Received: 28 Aug. 2024, **Accepted:** 27 Nov. 2024
Published online: 17 Dec. 2024
DOI: https://doi.org/10.22201/igg.25940694e.2024.2.118 **Volume:** 8, **Issue:** 2, **Pages:** 1-6

terra digitalis
international e-journal of maps

Cholera in the Nineteenth Century: Cartographic construction and global spatio-temporal modeling☆

El cólera en el siglo XIX: Construcción cartográfica y modelado espacio-temporal global

Gustavo D. Buzai[a], Eloy Montes-Galbán[a]

[a]*Universidad Nacional de Luján, Instituto de Investigaciones Geográficas – CONICET, Buenos Aires, Argentina*

Abstract

The spatial analysis of diseases allows historical approaches based on the study of the spatial diffusion of infections at different scales of geographical space and time. Using historical maps to illustrate the spatial distribution of cholera in different spaces and years, the objective of this work was to achieve a synthesis that captured the global spatial process of the disease. The result is a map of the global spatial diffusion of cholera during the 19th century, identifying the vectors followed by the disease and the main population centers affected from Hindustan to South America. As a basis for a socio-spatial interpretation, the complete results are presented in a poster that includes the six periods analyzed, a global synthesis map, the temporal evolution and the spatial model.

Keywords: Cholera, Vibrio Cholerae, Pandemic, Disease Mapping, Medical Geography

Resumen

El análisis espacial de las enfermedades permite realizar abordajes históricos a partir del estudio de la difusión espacial de los contagios en diferentes escalas del espacio geográfico y el tiempo. Mediante la utilización de mapas históricos que presentan la distribución espacial del cólera en diferentes espacios y años, el objetivo del presente trabajo fue lograr una síntesis que captara el proceso global espacial de la enfermedad. La tarea realizada lleva al mapa de la difusión espacial mundial del cólera durante el Siglo XIX, en el cual se determinan los vectores seguidos por la enfermedad y los principales núcleos poblacionales afectados desde Indostán hasta América del Sur. Como base de una interpretación socioespacial, los resultados completos se presentan en un poster que incluye los seis períodos analizados, un mapa síntesis mundial, la evolución temporal y el modelo espacial.

Palabras clave: Cólera, Vibrio Cholerae, Pandemia, Mapeo de enfermedades, Geografía Médica

1. Introduction

Population health represents a synthesis of the relationship between society and its environment; in this sense, the spatial distribution of diseases includes significant topics in the field of Human Geography, particularly addressed by the branch of Medical Geography. The spatial dimension, in this case the consideration of geographical space through the materiality of the surface of Earth, is the fundamental basis that structures the spatial distribution of social relations. During the 19th century, the technological advances of the Industrial Revolution accelerated time and brought space closer together.

Technological advances in transportation, notably the steam engine and the railroad, reduced spatial frictions and enabled the faster movement of people and production and consumption goods, as well as the spread of diseases. In the context of a new phase in global capitalist expansion, this paper reconstructs the global spread of cholera in the 19th century.

We present the scope of Medical Geography together with the fundamental concepts of spatial nature that underpin its methodological development. Historical cartography makes it possible to determine the main vectors of diffusion and the years of arrival of cholera in each population center.

The results provide the material for the preparation of the poster map on Cholera in the 19th century, the global spatial modeling being the central proposal of this article.

**E-mail addresses:* gdbuzai@conicet.gov.ar, emontesgalban@conicet.gov.ar

2. Medical Geography

Geography as a human science studies social spatiality and does so through its formal object of study. The perspective of analysis is centered on the approach to spatial differences.

In this context, the branch of Medical Geography studies the spatial analysis of diseases. The focus is placed on the spatial study of their distributions, correlations and diffusion (Buzai, 2014).

The objective is to understand the spatial behavior of diseases, the distribution of their causes, contagion and mortality, taking into account global and local factors related to the physical-natural and human context. Territorial management requires governmental decision-making to apply these results to health prevention and promotion (Santana, 2014).

Studies in Medical Geography proved that the spatial distribution of diseases is related to social factors, including population, household and housing conditions; in this sense, there are associations between the occurrence of diseases and geographical, social, economic, cultural, housing and political factors in the place where daily activities take place. The socio-spatial determinants of health (Buzai and Santana, 2018) affect the population by generating different degrees of vulnerability.

By understanding these processes, it is possible to model the regular patterns that generate specific disease behaviors in space and time at scales ranging from global to local; in this case, from global interactions to local occurrences.

3. Social Cartography in context

Social cartography emerged as an independent discipline in the 19th century following the publication of the *Carte Figurative de Instruction Populaire de la France* by Charles Dupin in 1826. This map, which used grayscales to show the educational level of the population by district was the first choropleth map to illustrate themes that could not be directly observable in the territory. In this way, the use of isolines to represent elevations in physical-natural studies was extended, and the subject matter progressed with the representation of themes such as population density, economic aspects, various types of social problems (crime, alcoholism, prostitution) and there was great interest in the creation of disease maps. Cholera, which reached Russian territory in 1823 and the major cities of Western Europe in 1831, was the main cause of this orientation. The first map produced by Jameson (1820) shows the spread of cholera in the Ganges basin and also represents a first example of the selective use of information, demonstrating what Harley (2001) calls "external power", given the British government's interest on the impact of the pandemic on economic activity and "internal power", which leads the author to focus his representation on the British population and to deliberately exclude the local population. In this sense, a critical review of classical historiography (Wigh perspective, Butterfield, 1965) applied to cartography shows the map in its own context and as an instrument of political power, in this case as an instrument of 19th century imperialism.

In short, the scientific perspective which considers the map as a technical document, is expanded. Objectivity is questioned from a social perspective that discovers in maps the influence of social, political, cultural and economic entities. Cartographic representation shows a permanent interaction between technical and social aspects.

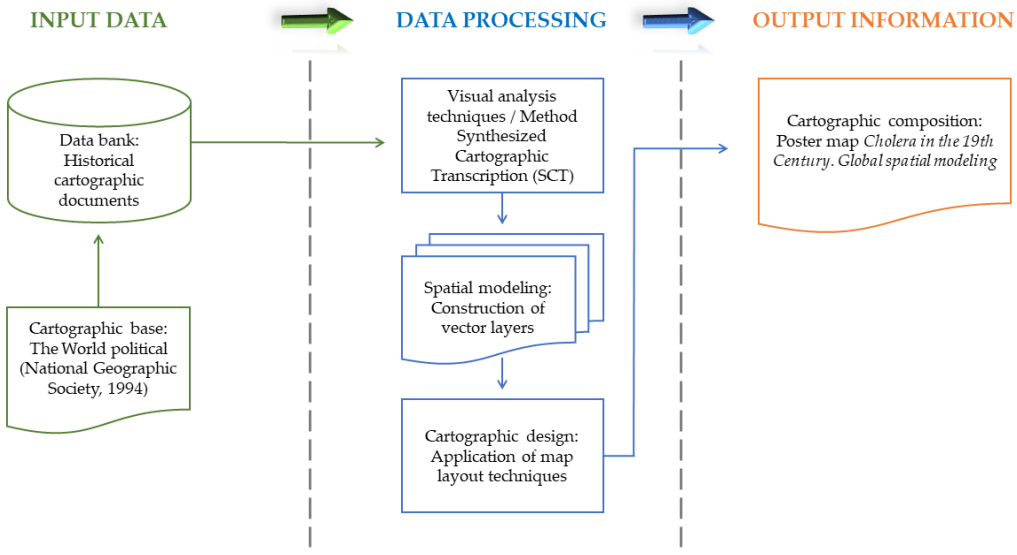


Figure 1. Methodological stages, flowchart / Figura 1. Etapas metodológicas, diagrama de flujo

4. Spatial concepts

The research considers the existence of three instances in human spatiality, corresponding to lived space, perceived space and conceived space. Piaget (2007) studied them as part of the evolution of spatial thinking.

The first and second spaces represent a continuum from empirical lived experience to the intellectual maturation that allows linking to the spatial context. The third space corresponds to the highest level of abstraction by its representation in a model. In our case the model is the map as the main language of Geography.

Each element of the map is part of the third space and is derived from the two previous ones. Within each location and each vector there are concrete experiences and perceptions of different human societies.

Every element represented has a specific location in the coordinate system as *absolute space*, a geographic space containing different elements. Distances in kilometers are distorted when measured in time due to the different transport capacities that generate vectors with different friction in the *relative space*.

The relative distance shows that, starting from Hindustan, Cholera took 6 years to travel ~6,000 km, and 10 years to travel ~10,000 km, to reach European Russia, in the first case via Astrakhan and the Volga River in the Caspian Sea, and in the second case crossing Siberia; in this sense, it can be estimated that the friction in Asia allowed a speed of 1,000 km per year. In contrast, the diffusion from Europe to North America shows the lowest friction of all the vectors analyzed, as it took one year to move ~6,000 km. Conversely, the highest frictions are found on the American continent, in North America it took 30 years to travel ~11,000 kilometers and in South America 50 years to travel ~13,000 kilometers, respectively 370 and 260 kilometers per year.

Combining conceived space with aspects of absolute space and relational space, the development of the poster map is based on the following central concepts of spatial analysis: location (site and position), spatial distribution, spatial interaction and spatial evolution (temporal dimension).

The location is resolved with punctual information on the main sites, in this case corresponding to population centers. Spatial distribution is how these sites are distributed to create areas. Interaction is the movement between sites represented by arrows indicating the extent and direction. Spatial evolution takes into account the years of cholera occurrence at each site.

5. Materials and methods

The technical work was carried out by using visual analysis techniques to construct a conceptual generalization of central places and vectors of disease diffusion based on historical cartography.

In order to carry out the research, a current cartographic base was selected with a scale and projection appropriate to the proposed objective to achieve the final cartographic representation (the poster map). Twenty historical sources of cartographic information at different scales were selected and examined. Information processing, design and final artwork were carried out using QGIS desktop GIS software (QGIS Development Team, 2022).

5.1. Base map and historical cartographic sources

The base map used in this systematization corresponds to the 1:33,120,000 scale planisphere (National Geographic Society, 1994) with the Winkel-Tripel projection (Winkel III) proposed by Oswald Winkel (1874-1953) in 1921 and adopted as standard by the National Geographic Society of the United States as the standard for its world maps. Table 1 presents historical cartographic sources classified at different scales.

5.2. Information processing and cartographic construction

The procedure called *Cartographic Transcription* is one of the main methods used to work with historical cartography in the Geographic Information Systems environment (Montes Galbán, 2024). While georeferencing and digitizing consider an absolute space defined through a coordinate system, cartographic transcription involves a conceptual selection process to achieve compatibility between different historical sources and/or structural simplification.

The treatment of the historical cartographic information, to capture the global spread of cholera, was a Synthesized Cartographic Transcription (SCT). This method consists of the visual interpretation of a historical cartographic document (in analog or digital format) for its subsequent simplified representation on a current cartographic base. In this way, a conceptual filtering is carried out, taking into account the basic elements that make it possible to obtain the general spatial structure, overcoming the incompatibility between different sources (Benavides Quecán, 2004).

In this case, we began with a visual interpretation in order to identify, in the historical cartography, the main point locations (population centers), the main vectors of the diffusion of the disease (diffusion trajectory) and create the surfaces containing the different waves of contagion (areas of influence), and then we digitized the geographic entities, points, lines and polygons on the current cartographic base.

Finally, by obtaining a series of partial results that contemplate chromatic maps, the point maps, and the flow maps, taken from Ormeling's classification (2014) and the subsequent application of map design and diagramming techniques, the final cartographic composition was achieved with a working scale of 1:75,000,000 in the central synthesis map. Figure 1 details the methodological sequence.

5.3. Modelling

The six maps that accompany the synthesis map show the spatio-temporal evolution of the disease and the modelling results are presented in two schematic figures located in the upper right part of the composition.

Tabla 1: Historical Cartography Analyzed / Tabla 1. Cartografía histórica analizada

Historical cartography on a global scale:
WORLD 1816-1950: Distribution of Cholera 1816-1950 by Jacques May in 1951. Map included in Geographical Review (Vol. 40, 1951). https://collections.lib.uwm.edu/digital/collection/agdm/id/5240/
WORLD 1830-1832: World Map. Spread of Cholera in 1830, 1831, and 1832 by Henry Schenck Tanner in 1832 in Osborne (2020). https://philadelphiaencyclopedia.org/essays/cholera/
WORLD 1832: Chart Shewing the Progress of the Spasmodic Cholera (1832) by Amariah Brigham Hartford in 1832 in Killingsworth (2017) https://exhibits.stanford.edu/blrcc/feature/mapping-cholera-19th-century
WORLD 1832-1873: Actual & Supposed Routes of Cholera from Hindoostan to Europe and to North & South America in 1832, 1848, 1854, 1867, 1873 by John C. Peters in 1885 in Went (1885) https://wellcomecollection.org/works/w83cpm5u/items?canvas=5
WORLD 1846-1860: Pandemic Map: Cholera by Yik Sang Fong Dorothy in 2020 in Mulhem (2020) https://earth.org/data_visualization/pandemic-map-cholera/
Historical cartography on a continental scale:
EURASIA 1817: CHOLERA-KARTE oder Uebersicht der progressive Verbreitung der Cholera seit ihrer Erscheinung im Jahr 1817 über Asien, Europe und Africa by Carl Ferdinand Weiland (1832). https://bostonraremaps.com/inventory/rare-cholera-map-weiland/
ASIA 1824: L'Esquisse itineraire du Cholera morbus pestilentiel de l'Inde et de Syrie by Alexandre Moreau de Jenné (1824) in Petrella (2020) https://storicamente.org/sites/default/images/articles/media/2127/storia-del-colera-petrella.pdf
EURASIA 1831: Tablaeu des progrès du cholera morbus depuis 1817 jusqu'au mois d'Octobre 1831 by D. Lombard (1831) in Storms (2020) https://www.leidenspecialcollectionsblog.nl/articles/mapping-epidemics-nineteenth-century-cholera-maps-of-leiden#10221
EURASIA 1831: Map of the Progress of the Cholera in Asia, Europe and Africa by Anonymous (1831) in Koch (2014) https://doi.org.10.1093/ije/dyu099
Historical cartography on a national scale
HINDUSTAN (Ganges basin) 1820: Map Shewing the places chiefly visited by de epidemic by James Jameson (1820) https://wellcomecollection.org/works/mkxz3gdn
BRITISH ISLES: Cholera map of the British Isles showing the districts attacked in 1831, 1832 and 1933 by Augustus Petermann (1852) in Gilbert (1958) https://www.jstor.org/stable/1790244
POLAND 1831: Itinéraire du Colera Morbus en Pologne 1831 by Desmadryl (1831) https://www.alamy.com/cholera-in-poland-relation-historique-et-mdicale-du-cholra-morbus-paris-1832-source-1168g23-language-french-image226825725.html
USA 1866: The movement of cholera in 1832, The movement of cholera in 1849, The movement of cholera in 1866 by Gerald F. Pyle (1969) https://onlinelibrary.wiley.com/doi/10.1111/j.1538-4632.1969.tb00605.x
Historical Cartography on an urban scale
PARIS 1834: Rapport sur la marche et les effets du Choléra-Morbus dans Paris et les comunes rurales du département de la Seine by Commission Mommée, avec l´aprobation de M. le ministre du commerce et des travaux publics (1834) in Picquet & Chateuneuf (1834) https://www.crouchrarebooks.com/books/the-first-epidemiological-maps https://gallica.bnf.fr/ark:/12148/bpt6k842918.image
EXETER 1834: Map of Exeter in 1832 Shewing the localities where the Deaths caused by Pestilential Cholera occurred in the years 1832, 1833 & 1834 by Thomas Shapter (1849) https://library.princeton.edu/visual_materials/maps/websites/thematic-maps/quantitative/medicine/medicine.html https://wellcomecollection.org/works/f4rzk3x8/items?canvas=6
HAMBURG 1836: Zu Rothenburg's Cholera-Epidemie des Jahres 1832 in Hamburg by J.N.C. Rothenburg (1836) in Vaughan (2020) https://urbanformation.wordpress.com/2020/06/24/pathways-of-disease/
LEEDS 1842: Sanitary map of the Town of Leeds by Edwin Chadwick (1842) in Cartography (Cornell University, posted in 2017) https://www.parliament.uk/about/living-heritage/transformingsociety/livinglearning/coll-9-health1/health-02/ - https://digital.library.cornell.edu/catalog/ss:19343540
OXFORD 1854: Map of Oxford. To illustrate Dr. Acland´s Memoir on Cholera in Oxford in 1854, showing the localities in which cholera & Choleraic diarrhœa Occurred in 1854, and Cholera in 1832 & 1849 by Henry W. Acland (1856) https://exhibits.stanford.edu/blrcc/catalog/rt260gd2393
LONDON, SOHO 1855: On the Mode of Communication of Cholera, John Snow (1855), geographical analysis in Buzai (2020), Cheshire (2022) and Polo Martín (2022). https://theconversation.com/sewage-alerts-the-long-history-of-using-maps-to-hold-water-companies-to-account-189013
LEIDEN 1867: Kaart aanwijzende de verspreiding der cholera, en het aantal sterfgevallen aan deze ziekte in elk der 39 buurten van Leiden, 1867 by Jan W. Schaap (1867) in Storms (2020) https://www.leidenspecialcollectionsblog.nl/articles/mapping-epidemics-nineteenth-century-cholera-maps-of-leiden#10221

Temporal model: One-dimensional time line in which the central point of each period is highlighted as a peak in the development of the disease. From these, the successive waves are formed, from peak to peak, according to the degree of inclination produced by the amplitude of the intervals. The sequence shows a regularity formed by five waves with amplitudes between 13 and 20 years.

Spatial model: Two-dimensional space in which the main paths of cholera from the Sundarbans to cover the entire relative space. The main vectors produce circular movements, two counter-clockwise in Eurasia, and three clockwise in Africa, North America and South America. The less developed vec-

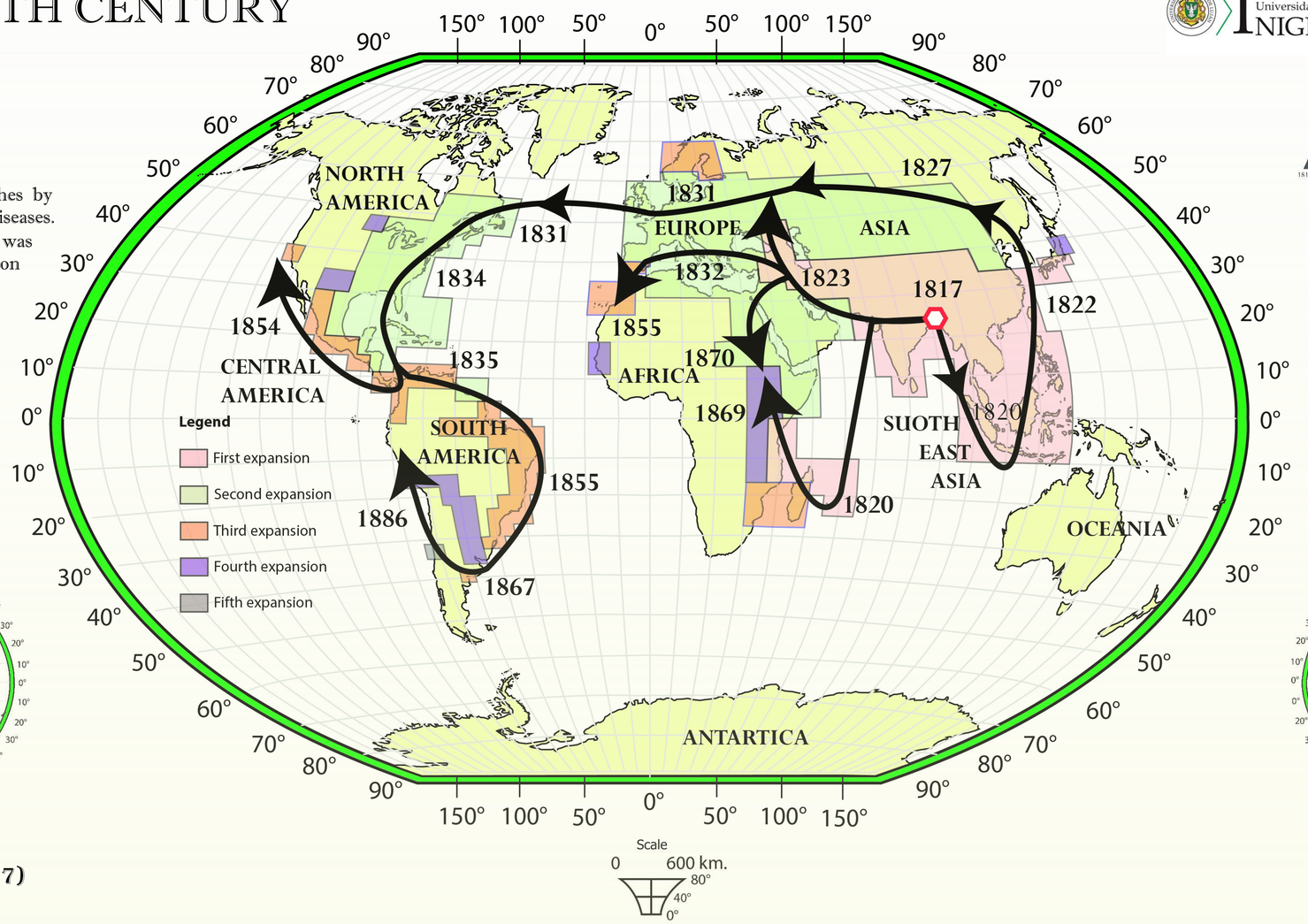
CHOLERA IN THE 19TH CENTURY

World space modeling

Dr. Gustavo D. Buzai
Dr. Eloy Montes Galbán

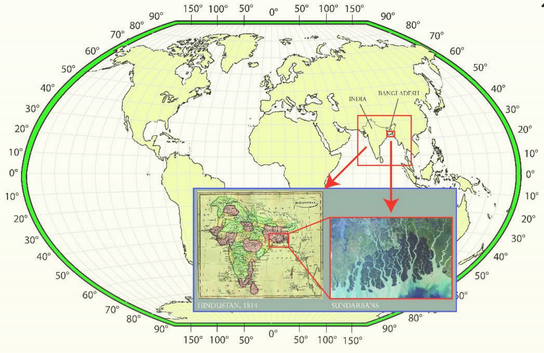
Instituto de Investigaciones Geográficas
Universidad Nacional de Luján
INIGEO
GESIG
LAB SIG
terra digitalis
international e-journal of maps

Medical Geography allows for historical approaches by studying spatial distributions and evolutions of diseases. Using historical cartography, a generalization process was carried out that is useful for modeling the spatial diffusion of cholera during the 19th century. The concept of expansion allows us to determine the main sites, areas and vectors of its spatio-temporal evolution between regions, countries and cities. From Hindustan (1818) to South America (1887) there is a long process of incorporating spaces until reaching its maximum extension in the period. The central cartographic result corresponds to a conceptual and operational synthesis approach of its global spatial modeling.



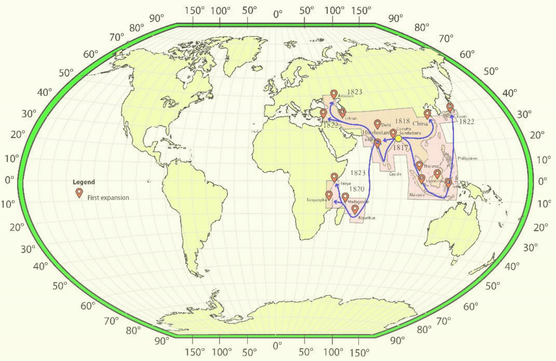
WINKEL-TRIPEL MAP PROJECTION, CENTRAL MERIDIAN 0°
DATUM [World Geodetic System 1984]
CENTRAL MAP SCALE 1:75.000.000
1 CENTIMETER = 750 KILOMETRES

Buenos Aires, 2024



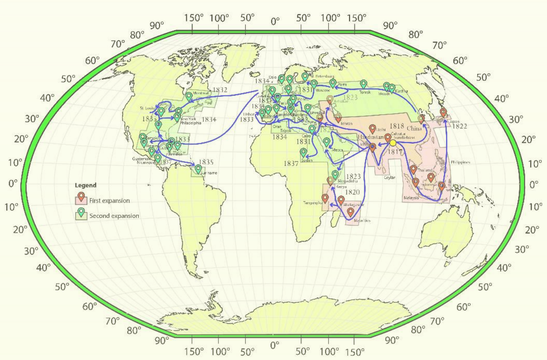
ORIGIN IN SUNDARBANS FOREST (1817)

Beginning of the spread of cholera. From the Sundarbans forest on the current border of India and Bangladesh in the Bay of Bengal, territories that were part of Hindustan until 1947.



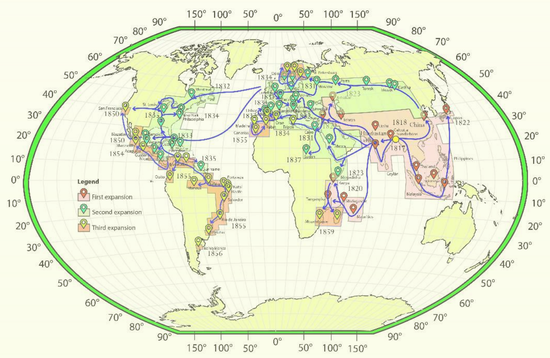
FIRST EXPANSIÓN (1818-1823)

Four expansion vectors. Towards Southeast and East Asia reaching Japan and China. Towards West Africa to Tanganyika and the Middle East from India to Astrakhan.



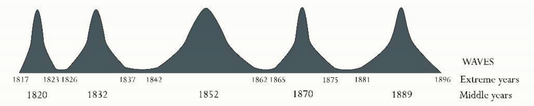
FIRST AND SECOND EXPANSION (1826-1837)

Eight expansion vectors. Towards the north of Europe, Berlin-London. Mediterranean Sea towards Spain. Cross Arabia. North Africa towards Tunisia. Towards America, New York, New Orleans, Mexico and the Caribbean.

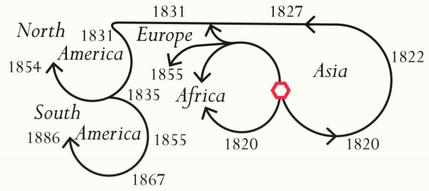


FIRST TO THIRD EXPANSION (1842-1862)

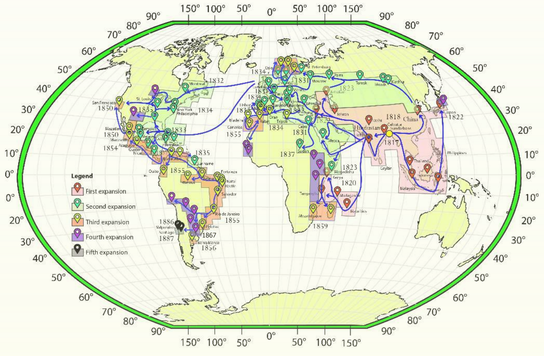
Eight expansion vectors. Towards Scandinavia. From Spain to Rabat. Towards Mozambique. Panama and coast of the Pacific Ocean towards San Francisco. South America, Ecuador, Amazon towards Manaus and Southern Brazil.



TEMPORAL EVOLUTION

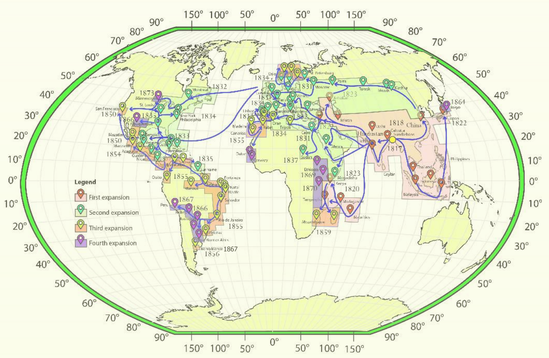


SPATIAL MODEL



FIFTH EXPANSIÓN (1881-1896)

One expansion vector. From Buenos Aires to Santiago de Chile and Valparaíso on the Pacífico Coast.



FIRST TO FOURTH EXPANSION (1865-1875)

Three expansion vectors. Northwest Africa towards Dakar-Guinea. River linearity from Paraguay and Brazil to Buenos Aires. Crossing South America from Paraguay to Peru.

tors end in Africa and Europe. The Middle East acts as a node distributing the vectors.

6. Global context

The spatio-temporal dynamics presented in the poster map can be considered an emergence of social, cultural and economic processes based on capitalist expansion (Buzai, 2023). Table 2 presents some relevant data from each period, such as the world population, cholera deaths in specific geographical areas and the context provided by the first and second industrial revolutions. New productive processes based on mechanization intensify international relations and their analysis from global history reveals important causal processes. (Olstein, 2015; Conrad, 2016). In this context, the development of transport (Vance Jr., 1990) extends European dominance centered on political-military conquest for the exploitation of natural resources and international trade.

7. Conclusions

In the course of this work it was possible to draw a global overview of the spatial evolution of cholera during the 19th century from its beginning in Hindustan (1817) to the end of the last wave of contagion in South America (1896).

The construction of the six maps showing the vectors of propagation, the main populations and the areas affected made it possible to define the synthetic spatial structure. This visible manifestation, in turn, emerges as a consequence of the industrial revolution and the capitalist expansion in terms of the exploitation of natural resources and the expansion of international trade. It encompasses various regional geographic spaces including most of the countries which cover the surface of our planet.

The first maps that represented the spatial behavior of the disease were made by physicians, statisticians, geographers and military authorities, giving us the possibility, many years later, to compile them to achieve a synthesis model of the global behavior. The poster map resulting from this application is presented as a structural result in Medical Geography.

The cholera pandemic was the most disturbing and the most studied of the 19th century. The advances made in its study include the combination of biological, medical and geographical aspects in a continuum that includes bacteria, societies and geographical spaces.

Spatial analysis provides an important perspective that helps to interpret the disease in its socio-spatial behavior and, in this sense, provides elements to better confront it, because as Marie Curie (1867-1934) said, *in life there are no things to fear, there are only things to understand*.

Acknowledgments and funding

We would like to thank Claudia A. Baxendale for critical reading of previous versions. Our gratitude also goes to Noelia Principi, Ernest Ruiz and Norma Sánchez for their bibliographical support. We further acknowledge the two anonymous reviewers who made it possible to improve the original article.

Tabla 2: Industrial Revolutions and Populations / Tabla 2. Revoluciones industriales y poblaciones

Period	**World Population***	**Number of Deaths by Geographical Area****	**Industrial Revolutions / First and second Kondratiev Waves*****
1817	1.07	**1817**: Bengal, Hindustan (507,500 km²) 200 in one day	**First Industrial Revolution** (1730–1850): Center: Great Britain. Energy: Coal. Industry: Textile (cotton) and steel (iron). Expansion of international trade: Railways, roads, and canals. Transport: Steamboats and steam locomotives. Communications: Telegraphy.
1818–1823	1.11	**1819**: Port Louis, Mauritius, 6,000 in three weeks. **1820**: Java Island, Philippines, 100,000 including Batavia 17,000. **1821**: Basra, Persian Gulf, 18,000 in three weeks.	
1826-1837	1.19	**1831**: Mecca, pilgrims 12,000. **1832**: England 5,432. Belgium 7,984. Quebec, Canada 1,000 in two weeks.	
1842-1862	1.35	**1846** (November): Mecca, 15,000. **1851**: Great Canary, Spain 9,000. **1852**: England 53,293.	
1865-1875	1.45	**1866**: Belgium 30,000. Bohemia-Moravia 80,000. Great Britain 14,378 (London: 5,596. Ireland: 2,501 and Scotland: 1,170). Guadalupe 12,000. Hungary 30,000. Netherlands 20,000. New Orleans 1,200. New York 2,000. Prussia 115,000. Russia 90,000. Sweden 4,503. USA 50,000. **1867**: Italy 130,000. Algeria 90,000. Bathurst, Australia 1,700. New Orleans 575. Zanzibar, Africa. **1869**: 70,000. **1872-1873**: Hungary 190,000. **1873**: German cities 33,156. **1875**: India 364,755.	**Second Industrial Revolution** (1870-1940) Center: Europe, USA and Japan Energy: Electricity and oil. Industry: electric power industry and automotive industry, ship (steel, machines and tools) Emerging transport: Rail and automotive. Comunications: Telephony
1881-1896	1.62	**1883**: Egypt 58,511. Naples, Italy.**1884**: 5,000 deaths in two months. Spain 592. Valencia-Murcia, **1885**: Spain 60.000. **1892**: Hamburg and Suburbs (Altona, Vandsbeck) 7,582; 328; 43. **1893**: Germany 396. **1896**: Germany 490. Egypt 16,000.	

*Data are presented in billions for the final year of each period. Sources: Maddison Project and United Nations, World Population Prospects 2019. **Consistent global data are not available. Partial studies exist for specific geographical areas. Source: Pollitzer (1959). ***Aligned with the Kondratiev Waves as described by Hall and Preston (1988).

This study was carried out on the topic of Spatial Analysis of Health and developed by Dr. Buzai for the National Scientific and Technical Research Council (CONICET) at the National University of Luján (UNLu), Argentina.

Referencias

Acland, H. W., 1856. Memoir on the cholera at Oxford, in the year 1854: with considerations suggested by the epidemic. John Churchill.

Benavides Quecán, J., 2008. El uso de métodos históricos de levantamiento topográfico y cartográfico en la elaboración de mapas confiables de ciudades: caso de estudio: Zwolle, Holanda. Scripta Nova: revista electrónica de geografía y ciencias sociales 8.

Butterfield, H., 1965. The Wigh Interpretation of History. The Norton Library.

Buzai, G. D., 2014. Análisis espacial en Geografía de la Salud. Lugar Editorial.

Buzai, G. D., 2020. The cholera map by John Snow (London, 1854): A health solution as a conceptual summary of Applied Geography. Anales de la Sociedad Científica Argentina 268 (2), 5–18.

Buzai, G. D., 2023. Expansión mundial del cólera en el Siglo XIX: Su modelización espacial. Anales de la Sociedad Científica Argentina 274 (3), 5–26.

Buzai, G. D., Santana Juárez, M. V., 2018. Métodos cuantitativos en Geografía Humana. Instituto de Investigaciones Geográficas, UNLu.

Chadwick, E. C., 1842. Reports from Commissioners, 1842. Sanitary Condition of the Labouring Population of Great Britain (Vol. XXVI).

Cheshire, J., 2022. Sewage alerts: The long history of using maps to hold water companies to account. The Conversation, Online, available at: https://theconversation.com/sewage-alerts-the-long-history-of-using-maps-to-hold-water-companies-to-account-189013. Accessed on August, 19.

Conrad, S., 2016. What Is Global History? Princeton University Press.

Desmadryl, A., 1831. Itinéraire du Colera Morbus en Pologne 1831.

Dutta, M., 2021. Cholera, British seamen and maritime anxieties in Calcutta, c.1830s – 1890s ´The William Bynum Prize Essay´. Medical History 65 (4), 313–329.

Gilbert, E. W., 1958. Pioneer maps of health and disease in England. The Geographical Journal 124 (2), 172–183.

Hall, P., Preston, P., 1988. The Carrier Wave. New Information Technology and the Geography of Innovation, 1846-2003. Unwin Hymann.

Harley, J. B., 2001. The new nature of maps: essays in the history of cartography. The John Hopkins University Press.

Jameson, J., 1820. Report on the epidemick cholera morbus, as it visited the territories subject to the Presidency of Bengal, in the years 1817, 1818, and 1819. A.G. Balfour.

Kellingsworth, L., 2017. Medical topography: Mapping Cholera in the Nineteenth Century. Barry Lawrence Ruderman Conference on Cartography, Stanford Libraries.

Koch, T., 2014. 1831: the map that launched the idea of global health. International Journal of Epidemiology 43 (4), 1014–1020, https://doi.org/10.1093/ije/dyu099.

May, J., 1951. Distribution of Cholera 1816-1950. Geographical Review 41 (2), map included, Atlas of distribution of diseases – plate 2.

Montes Galbán, E., 2024. Cartografía histórica y su valor científico en los estudios geográficos. Aportaciones teóricas y metodológicas. Anales de la Sociedad Científica Argentina 275 (2), 35–48.

Mulhern, O., 2020. Pandemic map: Cholera. Earth Org, accessed August 4, 2020. Available at https://earth.org.

Olstein, D., 2015. Thinking History Globally. Palgrave Macmillan.

Ormeling, F., 2014. Mapas temáticos. En: Ormeling, F., Rystedt, B. (Eds.), El mundo de los mapas. International Cartographic Association, pp. 40–50, recuperado de https://mapyear.icaci.org/el-mundo-de-los-mapas/index.html.

Osborne, J., 2010. Cholera. University of Pennsylvania Press, the Encyclopedia of Greater Philadelphia.

Petrella, M., 2020. Cartografia e storia del colera: gli itinerari epidemici nella produzione scientifica del primo Ottocento. StoricaMente 54, 1–16.

Piaget, J., 2007. La representación del mundo en el niño. Morata.

Picquet, C., Chateuneuf, L., 1834. Rapport sur la marche et les effets du cholera-morbus dans Paris et les communes Rurales du department de la Seine. Imprimeire Royale.

Pollitzer, R., 1959. Cholera. World Health Organization.

Polo Martín, B., 2022. El Mapa del cólera de John Snow, Cartografía Social y Urbana. EMSE EDAPP.

Pyle, G. F., 1969. The Diffusion of Cholera in the United States in the Nineteenth Century. Geographical Analysis 1 (1), 59–75.

Shapter, T., 1849. The history of cholera in Exeter in 1832. John Churchill.

Society, N. G., 1994. The World political [Mapa]. National Geographic Society, scale: 1:33.120.000.

Storms, M., 2020. Mapping epidemics: nineteenth-century cholera maps of Leiden. Universiteit Leiden, leidenspetialcollectionsblog.

Team, Q. D., 2022. QGIS. Un Sistema de Información Geográfica libre y de Código Abierto. Recuperado de https://qgis.org/es/site/.

Thrower, N. J. W., 1996. Maps and Civilization. The University of Chicago Press.

Vance Jr., J., 1990. Capturing the Horizon: The Historical Geography of Transportation since the Sixteenth Century. Johns Hopkins University Press.

Vaughan, L., 2020. Pathways of disease. Mapping Urban Form and Society Blog, https://urbanformation.wordpress.com/.

Weiland, C. F., 1832. CHOLERA-KARTE oder Uebersicht der progressive Verbreitung der Cholera seit ihrer Erscheinung im Jahr 1817 über Asien, Europe under Africa. Verlag des Geographischen Instituts.

Went, E. C., 1885. A Treatise on Asiatic Cholera. William Wood and Company.

This article accompanies the following material:
Static map: 10.22201/igg.25940694e.2024.2.118.6