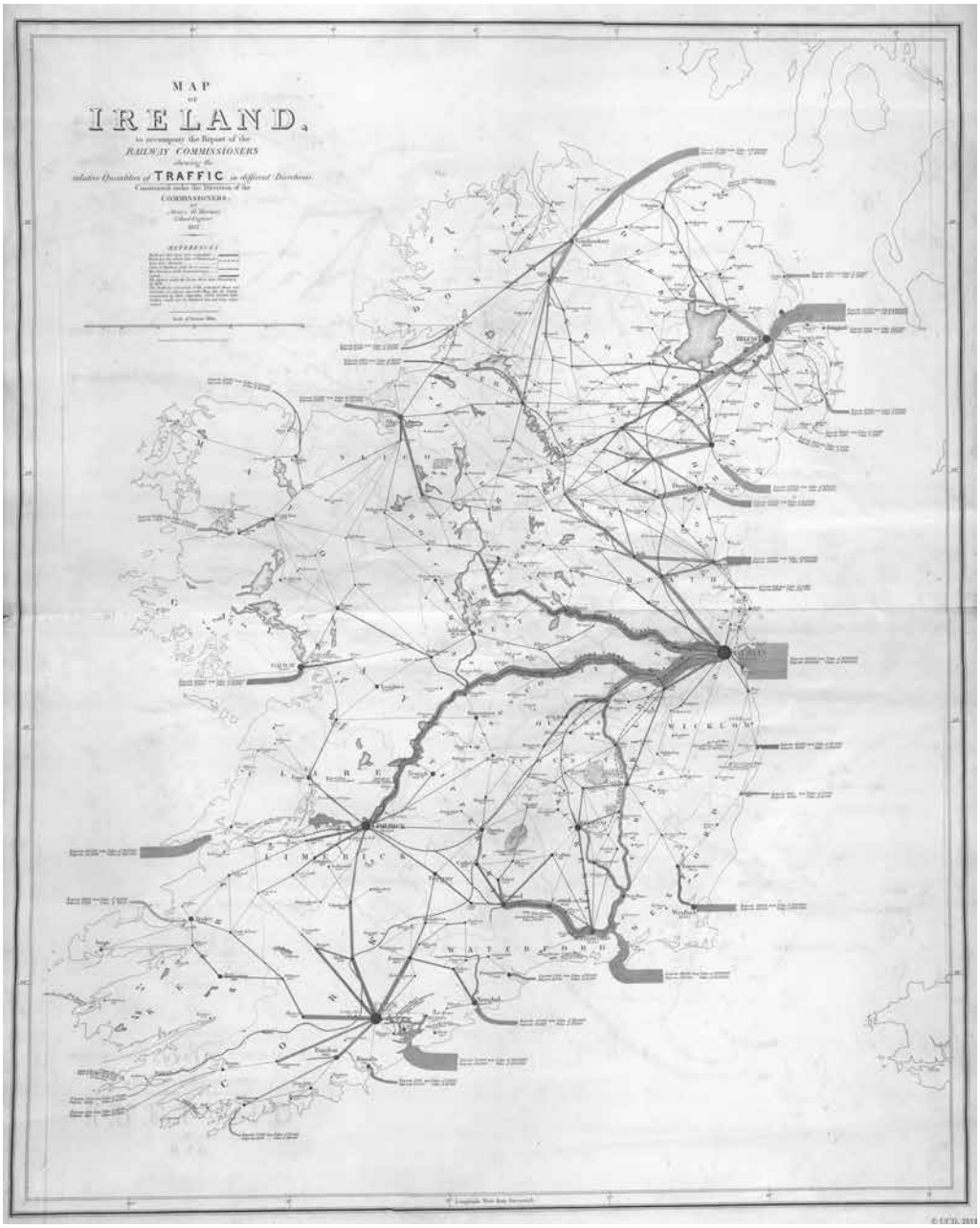


Figure 18: The first flow map ever made. Map IV 'Shewing the relative number of passengers in different directions', in: Henry Drury Harness, *Atlas to accompany 2d report of the Railway Commissioners Ireland 1838* (1838). Published with the permission of the University College Library.

created by Henry Drury Harness (1804-1883) to augment the second report to the railway commissioners of Ireland in 1837.[6] Harness was an engineer in the British army, who had no previous experience or education in cartography. His flow maps show the relative number of passengers travelling in different directions throughout Ireland (Figure 18). The lines on the maps are shaded and the varying widths are proportional to the average number of weekly commuters along that route.

Within ten years, Alphonse Belpaire (1807-1857) from Belgium and Charles Minard (1781- 1870) from France began publishing flow maps as well. According to all records, each of the three had no knowledge of the other two. Belpaire, an engineer with the Belgian Railways, included two flow maps in his 1847 treatise on railway expenses. These maps, much like that of Harness, showed transportation movement in Belgium in 1834, 1835, and 1844. He used these maps to make the point that railroads did not take traffic away from canals and that in the vicinity of towns there was an intense use of road carriage.

Unlike the other two map-makers, who never again published maps, Minard was a French civil engineer who became a cartographer at age 64 and published 51 maps, most of which were flow maps. In 1845, he published his first flow map, in which he depicted the number of travellers from Dijon to Mulhouse. His maps covered a large array of topics ranging from human flows, and rail traffic to coal and commodities, to Napoleon's Russian campaign of 1812. With the exception of a few maps that were published in his final years, Minard's work tended to display the movement of people and commodities within France.[7]

Although the second half of the nineteenth century is defined as the golden age of statistical graphics, the innovations of Harness, Belpaire, and Minard had little effect on commercial cartographic production. Harness and Belpaire published their maps within professional engineering publications and were only rediscovered decades later by historians of cartography.[8] Minard, on the other hand, was known to French officials and French statisticians but had very little contact with contemporary geographers, cartographers, and commercial editors of atlases and maps.[9]

From pioneers to commercial publishing

A survey of 414 different commercial atlases, published between 1837 and 1939 in four of the most central production centres of cartographic material (USA, UK,

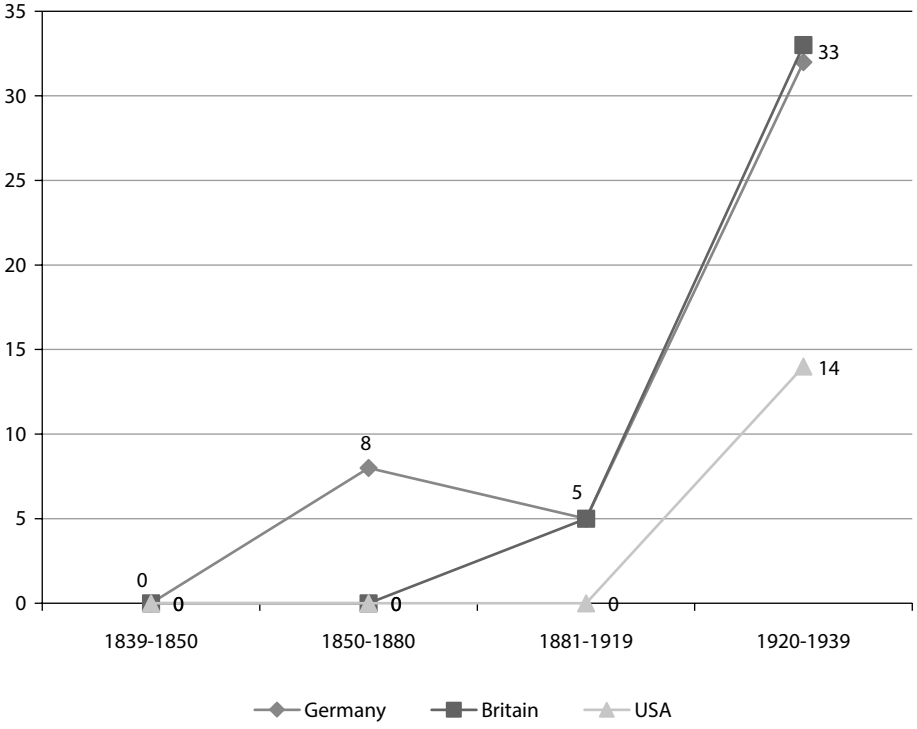
6 Robinson, 'The 1837 Maps of Henry Drury Harness'.

7 Only fourteen of Minard's flow maps described foreign trade or travel, of which eleven were produced between 1861 and 1869.

8 Robinson, 'The 1837 Maps of Henry Drury Harness'.

9 Robinson, 'The Thematic Maps of Charles Joseph Minard', p. 96; Rendgen, *The Minard System*, pp. 26-28.

Diagram 1: A graph showing the percentage of commercial atlases published between 1837 and 1939 that contain flow maps. Source: Atlas collection at the Library of Congress.



Germany, and France), shows that the popularization of flow maps was not directly related to the early pioneers.[10] Diagram 1 shows the percentage of commercial atlases published between 1837 and 1939 that contained flow maps. The graphs distinguish between four historical periods, and three places of atlas production: Germany; the UK; and the USA.

France is not included in this graph since none of the French atlases at the Library of Congress had any flow maps. Minard's influence on French cartography was limited to the realm of French public services and did not spread further to commercial cartography. In 1879, the newly established French Bureau of Statistical Graphics, which was established under the Ministry of Public Works, began publishing an annual series of statistical atlases that expressed graphically the flow of passenger travel as well as freight. The *Album de Statistique Graphique* was

10 The survey included 156 American atlases, 121 British atlases, 106 German atlases, and 31 French atlases. All are kept in the Geography and Map division at the Library of Congress. New editions of each atlas were surveyed as well but are not added to the atlas total.

published between 1879 and 1897 and included many flow maps, with the proposed intention of supporting the planning, development, and administration of public works. In 1897, the French Bureau of Statistical Graphics was dissolved and the series was discontinued due to the high costs of production;[11] its maps and their relative themes were not reflected in contemporary commercial atlases. While the French Bureau of Statistical Graphics was interested in visualizing aggregated individual statistics on a national scale, commercial atlases were much more focused on global movement, as will be described further on.

The first flow maps in commercial atlases appeared in the third quarter of the nineteenth century, but only in German atlases. Between 1851 and 1880, eight per cent of German atlases included in the survey displayed a flow map. Its appearance in German atlases was a continuation of the development of thematic mapping in Germany. Since the publication of Heinrich Berghaus' *Physikalischer Atlas* in 1845, which did not include flow maps, German cartographers attempted to visualize cartographically various physical and human aspects of the earth that had not been represented previously. The inclusion of flow maps that depict global movement was a direct outcome of the ethos of German thematic mapping. Accordingly, the first flow maps did not refer to any of the three pioneers of flow mapping; instead, they all referred to previous work done on physical, meteorological, and commercial thematic cartography in German atlases.

British atlas publishers introduced flow maps from 1891 onwards, yet the low number of atlases that included flow maps (five per cent) reflects a limited popularity among publishers. This applies even more in the case of American atlases that generally refrained from representing motion in their maps, and preferred to depict static places and locations. Between the two world wars, these percentages grew to over 30 per cent of all new British and German atlases as well as fourteen per cent of all American atlases. This growth seems ill-placed. It did not reflect the innovation itself, which had happened almost 80 years earlier, nor was it connected to any new print technology or graphical innovation. In fact, the first half of the twentieth century is even referred to as the 'dark ages' in terms of introductions of new methods in statistical graphing and thematic cartography.[12] However, as Michael Friendly claims, this was a time of dormancy, application, and popularization, rather than new inventions. Statistical graphics during this period became both mainstream and standard use in public and private sectors of society; commercial atlases were affected by this change. The next sections investigate the themes and the visual appearances of published flow maps in order to have a clearer understanding of the changes in popularity.

11 Faure, 'France', p. 295.

12 Friendly and Denis, 'The Early Origins'.

Early flow maps (1850-1880) and physical geography

The earliest examples of flow lines in German atlases were very different in content and style from the pioneering flow maps. They were not even flow maps per se, since the depicted flows were not the sole focus of the maps. Unlike the originals, these maps rarely showed inland movement, nor did they focus on a specific national territory. Flow lines were not a tool to solve state-centric problems, as they were for Harness, Belpaire, and Minard, but a graphical way to depict growing global trade and its various modes of trans-oceanic transportation as well as understanding the emerging globalization. The mapping of flow maps in German atlases followed the steps of Von Humboldt, who saw geography as a natural science addressing itself to the whole globe.[13]

One of the first examples appears in the second map of *Meyer's Hand-Atlas* (1867).[14] A map entitled *Erdkarte* ('Map of the Earth') emphasizes postal ship routes and the colonial division of the world and uses a unique graphical technique in order to describe the routes of ships, as well as the duration of travel time and frequency of journeys. Much like other maps of the mid-nineteenth century, the map's prominent symbol is that of natural motion, dotted white lines, which signifies ocean currents, and sporadic black arrows that describe their direction. However, only ship routes are drawn as multivariate lines. Two types of black lines are used to distinguish between routes leading from Europe to routes leading to Europe, dots above the lines define the frequency of the ships along this course (monthly, fortnightly, or weekly), and numbers describe the length of travel in days. Although the graphic is simple and still relies on verbal notation, it provides information about the direction, frequency, duration in travel time as well as length in distance travelled. The purpose of the map is to reflect the multiplicity and complexity of trans-oceanic traffic.

A similar, but more advanced map entitled *Allgemeine Welt-Karte* ('General Chart of the World'), was drawn by Hermann Berghaus in 1863 and published by Perthes Publishing in German and in English (Figure 19).[15] This map, in its various editions, depicts telegraphs, submarine cables, and railway lines, all of which are drawn as lines with no other quantitative value attached. However, oceanic currents and steam ship routes are drawn as multivariate lines indicating direction, route, and the magnitude of the movement. Four different types of currents are depicted: Equatorial currents; Equatorial counter currents; periodical currents; and Polar currents. The currents include arrows indicating their direction and numbers indicating their mean

13 Wardenga, 'German Geographic Thought', p. 137.
14 Meyer, *Meyers Hand-Atlas*.
15 Berghaus, *Allgemeine Welt-Karte*.

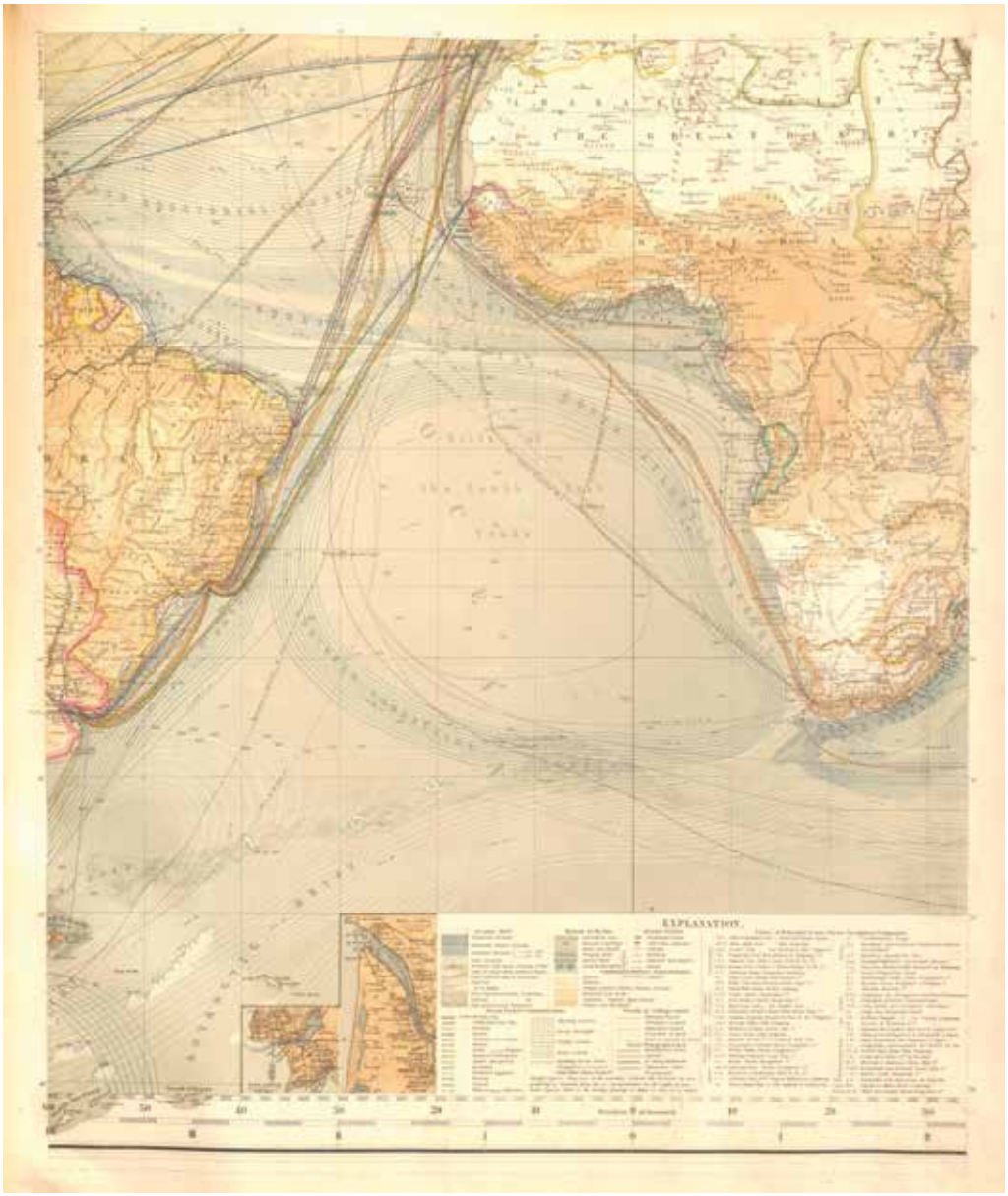


Figure 19: The South Atlantic Ocean segment of the 'Chart of the world' by Heinrich Berghaus, published by Perthes Publishing (1879). Published with the permission of the Library of Congress.

velocity. Steam ship routes are identified by their national flags (sixteen different nationalities indicated by colour), principal companies (56 different companies indicated by initials), as well as their frequency (monthly, fortnightly, weekly, and bi-weekly), and direction, visualized by shape. Numbers above the depicted lines describe distances in nautical miles and days of travel. The resulting image is that of a flow map since the multiplicity of lines and the abundance of data reflects the amount of transport along oceanic routes. Despite the tremendous achievement of Berghaus' map, its influence on atlas production was limited, as evinced by the miniscule number of atlases that included similar types of maps.

The turn of the century (1880-1914) and economic geography

In contrast to the German school of cartography, which related global trade to the physical world and natural sciences, the British interest in global trade was more nationalistic and economically oriented. British flow maps were introduced as part of the late nineteenth-century emergence of economic geography in the academy as well as in school education, which was a consequence of imperial British commerce, a global trading system and the system of free trade.[16] British economic geographers believed that trade was above all a geographical phenomenon, and that Britain was at its centre.[17] Accordingly, the first British atlases to simultaneously depict time, space, and movement were the *Atlas of Commercial Geography* (1889) by John Bartholomew and the *Atlas of Commercial Geography* (1892) by W.A.K. Johnston, both published almost simultaneously as the first textbook on economic geography, George Chisholm's *A Handbook of Commercial Geography* (1889). Bartholomew and Johnston were two of the most prominent atlas publishers in late nineteenth-century Britain, but their only atlases that included these types of maps were atlases of commercial geography. These atlases had no flow maps, but utilized a different graphical style, developed a few years earlier, called isochrone maps.[18] Unlike flow maps, which focus on specific routes, an isochrone map depicts areas of equal travel time from a specific point. The thirteenth map of the Bartholomew atlas and the first map of the Johnston atlas depict the earth's surface as coloured regions, identifying areas of equal travel from London. The map in Johnston's atlas shows railways, caravan routes, steamer tracks, sailing ship tracks, and telegraphs, but only those related to routes leading to or from London. While German flow-maps were interested in the nature of global trade in general, and as such, usually centred

16 Barnes, 'In the Beginning was Economic Geography'.
17 Barnes, 'Inventing Anglo-American Economic Geography', p. 15
18 Galton, 'On the Construction of Isochronic Passage-Charts'.

its maps on the Atlantic Ocean, British flow maps were far more interested in the characteristics of British trade.

By the first decade of the twentieth century, the interest in commercial cartography made trade flows into a significant element in specialized atlases in Germany as well as in Britain. The first map of the *Handels Atlas zur Verkehrs und Wirtschaftsgeographie* (1902) is titled *Weltverkehr, Kolonien und Handelsflotten* ('World Traffic, Colonies, and Merchant Fleets').[19] It depicts the earth as divided among eleven colonial powers and connected through roads, railway lines, rivers, and ship routes, in that order of significance. All routes are defined as lines of various kinds, but the important routes of steam ships are depicted as stripes whose widths indicate the frequency of traffic along that route. The distance in travel time is written inside the relevant stripe. Unlike mid-nineteenth-century German maps, physical features, such as ocean currents and winds, are ignored. The shift from physical geography to economic geography transformed global trade into a central force without any relation to natural phenomena.

Despite the change in content, German maps were not nationalistic like the British maps. The 1871 unification of Germany did not initially alter the decentralized nature of German politics, nor did it hinder the independence of German publishing houses, which operated from many small towns and cities. As a result, its influence on German atlas production was underwhelming in the first few decades. Accordingly, the centre of the maps is the Atlantic Ocean and the flows have no national colours; they are all coloured with a similar tone of pink. In contrast, British flow maps remained nationalistic in style and content. The *Atlas of the World's Commerce* (1907) includes two flow maps, and an isochrone map centred on London.[20] Although all three maps show the entire world, their primary focus is Britain. The editor, John Bartholomew pronounces his intention in the preface of his atlas:

> Commerce leads the way, and in this new age, it has come to be realized that commerce is the real basis of our modern material civilization, and that the nations, which maintain commercial supremacy, will also be assured of political supremacy. National competition for the world's trade must every year become keener, and in such competition, a thorough appreciation of the whole economic situation will be of primary importance.[21]

The first flow map (Figure 20) is entitled 'Commercial Highways of the World' and depicts railway, telegraph, rivers, and steamship routes. Of these principal highways

19 Scobel, *Handels-Atlas*, pp. 2-3.

20 Bartholomew, *Atlas of the World's Commerce*.

21 Bartholomew, *Atlas of the World's Commerce*, Preface,

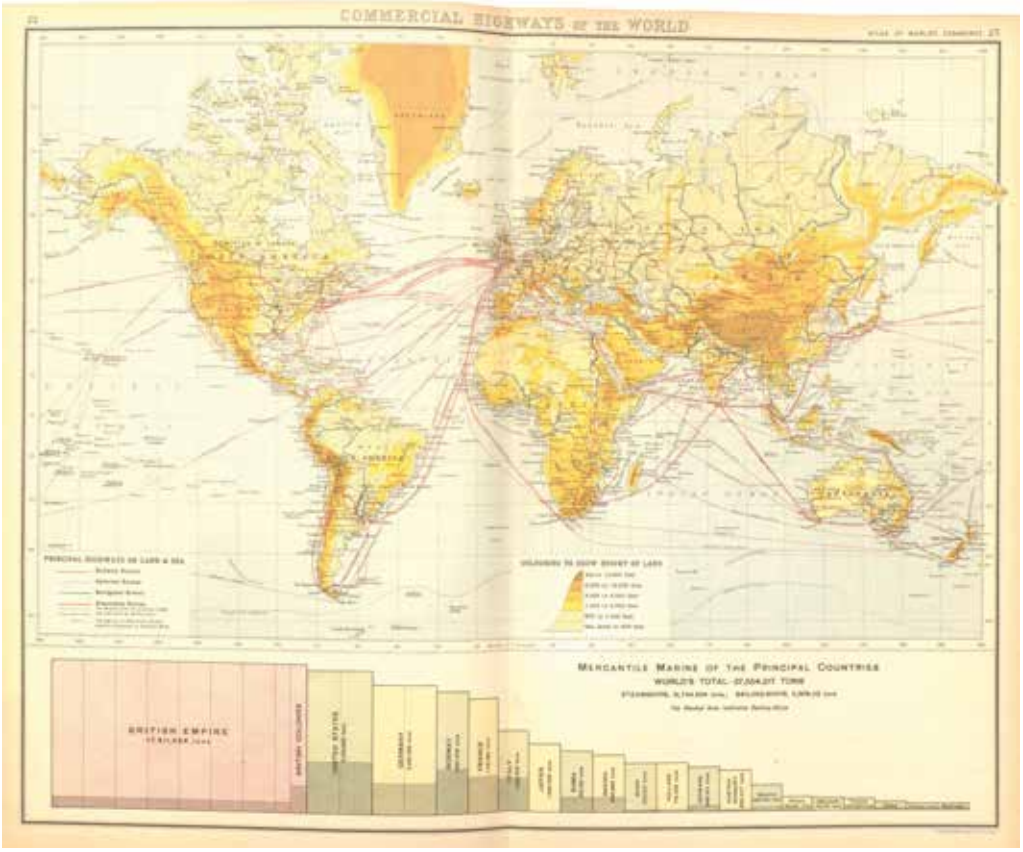


Figure 20: 'The Commercial Highways of the World', in: J.G. Bartholomew, *Atlas of the World's Commerce* (London: G. Newnes, 1907). Published with the permission of the Library of Congress.

on land and sea, only steamship routes are depicted in varying widths. However, unlike Drury, Belpaire, and Harness, it was not the intention to draw the width to scale. The map key states that 'the routes with the greatest traffic are indicated by thicker lines,' but Bartholomew never clarifies the meaning of 'greater traffic' in his thorough introduction or in a footnote. In this map, wider and narrower lines are not exact representations of quantitative differences but rather visual means to emphasize variance.

The second flow map in the *Atlas of the World's Commerce* depicts telegraphic communication. Unlike the previous map that uses width to indicate 'greater traffic', this map indicates traffic by the number of cables connecting two points on the map. For example, five British cables and three foreign cables connect south Britain to Nova Scotia, while only one foreign cable connects south Britain to the Azores. Graphically, the map itself is extremely simple. There are only five map symbols in the map key:

three types of lines signifying British cables, foreign cables and land telegraphs, and two colours of the earth's territories, 'countries with telegraphic communication' and 'regions without telegraphic communication'. Both distinctions, created by the map symbols, reflect Bartholomew's imperialistic agenda. The distinction between the two primary types of cables follows a nationalistic tendency of the map-maker, which distinguishes between us (Britain) and them (foreign nations). The territorial distinction between developed 'countries' and undeveloped 'regions' divides the world between countries that could not be colonialized and regions that are available for conquest. In short, it was a visual manifestation of Bartholomew's preface.

Interwar maps: Geopolitical cartography

Atlas production slowed to a halt during the First World War and was only revived in the mid-1920s. In British and German atlases published subsequently, flow maps appeared more frequently than before, and their colonial agenda was much more apparent than in previous years. In addition, in the first quarter of the twentieth century, there was a transition in the geographical paradigm: commercial geography changed the emphasis from race and climate to prioritizing trade and commerce. Consequently, the discourse of civilization described the world as divided according to an evolutionary logic of stages of human development.[22] Accordingly, many of the flow maps mutually depicted flows (primarily European) and territorial hierarchy. Movement and flows became the signifiers of cultural and scientific progress, while lack of movement was a sign of retardation.

For example, *Putnam's Economic Atlas* (1925) includes a flow map entitled 'Means of Transport and Communication' (Figure 21).[23] In this map, the colours of the regions of the world are based on the primary means of transport in that region. The colours range from yellow, used for motorized transport, to pink, indicating dog or reindeer sledges and canoe transport. Three different orange tones mark methods such as horses and oxen. The gradation in the colour scheme (yellow-orange-pink) establishes a hierarchy of civilizations. Simultaneously, the map depicts primary transport routes, which include railway lines, inland waterways, and principal channels of maritime trade. The latter are symbolized with blue stripes whose widths indicate the relative value of marine trade. Unlike the indistinct widths in Bartholomew's 1907 map, George Philip, the editor of the Putnam's Economic Atlas, clearly defines the widths. However, most stripes are identical in width and the variation that exists is an overt statement of his European and British bias. The stripes are widest around

22 Domosh, 'Geoeconomic Imaginations', pp. 947-948.

23 Philip, *Putnam's Economic Atlas*, pp. 3-4.

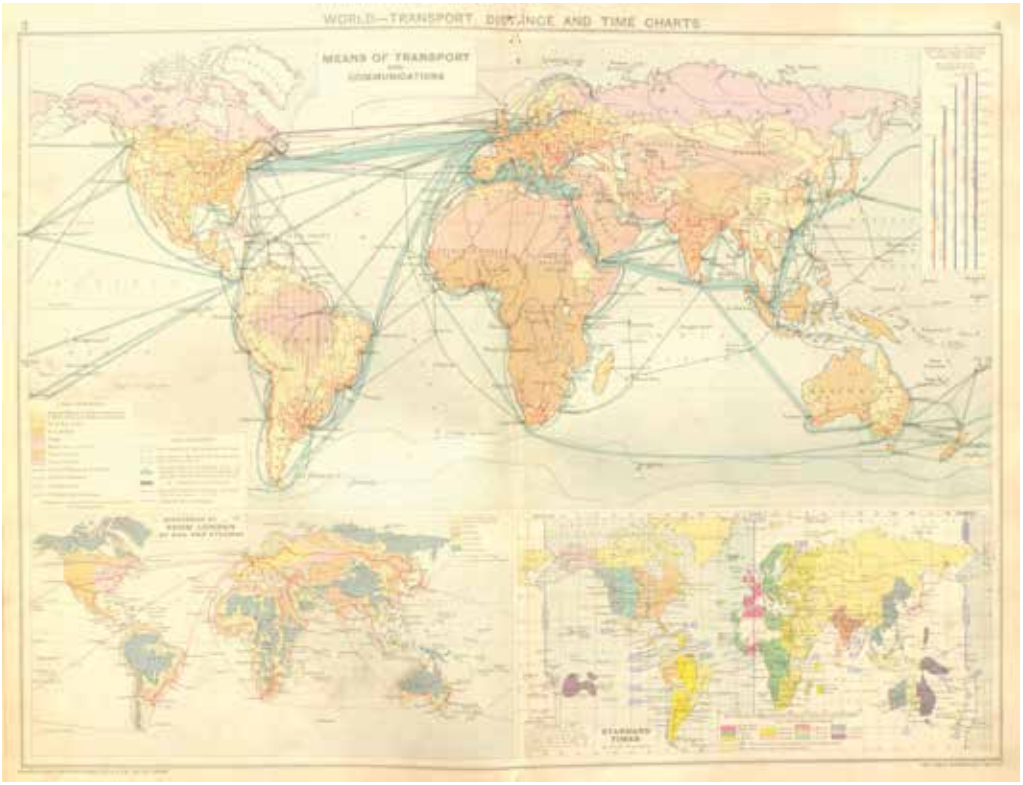


Figure 21: 'Means of Transport and Communication' in George Philip, *Putnam's Economic Atlas* (London: G. Philip, 1925). Published with the permission of the Library of Congress.

Europe and become narrower as the route moves further away. In addition, Britain is depicted as the only hub connecting Europe and North America.

Similar maps appear in other British atlases, and although the phraseology is different, the style and content of the various maps remain the same. For example, the fifth map of *Cassell's New Atlas* (1932) entitled 'The World: Commercial Development' follows a similar style as it depicts principal steamship routes with varying widths together with territories whose varying colours are based on their commercial development.[24] Although the categorization of the various lands is based on density of population, the title of each category reflects its level of sophistication: 'Highly developed manufacturing districts'; 'Highly developed agricultural and plantation regions'; 'Other industrial and agricultural regions'; 'Productive agricultural or pastoral regions, less highly developed'; 'Less productive or under-developed pastoral, forest, or agricultural regions'; and 'Other under-developed regions'. Instead of referring to

24 Philip, *Cassell's New Atlas*.

the actual data, density of population, the titles provide a value judgement for each region. The map is also surrounded by comparative diagrams showing the principal states of the world in order of population and area. These diagrams emphasize the magnitudes of empires, most importantly that of Great Britain.

German flow maps followed the British example and began emphasizing German flows, rather than global flows. The *Westermanns Welt Atlas* (1926), for example, includes a map entitled *Was die verschiedenen Teile der Erde dem Weltmarkte liefern* ('What the different parts of the world deliver to the world market').[25] This map shows the distribution of manufactured commodities around the world and in greater detail the production of major European states. The map, except for the letters marking the various commodities, is a reproduction of the opening map of the previously discussed *Handels Atlas* (1902). However, the reproduction includes a number of significant changes, reflecting the new agenda of German flow maps. The centre of the map is shifted eastward in order to focus on Germany, rather than the customary centre of global trade in the Atlantic Ocean. In addition, the map distinguishes between foreign ship routes, coloured light purple, and German ship routes, coloured with dark purple. Despite its lengthy key, this map, unlike the older map, does not explain the various widths. Much like the British maps, this map is a representation of European and German dominance, rather than reflecting actual quantities of trade.

Germany had now become the centre of the frame of German flow maps, and German flows were the most important element of these maps. In the *Lange Diercke Schulatlas* (1932), the map depicting global trade only mentions 'Germany's world trade and world traffic.'.[26] It marks German ships and cables, centres of production of imported goods, and trade flows between Germany and the rest of the world. The map itself does not visually depict any cultural hierarchy, but two small inset maps on the same page provide relevant information. The first map, in the bottom left corner of the page, shows the world divided by ways of animal transportation: horses; oxen; camels; yaks; llamas; and reindeers. The only colour without any explanation is that of the 'civilized' world, Europe and the United States. The second map, in the bottom right corner of the page, complements the first one by dividing the world based on agricultural advancement. These two inset maps are an integral part of the flow map above them. The superiority and centrality of Germany and its flows, as visually detailed in the main map, are the direct outcomes of the sophistication and superiority of Germany's communication and agricultural systems, as portrayed in the inset maps.

25 Liebers, *Westermanns Welt Atlas*, p. 108.

26 Original: 'Deutschhands Welthandel und Weltverkehr'. *Lange-Diercke Schulatlas Lange-Diercke Schulatlas* Lange and Diercke, *Lange-Diercke Schulatlas*, pp. 46-47; see also *Herders Welt und Wirtschaftsatlas*, pp. 13-14 and Eggers, *Deutsches Land*, pp. 70-71.

Interwar maps: Schematic cartography

Gradually, flow maps became a visual rhetoric. Map-makers started to simplify the iconography of the map with fewer symbols and colours, exaggerating the widths of the flows, and most importantly excluding references to the meaning of those widths. For example, the second and third maps of the *Practical Atlas of Modern Geography* (1931) are rainfall and wind maps.[27] Both maps have only four colours to reflect the rainfall amounts in different territories and a single symbol, a black arrow, to mark the wind trails. Although the arrows are differentiated by size and width, the symbolization is never explained or elaborated upon. Although each map has a long caption, verbally describing its content, the text only explains the seasonal weather and not the map symbology.

This minimalistic cartography enabled atlas publishers to portray the world as borderless, thus facilitating the smooth transition of capital around the world, forming a new type of imperialism, commercial imperialism. The *Welthandels Atlas* (1927), for example, is not explicitly a colonial atlas, since its maps are extremely minimalistic and do not show political borders. The atlas only consists of maps that show global import, export, and the production of various commodities related only to Europe (Figure 22). Three maps are drawn for each commodity, one describing world production and trade flows, and two smaller inset maps focusing on North America and Europe. The various maps have only two distinct symbols, wide arrows depicting flows and circles representing centres of production. The use of colour is also limited. Land surface is not coloured, while flows and location of production are coloured red. The maps in this atlas are very scientific in their verbal methodology; each symbol is described, the sizes of circles and arrows are in direct proportion to their relative part of global trade of a specific commodity, and the sources from which the information was gathered is noted. However, flows are now the sole element of the maps. While maps in the nineteenth century show trade flows alongside winds and ocean currents, thus relating human movement to the natural world, and maps at the turn of the twentieth century show flows as another consequence of European colonialism, flows in these maps are important in themselves. The world was reducible to human traffic, most importantly European traffic.

Similarly, the *Deutsches Land, Deutsche Volk und die Welt* (1937) includes a map entitled *Völker und Kulture. Staaten, Handel und Verkehr* ('People and Cultures: States, Trade and Traffic').[28] The map itself is a typical interwar colonial flow map, which simultaneously shows the colonial division of the world, the production

27 Stamp, *The Practical Atlas*.

28 Eggers, *Deutsches Land*, pp. 70-71.

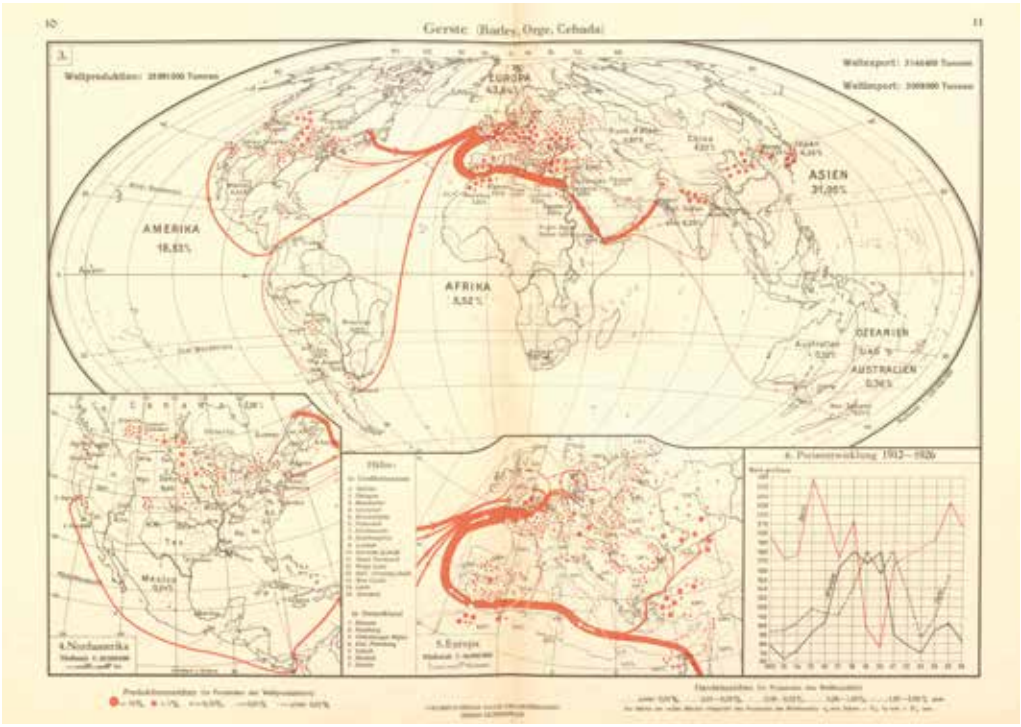


Figure 22: 'Gerste', in: Walther Schmidt and Georg Heise, *Welthandels-atlas: Produktion, Handel Und Konsum Der Wichtigsten Welthandelsgüter* (Berlin: Columbus-Verlag, 1927). Published with the permission of the Library of Congress.

centres, and the major trans-oceanic ship routes with changing widths. Although Germany is in the centre of this map, it is not emphasized in any other way. However, four inset flow maps on the bottom of the same page, which follow the question *Woher kommen die wichtigsten Handelsgüter, die wir einführen müssen?* ('From where do the most important goods, which we must import, come?'), construct the centrality of Germany.[29] These maps show the major import routes into Germany of ten different commodities. The German territory is coloured black in an otherwise uncoloured world, the flows are coloured blue, orange, red, and light brown, and are the only elements drawn on the map besides for the borders of the continents. The world constructed by these maps has a singular centre, Germany, which is both the centre of a borderless static world and the centre of the dynamic world of flows.

The use of flow maps as persuasive cartographies was not an innovation of the 1920s and 1930s. Harness, Belpaire, and, most notably, Minard repeatedly used such maps to influence their readers.[30] However, the original flow maps remained rich

29 Eggers, *Deutsches Land*, pp. 70-71.

30 Rendgen, *The Minard System*, pp.24-25.

with different types of data, and the pioneers were consistent in their motivation to use the method as an exact representation of quantitative values. Furthermore, the world seen through the early flow maps is not meant to be reducible to flows, and unlike flow maps of the 1930s, which will be discussed consequently, the resulting image was not intended to be propaganda.

Schematic flow maps with a nationalistic agenda became popular in British and German atlases from the early 1930s. The *Practical Atlas of Modern Geography* (1931), for example, includes a schematic flow map entitled 'The British Empire and the Main Ocean Routes of the World'.[31] The map contains very few symbols and has no key to explain them. The British Empire is coloured red while the rest of the world is uncoloured and without borders, except for the borders of the continents. Black stripes of varying widths connect Britain to the world thus marking its centrality in world flows. Much like the German map of 1937, Britain is both the centre of the static world, with its dominant red colour, and the centre of the dynamic world, through its flows.

Interwar maps: Goode and American flow maps

Unlike British and German cartography, American atlases tended to be far less international, and much more focused on the American continent.[32] However, the growing importance of global trade and economic geography in the early twentieth century forced the USA to be placed in the global framework rather than seeing itself isolated and superior.[33] Flow maps were still a rare sight in American cartography as a result of its focus on political world maps, and on place names rather than movement.[34] In 1923, the chief cartographer of Rand McNally John Paul Goode, who was extremely critical of the American style of cartography, edited an atlas that was meant to change the landscape of atlas production in America.[35] His atlas is innovative in many cartographic aspects, one of which is the inclusion of flow maps (Figure 23); a pioneering effort in the otherwise static worldview reflected by American published maps.

The first flow map is a polar projection of the northern hemisphere showing cyclone tracks circling the Earth. The tracks are sketched as dotted lines and not stripes, but the multiplicity of these lines manifest the frequency and volume of the cyclones, thus operating as width. The next page contains a map of ocean cables, operating in a similar way. Each line signifies a submarine cable and their

31 Stamp, *The Practical Atlas*, p. 6.
32 Schulten, *The Geographical Imagination*, p. 21.
33 Domosh, 'Geoeconomic Imaginations', p. 948.
34 Dent, *Cartography*, p. 192.
35 Goode, *Goode's School Atlas*, pp. 12-13; Schulten, *The Geographical Imagination*, p. 194.

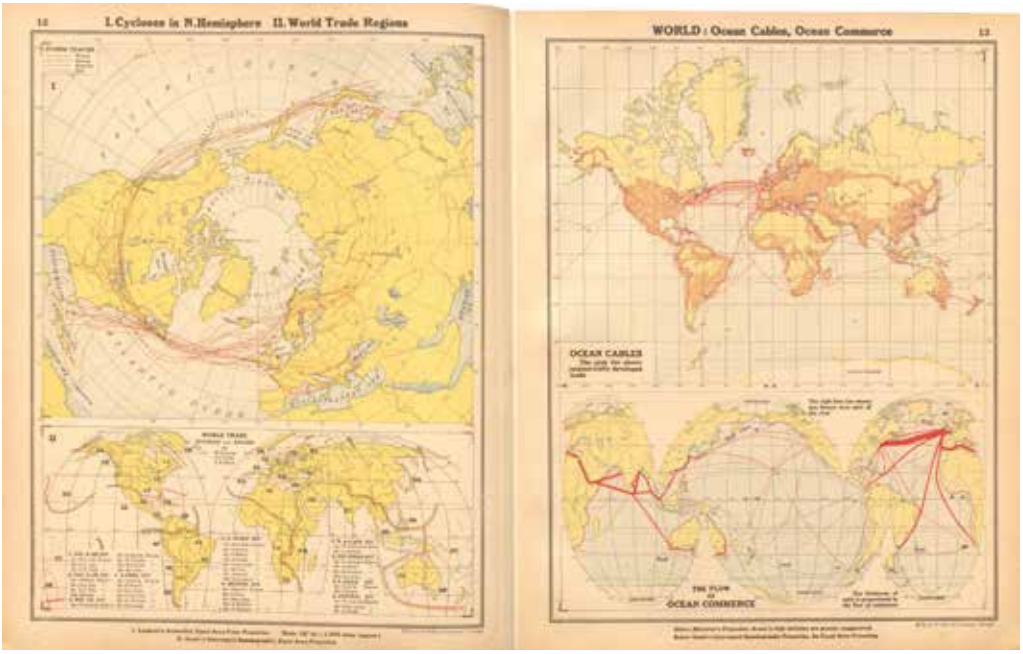


Figure 23: Three Types of Flow Maps Published in John P. Goode, *Goode's School Atlas* (New York: Rand McNally, 1923). Published with the permission of the Library of Congress.

multiplicity reflects the volume of traffic. On the bottom of that same page, Goode includes a map entitled 'The Flow of Commerce'. This map is a classic flow map, with red stripes of varying widths marking the flows, and an explanation defining the width as 'proportional to the flow of commerce.' Unlike contemporary European examples, these maps emphasize global trade and global flows, rather than national flows. State borders are not included or even mentioned, and the three maps are centred on the North Pole, Britain, and the Pacific Ocean, respectively. In addition, Goode deliberately avoids creating a global centre by changing map projections in each map.[36] However, the influence of European map-making is still prevalent in the schematic nature of these maps. Each map has a single symbol, notating the relevant type of flow, and a single colour, marking that specific movement. The land surface is not coloured, except for a pink tint marking commercially developed lands in the map of ocean cables.

Goode's maps did not affect other American mass-market atlases, which refrained from adding flow maps. American atlases were cautious of adding innovative maps since they were wary of confusing the consumer public. Rand McNally, for instance, continued to publish the Goode's World Atlas, but marketed it primarily

36 More on Goode's criticism of the Mercator projection in Schulten, *The Geographical Imagination*, p. 192.

for schools. The globalized worldview of Goode's 1923 flow maps was slightly altered in a reproduction published in *Rand McNally World Atlas* (1935), which was also edited by Goode.[37] The reproduced map shows Goode's unique holomographic projection and the same flow routes. The map is less schematic than Goode's map but still contains very few symbols; seven colours distinguish between regions of economic activities, small black dots mark mines, and red flows mark shipping routes. The main difference is the centre of the map. The map projection is altered in order to situate the American continent in the centre, because like British and German flow maps, American flow maps had also become nationalized.

The late 1930s and racial flow maps

As we have seen, most flow maps in commercial atlases were devoted to trans-oceanic world trade. Even the emerging national tendencies of the early twentieth century did not change this. However, the combination between schematic flow mapping and the racial agendas of the Nazi party in Germany introduced new types of flow maps with explicit racial and nationalistic content, which had little to do with global trade. This was part of a larger process, in which the German Right became increasingly aware of the persuasive power of maps.[38] Arnold Hillen Ziegfeld, one of the leading figures of the German school of suggestive cartography, stressed the importance of cartographically depicting dynamic aspects of life and movement.[39] During the 1930s, this type of cartography was a tool of propaganda and among its graphical elements arrows as well as flows were used repeatedly to emphasize the dynamic nature of the German territory. These maps intentionally connect two contradicting worldviews, a world divided into discrete and isolated racial groupings and a world described by movement.

This contradiction is emphasized in flow maps that show movement of races and nations. The purpose of these flow maps was not to depict a world of free movement but rather a world of growing tension. A map entitled *Volk ohne Raum* ('A People without Space') was published in *Deutsches Land, Deutsche Volk und die Welt* (1937).[40] The map shows the locations of Germans worldwide by red colours and their migration routes by red stripes with varying widths. The red flows are not explained and are used primarily as a rhetorical device. This map does not

37 'Economic Activities', in Goode, *Rand McNally World Atlas*.

38 Herb, *Under the Map of Germany*, pp. 76 and 134. On the insignificance of suggestive cartography in the German Left, see Herb, *Under the Map of Germany*, pp. 152-153.

39 Ziegfeld, 'Kartengestaltung'.

40 Eggers, *Deutsches Land*; see also 'Die Erde, Verbreitung der Deutschen' in *Herders Welt und Wirtschaftsatlas*.

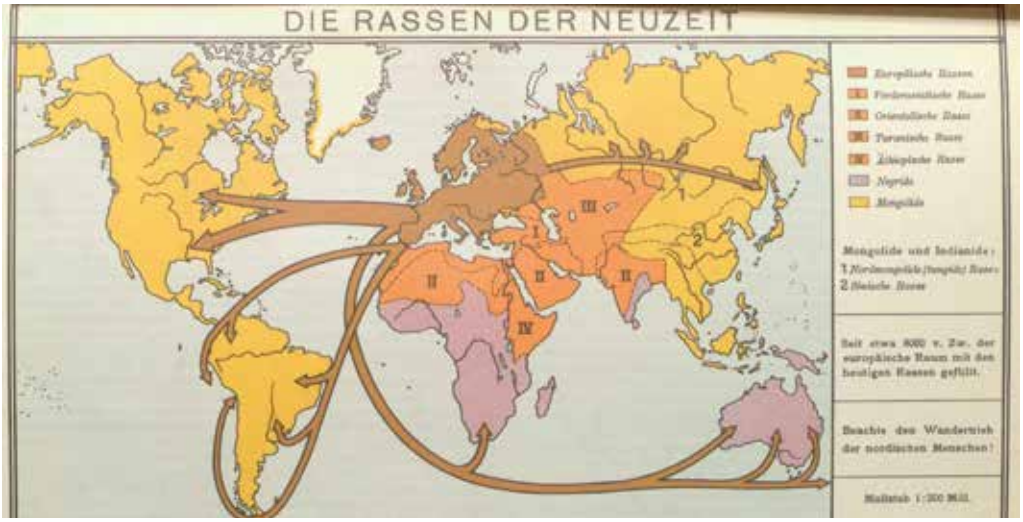


Figure 24: 'The Races of the Modern Times', published in: Bernhard Kumsteller, *Werden und Wachsen*, (Braunschweig: Westermann, 1938). Published with the permission of the Library of Congress.

distinguish between the static geography of places and the dynamic geography of flows. It is part of a political argument, mentioned in the map's title: Germany needs to grow and its current borders are irrelevant for this growth.

Flows had become a sign of struggle and contest over land. The *Werden und Wachsen* atlas (1938), for example, includes a number of flow maps that show racial movement.[41] The first shows 'the races of the modern times' and divides the world into four groups, European races, other Caucasian races, Black races, and Mongol races (Figure 24). Large brown arrows emerge from the brown European continent and spread across the world. These arrows have varying widths but are not explained, except for a side note stating 'the passion for travel of the northern people.' This flow map merges depictions of static territories and dynamic flows into what looks like a single organism that occupies the world.

Two other maps show 'The Northern Race and the Germans as Culture Bearers' and 'The Spread of the Jews in Europe', and provide larger scale maps of movement than those we have seen previously.[42] These illustrate the historical routes of Germans within Europe and Jews into Europe, respectively. Different colours and types of arrows depict the movement in various time periods. The arrows do not have varying widths, but their depiction as wide stripes resembles that of flows

41 Kumsteller, *Werden und Wachsen*.

42 Original: 'die nordische Rasse und die Germannen als Kulturträger', and 'Ausbreitung des Judentums in Europa'. In general, cartographers during the Nazi period turned their attention to the homeland, see Heske, 'Political Geographers of the Past', p. 278.

rather than arrows, which are usually narrow lines with an arrowhead. The purpose of these maps is not to reflect the historical movement of Germans or Jews within Europe, nor is it to depict their current locations, but rather to illustrate the state of conflict between the races. The same atlas uses flow mapping and its relation to the static depiction in two different ways: the first combined flows and territories into a single brown surface, while the second showed the contradiction between flows (Jewish immigration) that supposedly infiltrate and harm the integrity of the European territory. On the one hand, flow maps had returned to the original large scale of the 1830s, focusing on states and on Europe, but, on the other hand, they had changed drastically from the scientific intent of their innovators.

Conclusion

Flow maps were invented by three engineers, who sought a way to visualize and solve state-centric problems that involved personal and commercial inland traffic. However, their source of motivation and themes were not replicated in commercial atlases. In fact, flow maps only began appearing a few decades later, in response to the growing world trade and the extending European imperialism. Much like other types of late nineteenth-century maps, flow maps made the complex imperial project visible and comprehensible. The scale of these maps is much smaller than the pioneering flow maps, as they deal with the whole world, and the basic flow is always trans-oceanic traffic, which connects Europe and the world. Ongoing changes and trends in the study of geography, from physical geography to economic geography and later geopolitical geography, changed the content and context of the flow maps. Winds and ocean currents, colonial demarcations, and territorial hierarchies were added and removed as the trends shifted.

Flow maps gradually became a way to emphasize specific types of movement. Instead of being a sophisticated visual tool, accurately and objectively reflecting a scaled representation of spatial relations, they had become a simplified visualization used for the sake of national agendas. This reached its apex in German cartography of the late 1930s, as flow maps became a significant component in Nazi propaganda, showing the dynamism of the German territory and people.

Denis Cosgrove states that 'the thematic map reveals the presence of phenomena that are beyond our normal bodily senses.'[43] This was the initial intent of Harness, Belpaire, and Minard. However, a map is also 'a creative process of inserting our humanity into the world and seizing the world for ourselves.'[44] This creative process

43 Cosgrove, *Geography and Vision*, p. 168.
44 *Ibid*.

was reflected in this chapter through the changing roles of flow maps. These maps are used to represent colonial, imperialistic, nationalistic, and later racial worldviews, none of which had to do with the initial maps that depicted mainly individual railway travel.

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