Geog 126: Maps in Science and Society

Mapping Networks

Mapping Networks

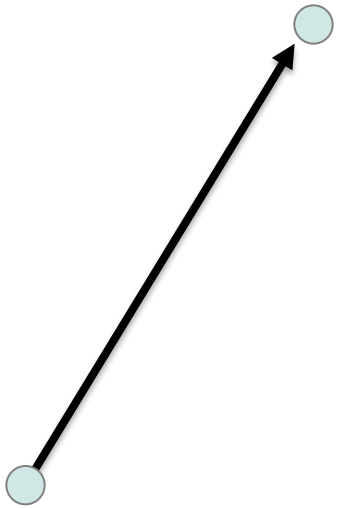
- What are Networks
- Elements of Network Mapping
- Schematic Maps
- A brief history
- Networks as state expansion: railroads and highways

Networks, Defined

- What is a network?
  - An interconnected group or system
  - a system of intersecting lines or channels; "a railroad network"; "a network of canals”
- Networks are important in geography and mapping
- Abstraction allows analysis and better mapping

Elements of Networks

- Networks are a collection of:
  - Nodes
    - AKA: Vertices
  - Edges
    - AKA: Links
  - Directions

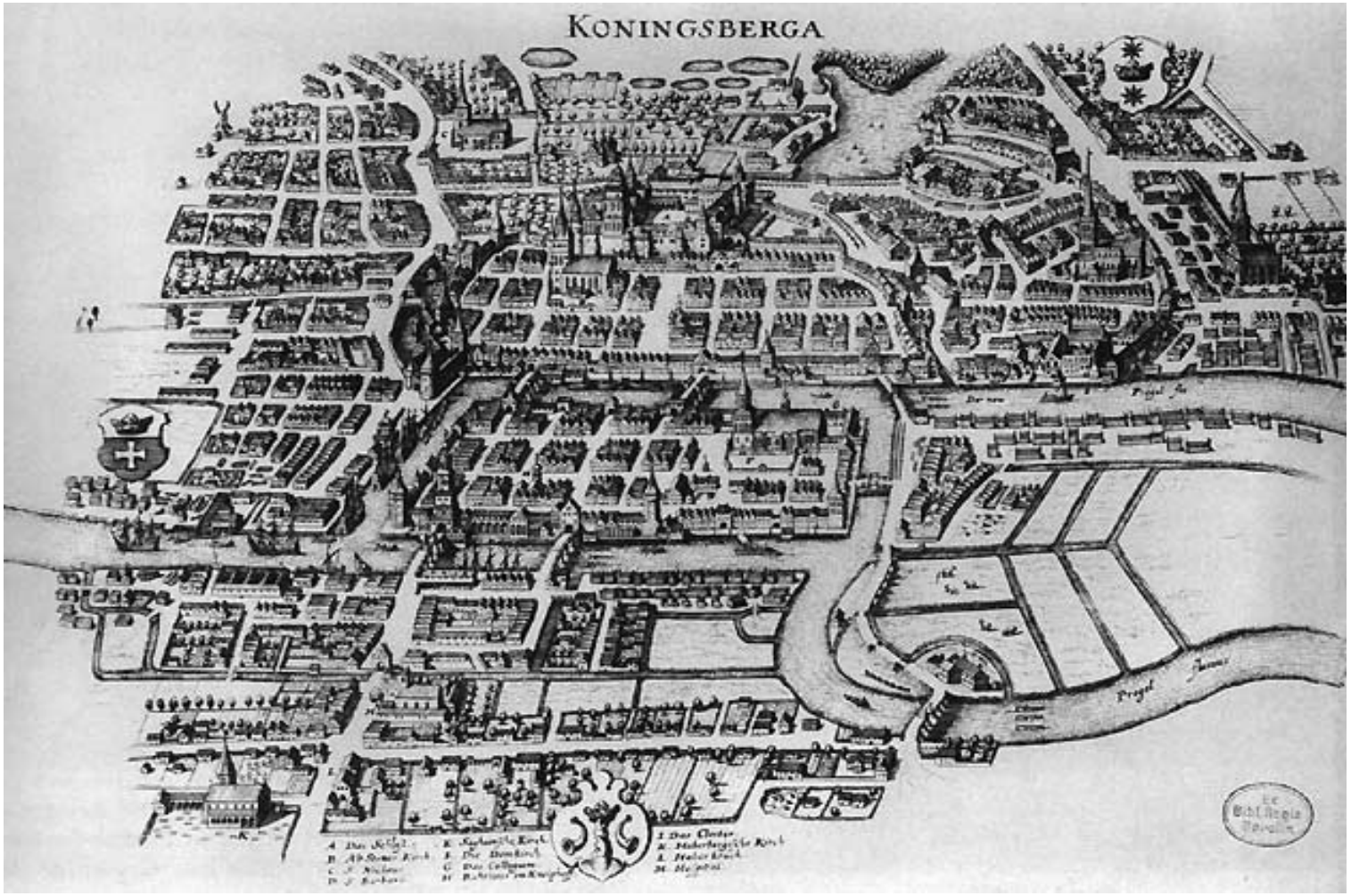


The Seven Bridges of Königsberg

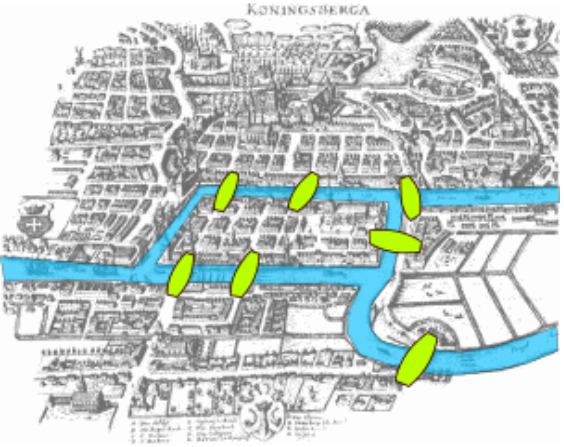
"The Seven Bridges of Königsberg is a historically notable problem in mathematics. Its negative resolution by Leonhard Euler in 1735 laid the foundations of graph theory and prefigured the idea of topology." Wikipedia

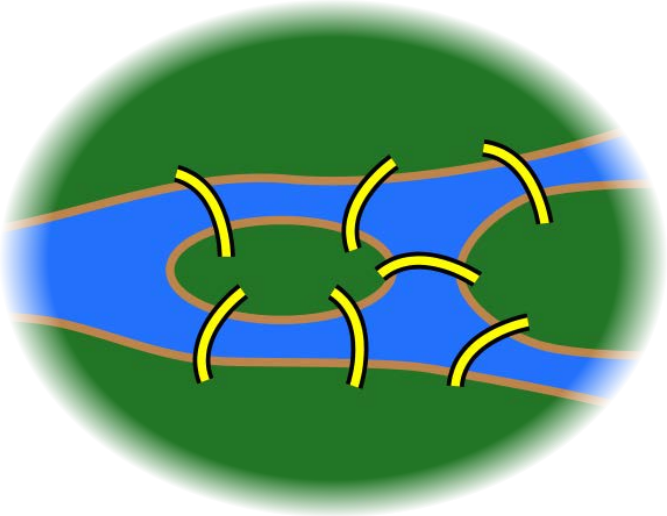
- Königsberg in Prussia (now Kaliningrad, Russia) was set on both sides of the Pregel River
- Two large islands, connected to each other and the mainland by seven bridges
- Is it possible to find a walk through the city that would cross each bridge once and only once?
- Islands can only be reached by the bridges
- Every bridge must have been crossed completely
- The walk need not start and end at the same spot

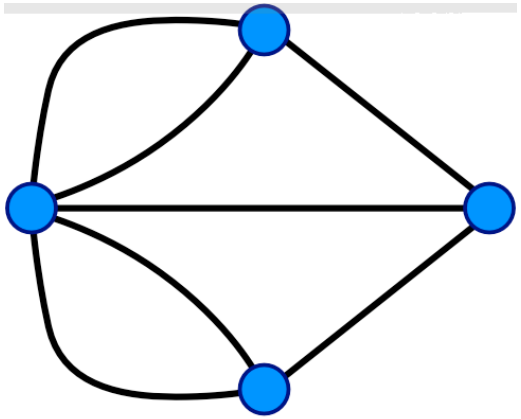
The Seven Bridges: 1651



The problem becomes simpler with abstraction….

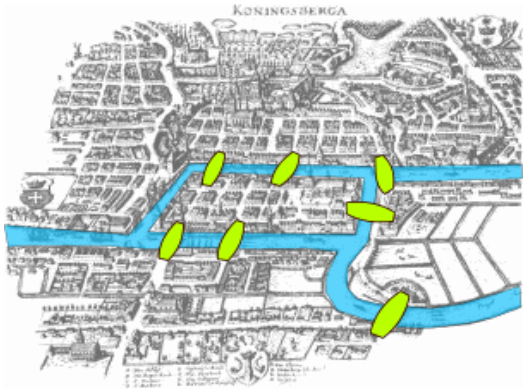






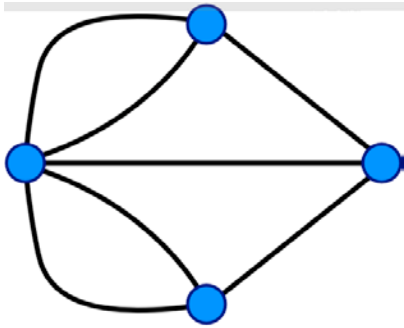
So, what's the solution?

- There is no solution! It is impossible.
- In 1736, Leonhard Euler proved it was impossible
- Invented "graph theory"
  - Eliminated all features except land masses and the bridges (nodes, edges)
- Work led on to topology

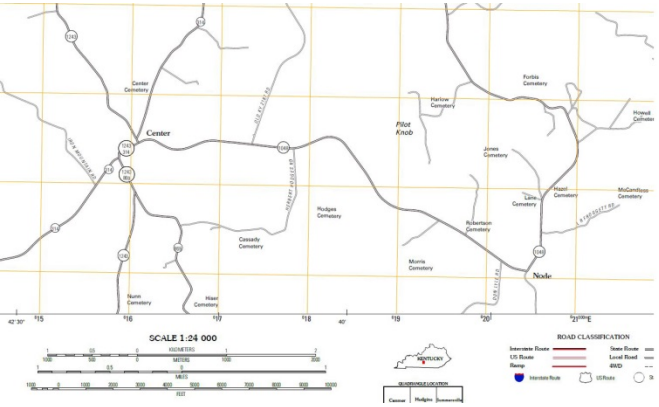


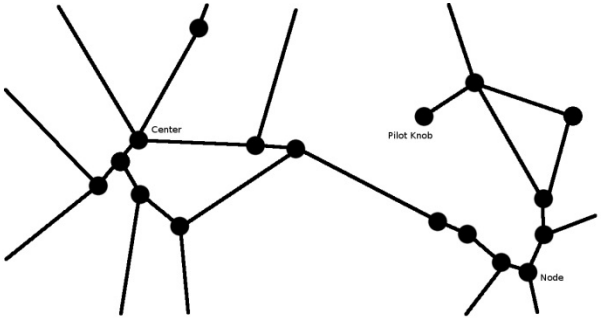
An Eulerian Path

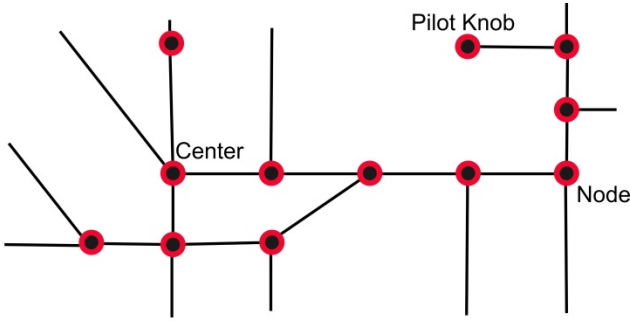
- Problem concerned degrees of nodes
  - Degree of a node is the number of edges that touch it
  - Konisberg: 1 5-degree node, 3 3-degree nodes
- Euler proved that a “circuit” is only possible if there are exactly 0 or 2 nodes of an odd degree
  - This type of walk is called a Eulerian Path



Roads near Center, Pennsylvania





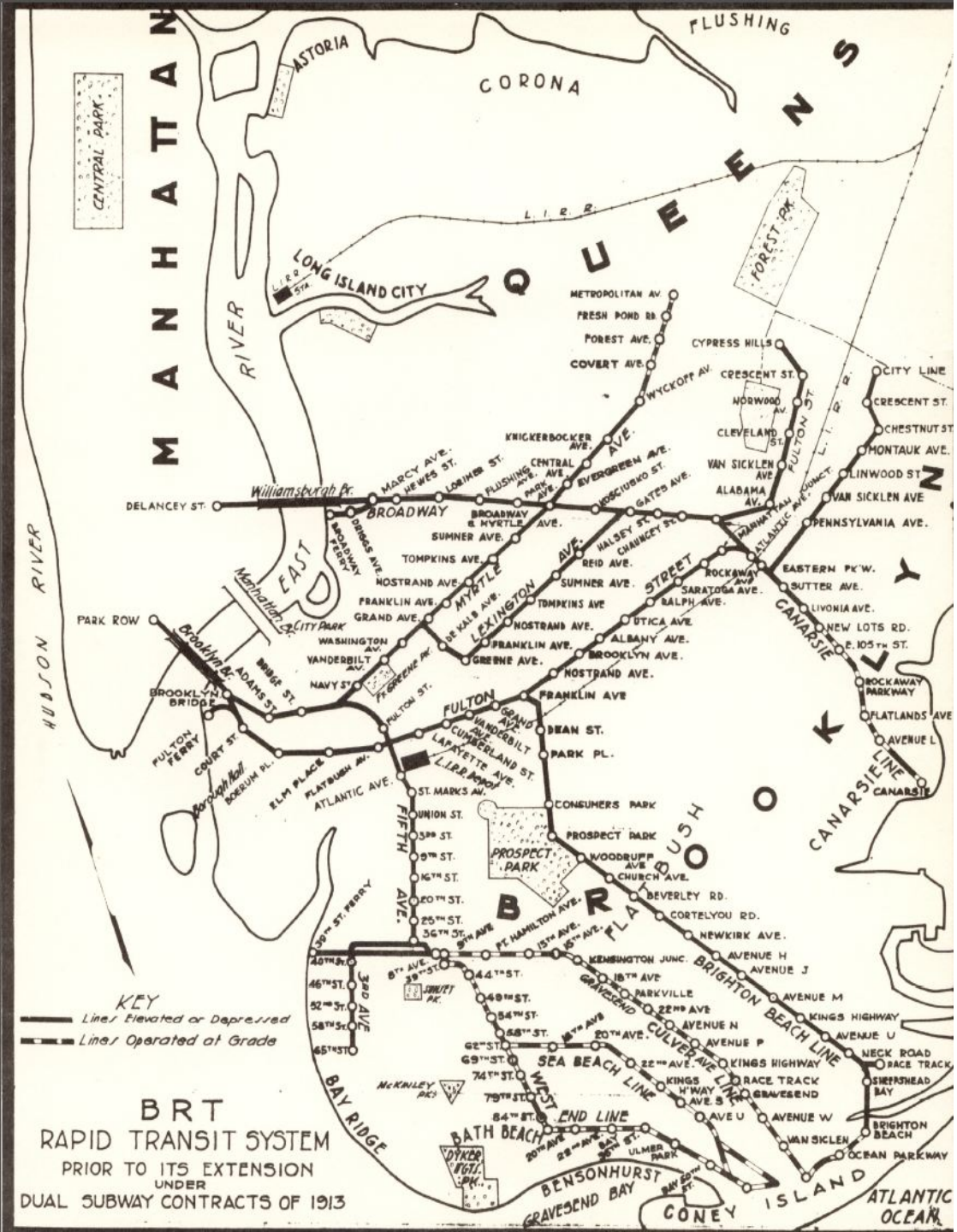


A modern equivalent

- Travel by car to each of the 48 contiguous U.S. States
- Visit each state in whatever order you chose, but start in Delaware
- Visit each state only once
- Do not go back into a state already visited
- What state do you finish up in?

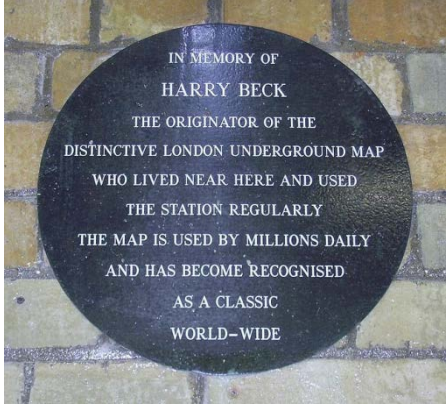
Networks

- Roads
- Rivers
- Pipelines
- Air travel
- Infrastructure—the grid, sewers, cable, gas
- Communications links, e.g. post offices, transmission towers
- Social media



Rapid Transit New York 1908

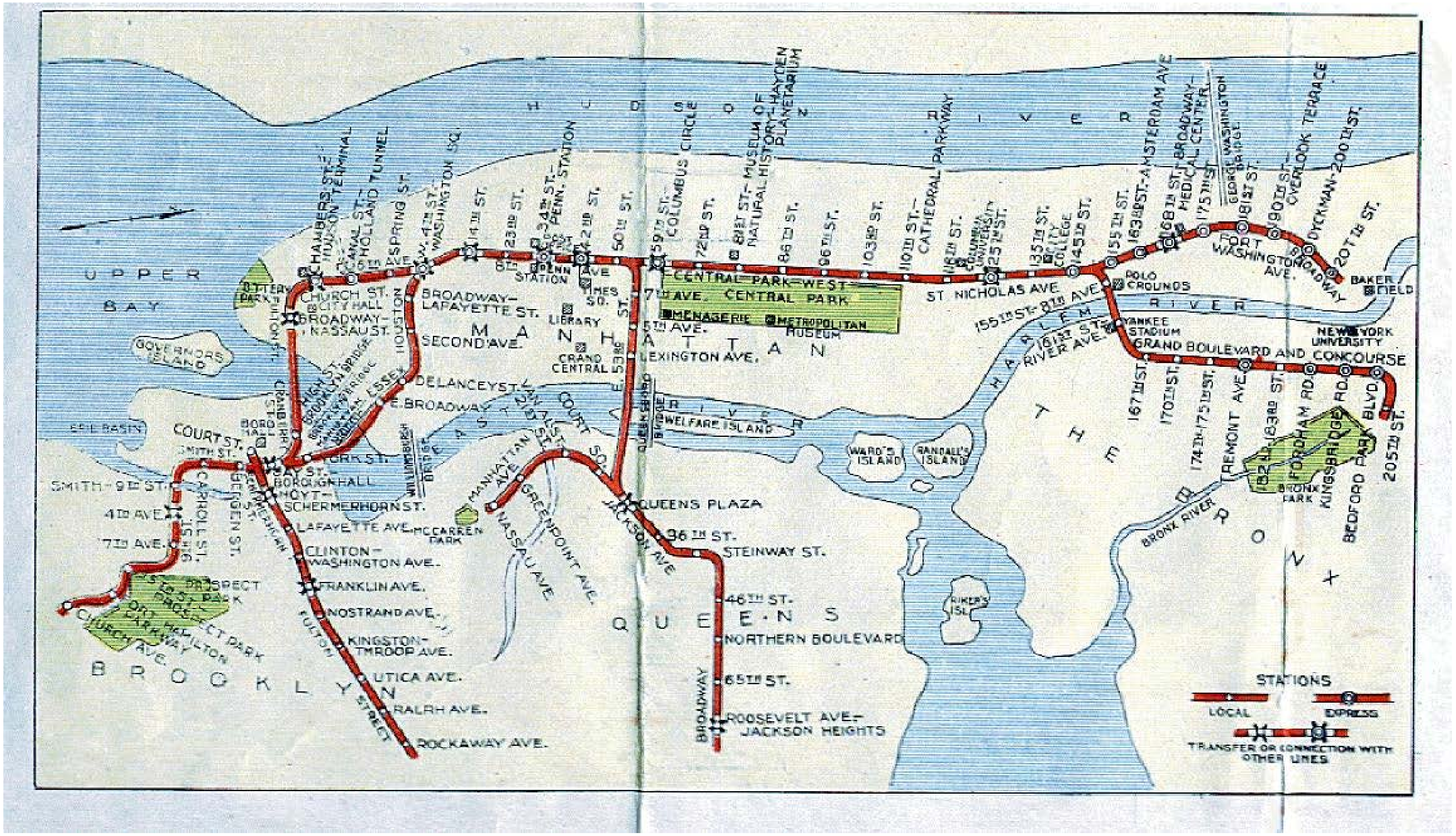
Harry Beck



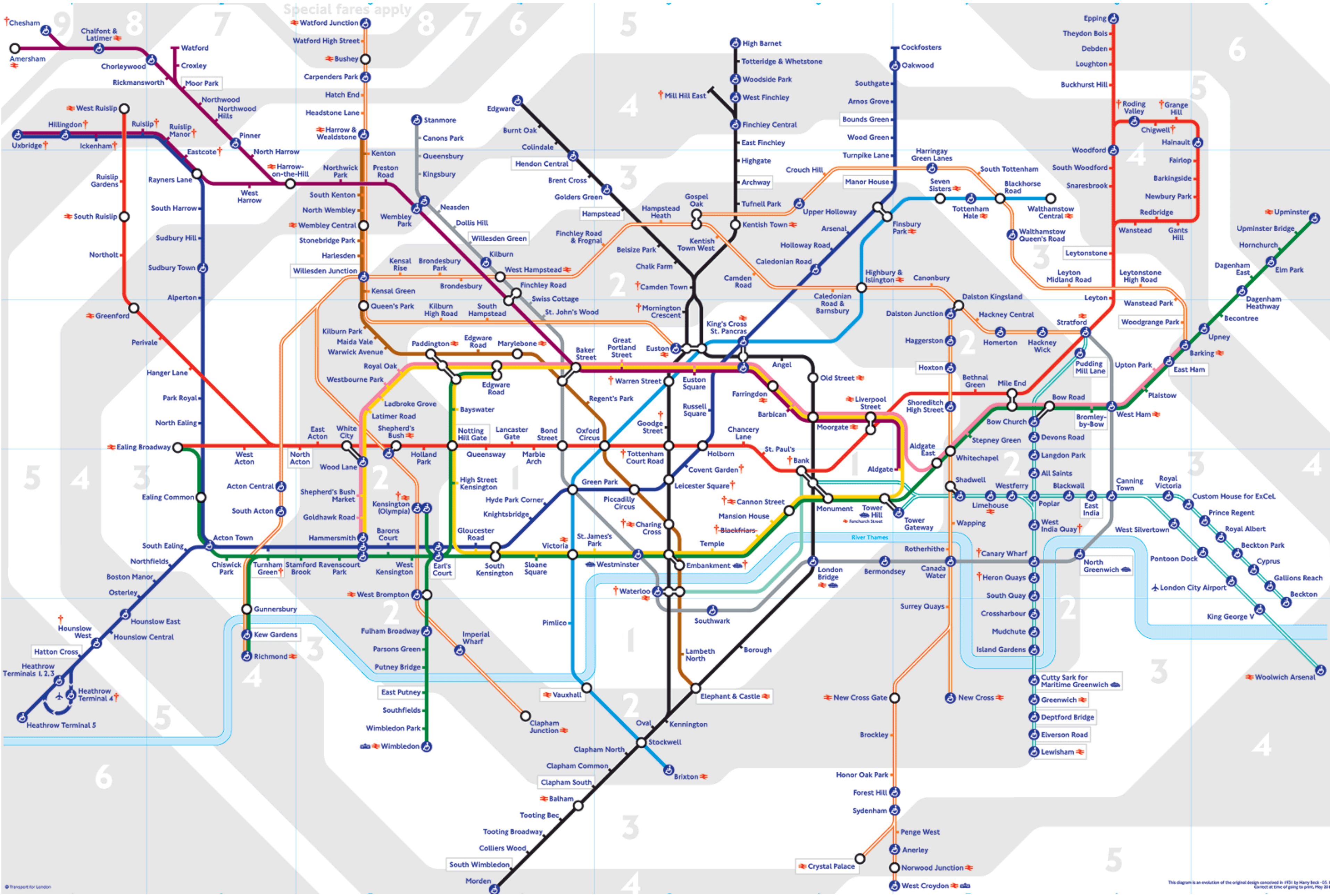
- Revised London Underground map, and revolutionized map design
- Henry Charles Beck (1902–1974) Electrical Draftsman, English
- Drew an electrical schematic on which all the stations were more or less equally spaced, angles simplified
- First submitted his idea to Frank Pick of London Underground in 1931,
- Considered too radical
- Trial production of 500 copies of Beck's map in 1932
- Full publication in 1933 (700,000 copies)
- Positive reaction of the travelers proved it to be sound design
- Large reprint after only one month

Beck's Original Design

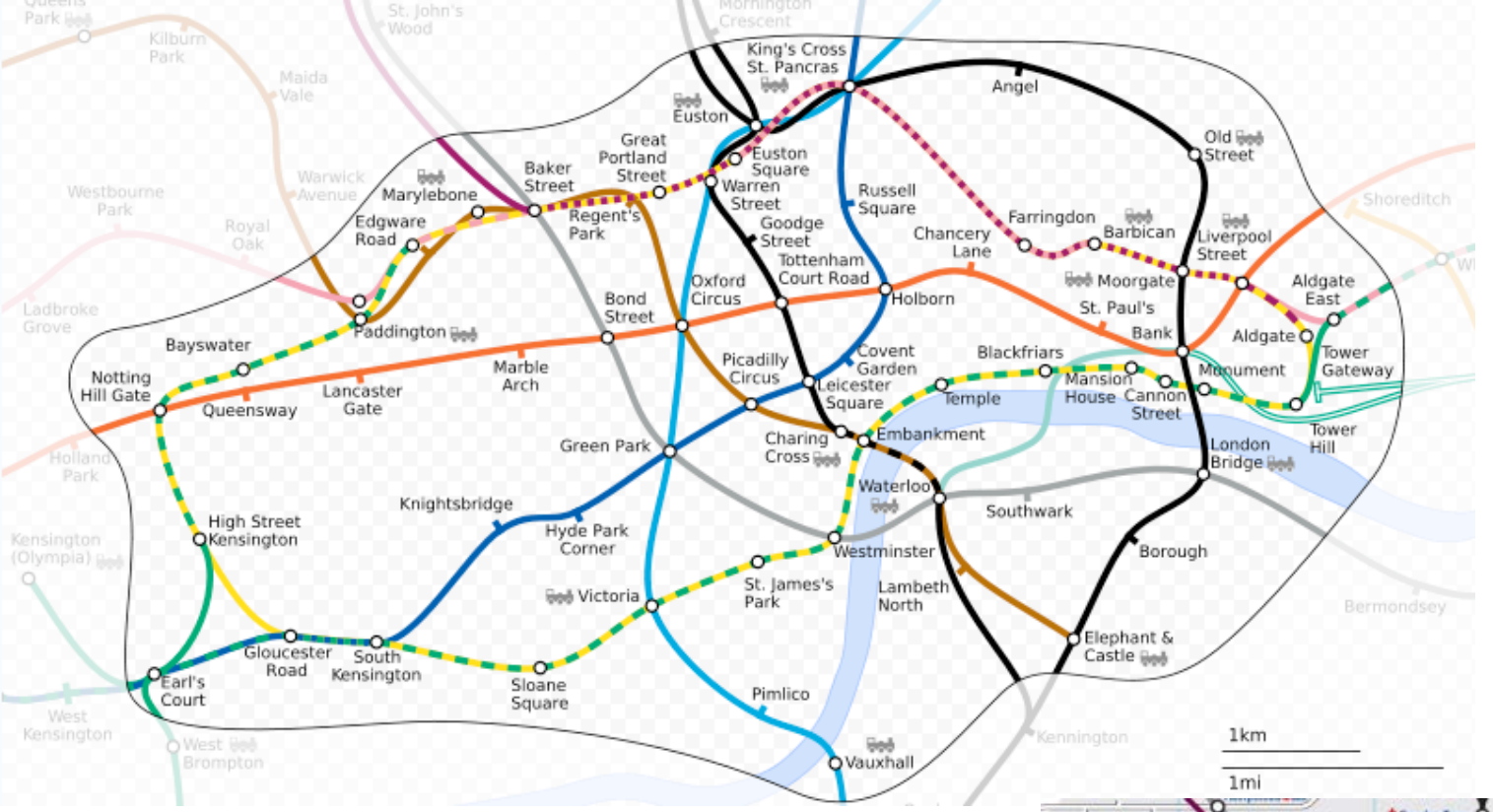
IND 1939



UPPER BAY
GOVERNORS ISLAND
MANHATTAN
BROOKLYN
QUEENS
HUDSON RIVER
EAST RIVER
HARLEM RIVER
CENTRAL PARK
CHAMBERS ST.–HUDSON TERMINAL
CANAL ST.–HOLLAND TUNNEL
SPRING ST.
W. 4TH ST.–WASHINGTON SQ.
14TH ST.
23RD ST.
34TH ST.–PENN. STATION
42ND ST.
50TH ST.
59TH ST.–COLUMBUS CIRCLE
72ND ST.
81ST ST.–MUSEUM OF NATURAL HISTORY–HAYDEN PLANETARIUM
86TH ST.
96TH ST.
103RD ST.
110TH ST.–CATHEDRAL PARKWAY
135TH ST.
145TH ST.
155TH ST.
163RD ST.–AMSTERDAM AVE.
168TH ST.–BROADWAY–MEDICAL CENTER
175TH ST.
181ST ST.
190TH ST.–OVERLOOK TERRACE
DYCKMAN–200TH ST.
207TH ST.
FORT WASHINGTON AVE.
BROADWAY
BAKER FIELD
POLO GROUNDS
ST NICHOLAS AVE
155TH ST–8TH AVE.
161ST ST.–RIVER AVE.
YANKEE STADIUM
NEW YORK UNIVERSITY
GRAND BOULEVARD AND CONCOURSE
167TH ST.
170TH ST.
174TH–175TH ST.
TREMONT AVE.
182ND–183RD ST.
FORDHAM RD.
KINGSBRIDGE RD.
BEDFORD PARK BLVD.
205TH ST.
BRONX PARK
BRONX RIVER
CENTRAL PARK–WEST
7TH AVE.
5TH AVE.
LEXINGTON AVE.
MENAGERIE
METROPOLITAN MUSEUM
GRAND CENTRAL
LIBRARY
BATTERY PARK
CHURCH ST.
CITY HALL
BROADWAY–NASSAU ST.
BROADWAY–LAFAYETTE ST.
SECOND AVE.
HOUSTON
ESSEX
DELANCEY ST.
E. BROADWAY
HIGH ST.–BROOKLYN BRIDGE
YORK ST.
COURT ST.
BORO HALL
JAY ST.–BOROUGH HALL
HOYT–SCHERMERHORN ST.
LAFAYETTE AVE.
McCARREN PARK
CLINTON–WASHINGTON AVE.
FRANKLIN AVE.
NOSTRAND AVE.
KINGSTON–THROOP AVE.
UTICA AVE.
RALPH AVE.
ROCKAWAY AVE.
FULTON STREET
SMITH–9TH ST.
4TH AVE.
7TH AVE.
CARROLL ST.
BERGEN ST.
PROSPECT PARK
CHURCH AVE.
ERIE BASIN
WILLIAMSBURGH BRIDGE
QUEENSBORO BRIDGE
WELFARE ISLAND
WARD'S ISLAND
RANDALL'S ISLAND
RIKER'S ISL.
MANHATTAN AVE.
NASSAU AVE.
GREENPOINT AVE.
VAN ALST
COURT SQ.
QUEENS PLAZA
JACKSON AVE
36TH ST.
STEINWAY ST.
46TH ST.
NORTHERN BOULEVARD
65TH ST.
ROOSEVELT AVE.–JACKSON HEIGHTS
STATIONS
LOCAL
EXPRESS
TRANSFER OR CONNECTION WITH OTHER LINES



Special fares apply
Chesham
Amersham
Chalfont & Latimer
Chorleywood
Rickmansworth
Watford
Croxley
Moor Park
Northwood
Northwood Hills
Pinner
North Harrow
Harrow-on-the-Hill
West Harrow
West Ruislip
Hillingdon
Uxbridge
Ickenham
Ruislip
Ruislip Manor
Eastcote
Ruislip Gardens
Rayners Lane
South Ruislip
South Harrow
Northolt
Sudbury Hill
Sudbury Town
Alperton
Greenford
Perivale
Hanger Lane
Park Royal
North Ealing
Ealing Broadway
West Acton
North Acton
East Acton
White City
Ealing Common
Acton Central
South Acton
Acton Town
South Ealing
Northfields
Boston Manor
Osterley
Hounslow East
Hounslow West
Hounslow Central
Hatton Cross
Heathrow Terminals 1, 2, 3
Heathrow Terminal 4
Heathrow Terminal 5
Chiswick Park
Turnham Green
Stamford Brook
Ravenscourt Park
Gunnersbury
Kew Gardens
Richmond
Watford Junction
Watford High Street
Bushey
Carpenders Park
Hatch End
Headstone Lane
Harrow & Wealdstone
Kenton
Preston Road
Northwick Park
South Kenton
North Wembley
Wembley Central
Wembley Park
Stonebridge Park
Harlesden
Willesden Junction
Kensal Green
Queen's Park
Kilburn Park
Maida Vale
Warwick Avenue
Royal Oak
Westbourne Park
Ladbroke Grove
Latimer Road
Shepherd's Bush
Wood Lane
Shepherd's Bush Market
Goldhawk Road
Hammersmith
Kensington (Olympia)
Barons Court
West Kensington
Earl's Court
West Brompton
Fulham Broadway
Parsons Green
Putney Bridge
East Putney
Southfields
Wimbledon Park
Wimbledon
Imperial Wharf
Clapham Junction
Stanmore
Canons Park
Queensbury
Kingsbury
Neasden
Dollis Hill
Willesden Green
Kilburn
West Hampstead
Finchley Road
Swiss Cottage
St. John's Wood
Kensal Rise
Brondesbury Park
Brondesbury
Kilburn High Road
South Hampstead
Edgware
Burnt Oak
Colindale
Hendon Central
Brent Cross
Golders Green
Hampstead
Belsize Park
Chalk Farm
Camden Town
Mornington Crescent
Finchley Road & Frognal
Hampstead Heath
Gospel Oak
Kentish Town West
Kentish Town
Camden Road
Caledonian Road & Barnsbury
Caledonian Road
Holloway Road
Arsenal
High Barnet
Totteridge & Whetstone
Woodside Park
West Finchley
Mill Hill East
Finchley Central
East Finchley
Highgate
Archway
Tufnell Park
Upper Holloway
Crouch Hill
Cockfosters
Oakwood
Southgate
Arnos Grove
Bounds Green
Wood Green
Turnpike Lane
Manor House
Harringay Green Lanes
South Tottenham
Seven Sisters
Tottenham Hale
Blackhorse Road
Walthamstow Central
Walthamstow Queen's Road
Finsbury Park
Highbury & Islington
Canonbury
Dalston Kingsland
Dalston Junction
Haggerston
Hoxton
Hackney Central
Homerton
Hackney Wick
Leyton Midland Road
Leytonstone High Road
Leytonstone
Leyton
Stratford
Wanstead Park
Woodgrange Park
Epping
Theydon Bois
Debden
Loughton
Buckhurst Hill
Roding Valley
Grange Hill
Chigwell
Hainault
Fairlop
Barkingside
Newbury Park
Woodford
South Woodford
Snaresbrook
Redbridge
Wanstead
Gants Hill
Upminster
Upminster Bridge
Hornchurch
Elm Park
Dagenham East
Dagenham Heathway
Becontree
Upney
Barking
East Ham
Upton Park
Plaistow
West Ham
Bromley-by-Bow
Pudding Mill Lane
Paddington
Edgware Road
Marylebone
Baker Street
Great Portland Street
Euston
Euston Square
King's Cross St. Pancras
Warren Street
Regent's Park
Goodge Street
Russell Square
Bayswater
Notting Hill Gate
Lancaster Gate
Bond Street
Oxford Circus
Queensway
Marble Arch
Holland Park
Tottenham Court Road
Holborn
Covent Garden
Leicester Square
Chancery Lane
Farringdon
Barbican
Angel
Old Street
Moorgate
Liverpool Street
St. Paul's
Bank
Aldgate
Aldgate East
Shoreditch High Street
Whitechapel
Bethnal Green
Mile End
Bow Road
Bow Church
Stepney Green
Devons Road
Langdon Park
All Saints
Shadwell
Westferry
Limehouse
Poplar
Blackwall
East India
Canning Town
Royal Victoria
Custom House for ExCeL
Prince Regent
Royal Albert
Beckton Park
Cyprus
Gallions Reach
Beckton
West Silvertown
Pontoon Dock
London City Airport
King George V
Woolwich Arsenal
North Greenwich
West India Quay
Canary Wharf
Heron Quays
South Quay
Crossharbour
Mudchute
Island Gardens
Cutty Sark for Maritime Greenwich
Greenwich
Deptford Bridge
Elverson Road
Lewisham
High Street Kensington
Hyde Park Corner
Knightsbridge
Gloucester Road
South Kensington
Sloane Square
Green Park
Piccadilly Circus
Charing Cross
Victoria
St. James's Park
Westminster
Embankment
Temple
Blackfriars
Mansion House
Cannon Street
Monument
Tower Hill
Fenchurch Street
Tower Gateway
River Thames
London Bridge
Bermondsey
Canada Water
Rotherhithe
Wapping
Surrey Quays
Waterloo
Southwark
Lambeth North
Borough
Elephant & Castle
Pimlico
Vauxhall
Oval
Kennington
Stockwell
Brixton
Clapham North
Clapham Common
Clapham South
Balham
Tooting Bec
Tooting Broadway
Colliers Wood
South Wimbledon
Morden
New Cross Gate
New Cross
Brockley
Honor Oak Park
Forest Hill
Sydenham
Penge West
Anerley
Crystal Palace
Norwood Junction
West Croydon
© Transport for London
This diagram is an evolution of the original design conceived in 1931 by Harry Beck

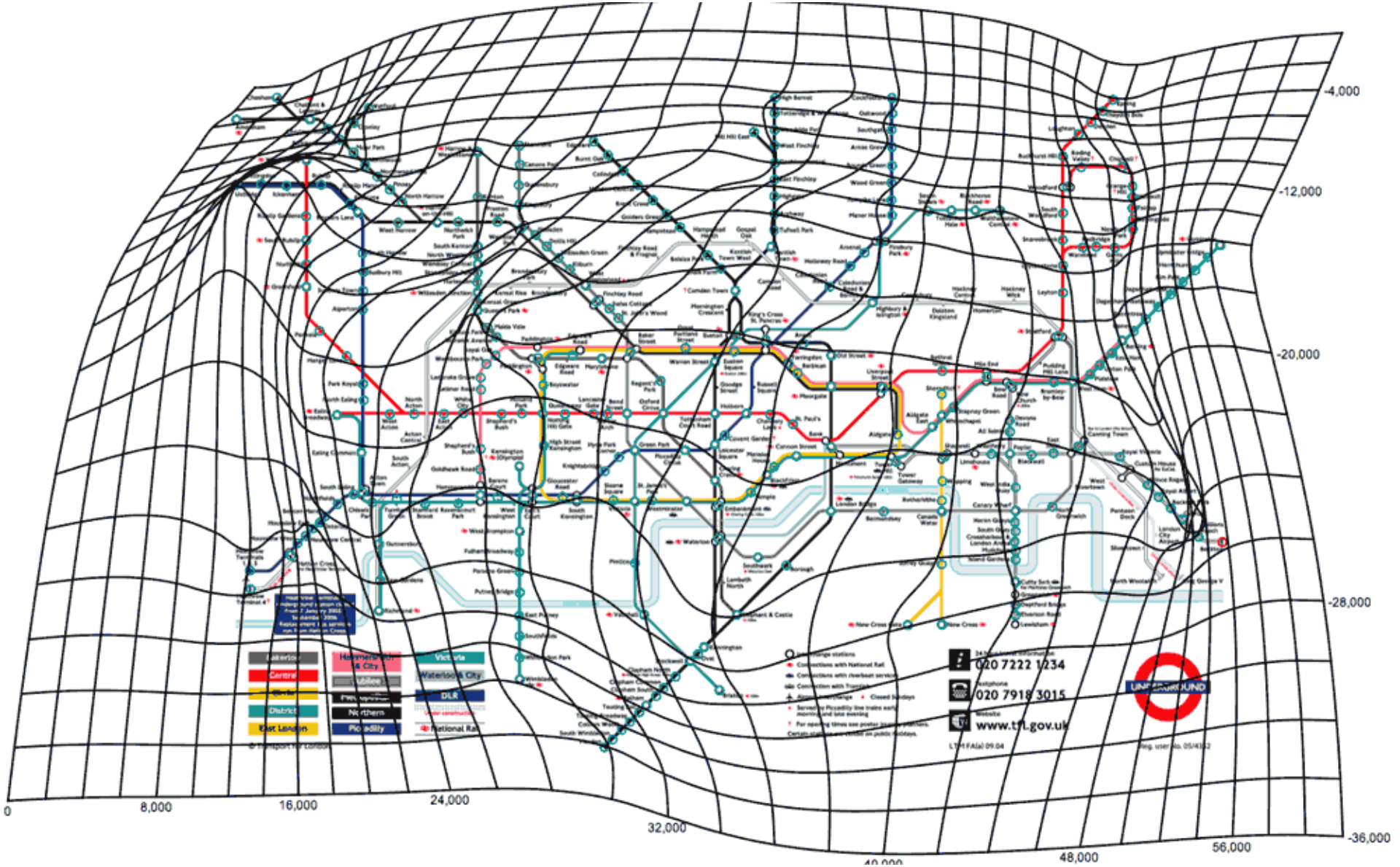

King's Cross St. Pancras
Angel
Euston
Old Street
Great Portland Street
Euston Square
Baker Street
Warren Street
Russell Square
Marylebone
Regent's Park
Farringdon
Barbican
Liverpool Street
Edgware Road
Goodge Street
Chancery Lane
Tottenham Court Road
Moorgate
Aldgate East
Oxford Circus
Holborn
St. Paul's
Bond Street
Paddington
Bank
Aldgate
Bayswater
Covent Garden
Blackfriars
Tower Gateway
Picadilly Circus
Monument
Notting Hill Gate
Marble Arch
Leicester Square
Mansion House
Cannon Street
Temple
Queensway
Lancaster Gate
Embankment
Tower Hill
Charing Cross
Green Park
London Bridge
Waterloo
Knightsbridge
Southwark
High Street Kensington
Hyde Park Corner
Westminster
Borough
St. James's Park
Victoria
Lambeth North
Gloucester Road
South Kensington
Elephant & Castle
Earl's Court
Sloane Square
Pimlico
Vauxhall
1km
1mi

Direct descendents

Washington DC

Octilinearity

- Every line on the map is drawn in one of 8 directions
  - Multiples of 45 degrees
  - Octilinearity
  - Reduces geographic congruence, increases clarity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Bakerloo
Central
Circle
District
East London
Hammersmith & City
Jubilee
Metropolitan
Northern
Piccadilly
Victoria
Waterloo & City
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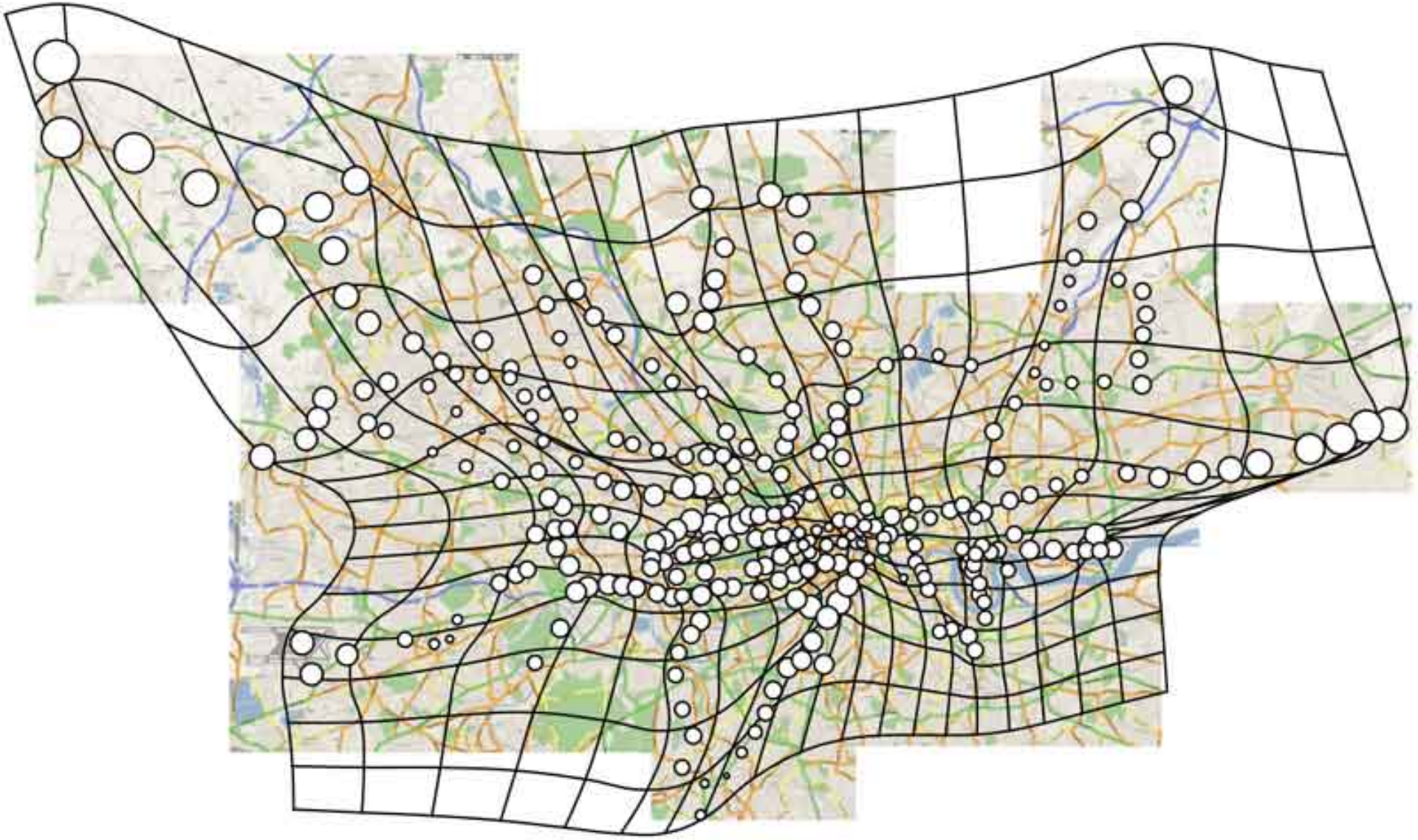
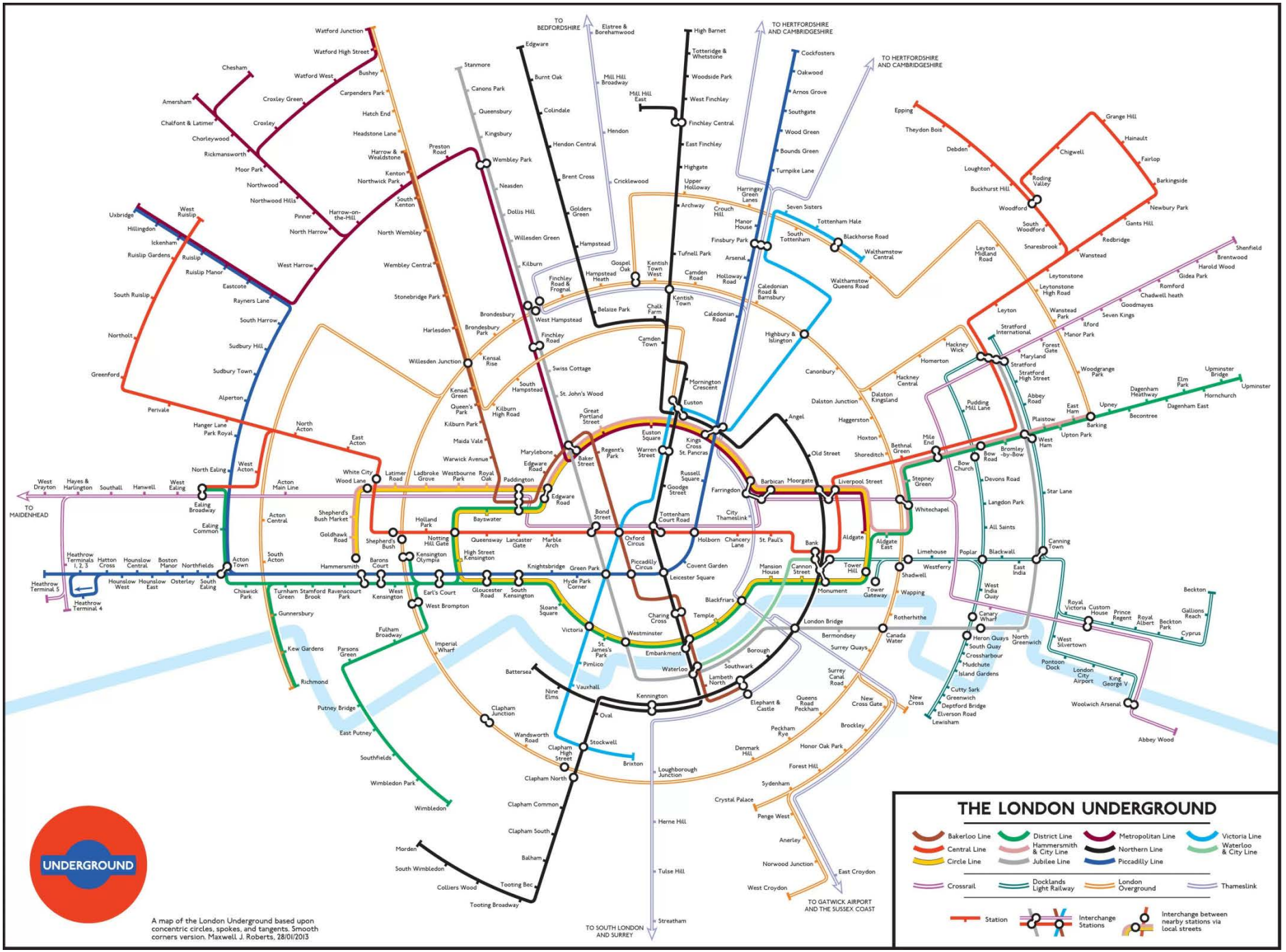


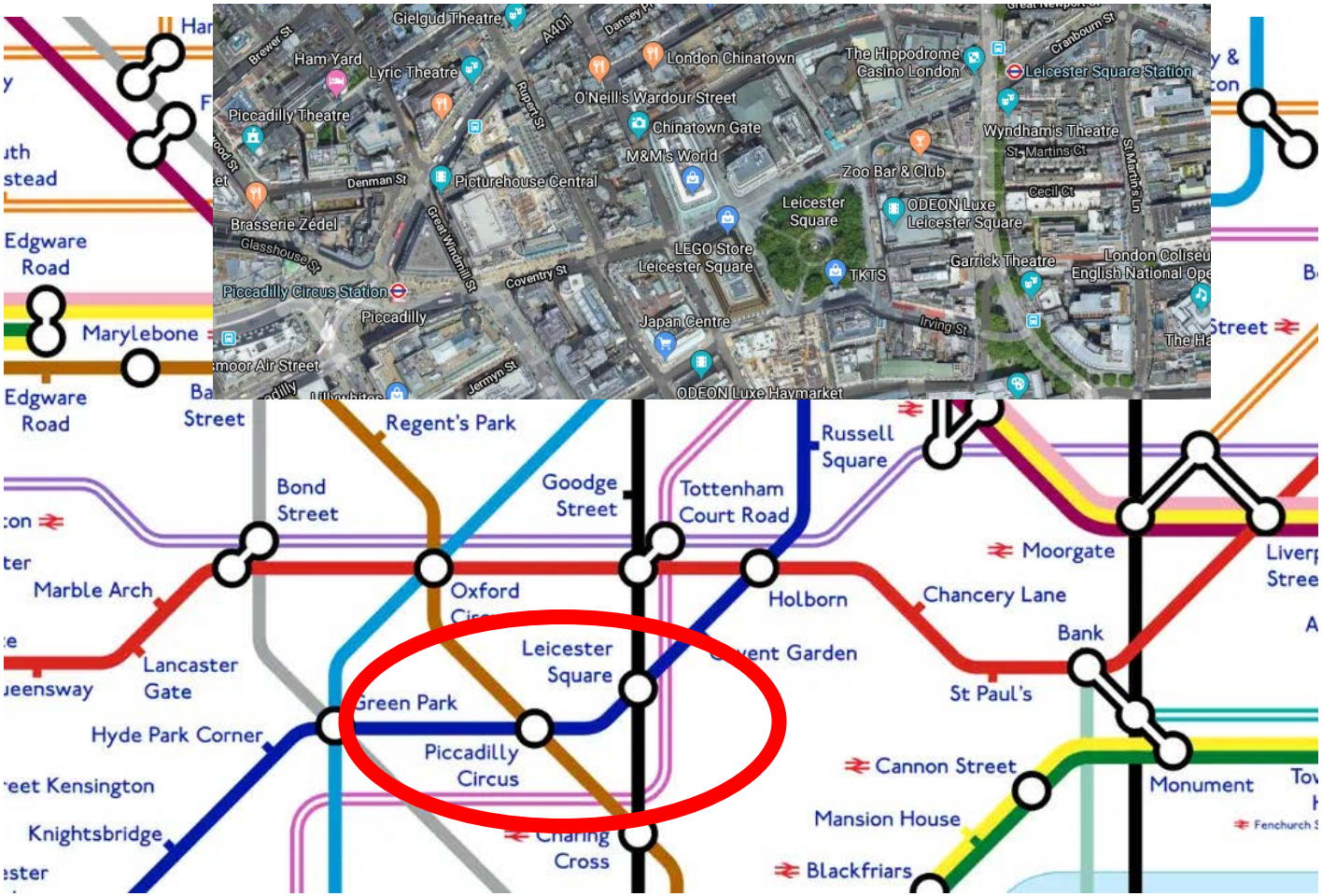
New Circular Underground Map


TO BEDFORDSHIRE
TO HERTFORDSHIRE AND CAMBRIDGESHIRE
TO HERTFORDSHIRE AND CAMBRIDGESHIRE
TO MAIDENHEAD
TO SOUTH LONDON AND SURREY
TO GATWICK AIRPORT AND THE SUSSEX COAST
THE LONDON UNDERGROUND
Bakerloo Line
Central Line
Circle Line
District Line
Hammersmith & City Line
Jubilee Line
Metropolitan Line
Northern Line
Piccadilly Line
Victoria Line
Waterloo & City Line
Crossrail
Docklands Light Railway
London Overground
Thameslink
Station
Interchange Stations
Interchange between nearby stations via local streets
UNDERGROUND
A map of the London Underground based upon concentric circles, spokes, and tangents. Smooth corners version. Maxwell J. Roberts, 28/01/2013

Dangers of the schematic style

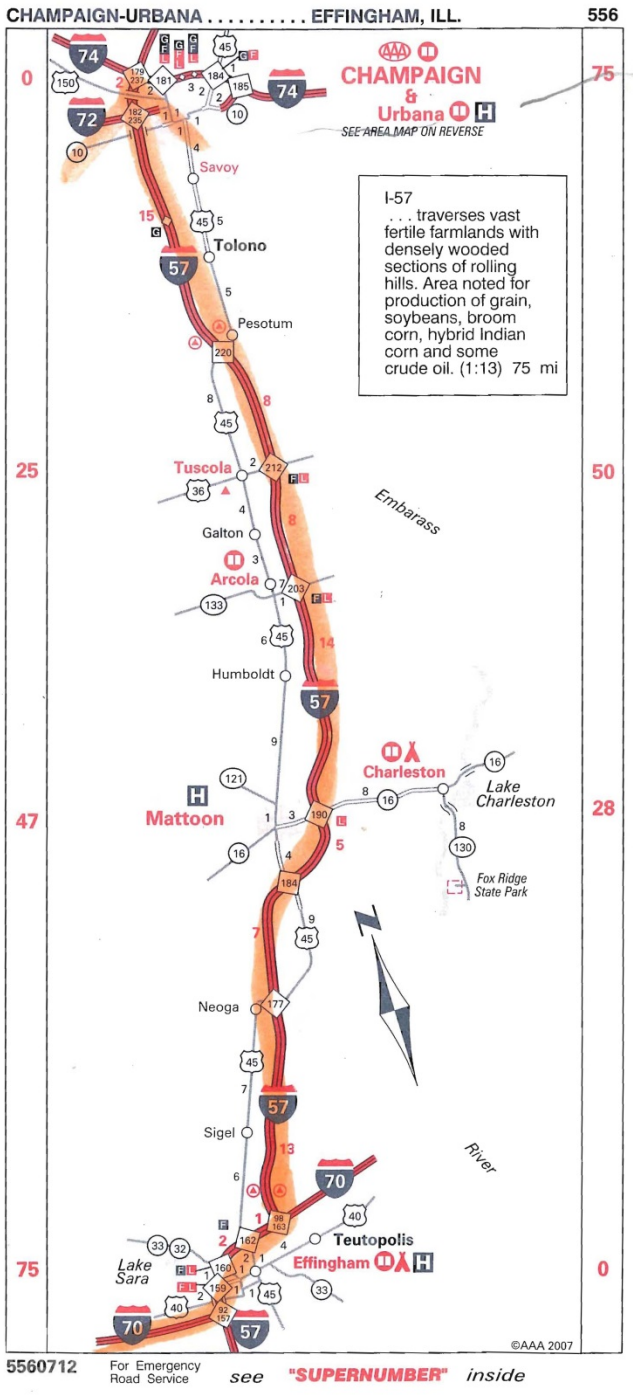
- Results in warped mental maps of actual geography
  - Distance and direction are inaccurate
  - Walking station to station often much shorter/longer than believed
  - North-South and East-West errors
- Leads to longer trips than necessary
- Does this apply in vehicle navigation systems?
- Hierarchy effect

Picadilly Circus to Leicester Square: 39 seconds

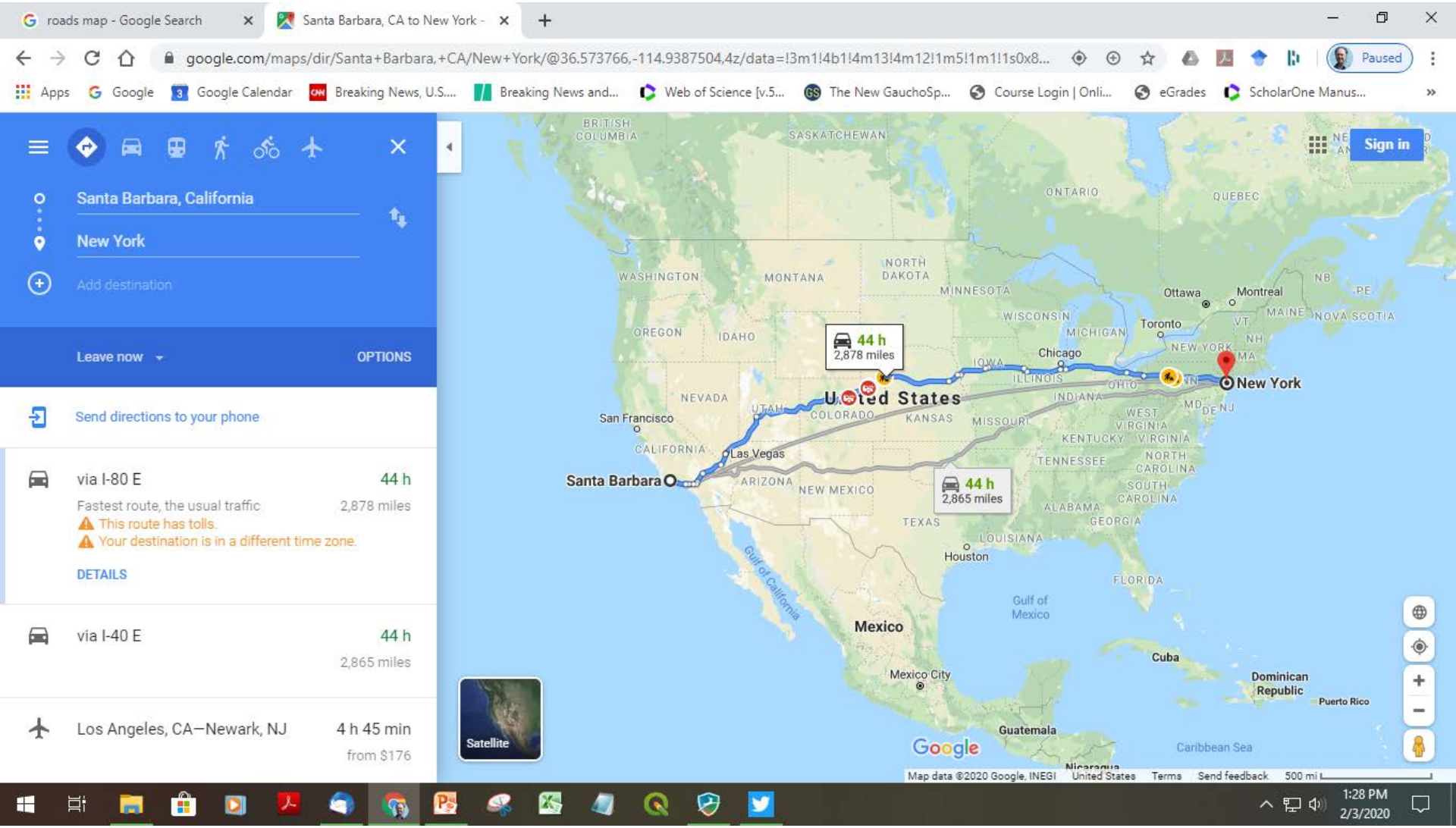


Triptik maps

- Patented by AAA in 1932
- Offered personalized maps for trips
- Offered online since 2000

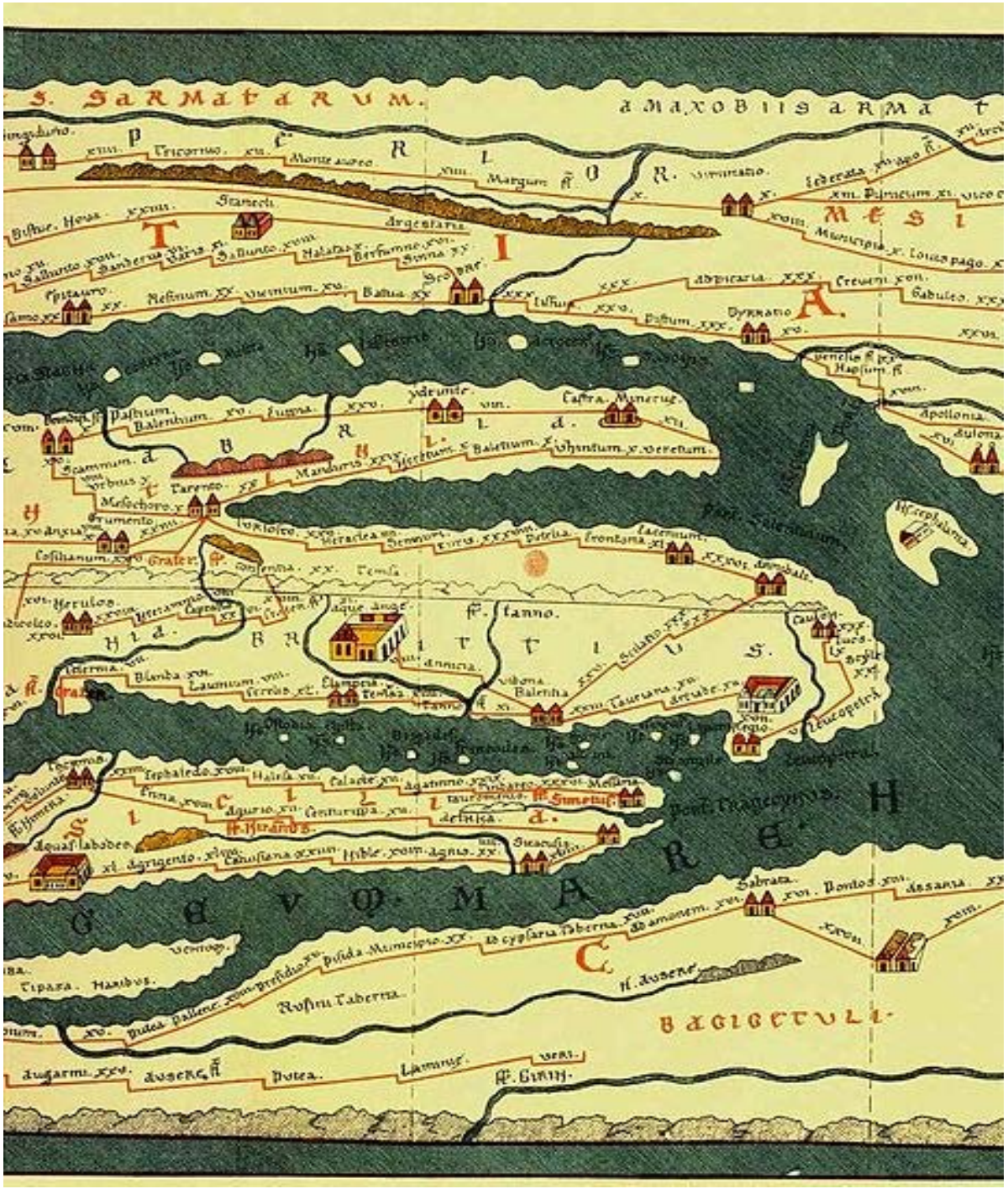


Google maps: Routing



Peutinger's table

- Tabula Peutingeriana: an itinerarium showing the cursus publicus the road network of the Roman Empire
- Original map was last revised in the fourth or early fifth century
- Covers Europe, parts of Asia (Persia, India) and North Africa
- Named for Konrad Peutinger, a German 15–16th-century humanist and antiquarian
- Original discovered in a library in Worms by Conrad Celtes, who bequeathed the map in 1508 to Peutinger
- Now in the Österreichische Nationalbibliothek, Vienna


S. SARMATARVM.
A MAXOBIIS ARMA
TIRRENVM
MESI
ADRIATICVM
MARE
GETVLIA
BAGIGETVLI
Tarento
Brundusium
Hydruntum
Castra Minerue
Apollonia
Dyrrachio
Tarentum
Messapia
Mare Tyrrhenum
Mare Ionium
Mare Creticum
Mare Siculum
Mare Libycum
Mare Tripolitanum
Mare Egyptium
Mare Cretense
Mare Pamphylium
Mare Pisidium
Mare Cilicium
Mare Syriacum
Mare Palestinum
Mare Aegyptium
Mare Cyrenaicum
Mare Libycum
Mare Numidicum
Mare Mauritanicum
Mare Balearicum
Mare Sardoum
Mare Ligusticum
Mare Gallicum
Mare Hispanicum
Mare Atlanticum
Mare Britannicum
Mare Germanicum
Mare Cimbricum
Mare Scythicum
Mare Caspium
Mare Rubrum
Mare Persicum
Mare Indicum
Mare Arabicum
Mare Aethiopicum
Mare Erythraeum
Mare Barbaricum
Mare Sinicum
Mare Australe
Mare Pacificum
Mare Magellanicum
Mare Antarcticum
Mare Glaciale
Mare Boreale
Mare Occidentale
Mare Orientale
Mare Meridionale
Mare Septentrionale
Mare Mediterraneum
Mare Adriaticum
Mare Aegaeum
Mare Ionium
Mare Tyrrhenum
Mare Siculum
Mare Libycum
Mare Tripolitanum
Mare Egyptium
Mare Cretense
Mare Pamphylium
Mare Pisidium
Mare Cilicium
Mare Syriacum
Mare Palestinum
Mare Aegyptium
Mare Cyrenaicum
Mare Libycum
Mare Numidicum
Mare Mauritanicum
Mare Balearicum
Mare Sardoum
Mare Ligusticum
Mare Gallicum
Mare Hispanicum
Mare Atlanticum
Mare Britannicum
Mare Germanicum
Mare Cimbricum
Mare Scythicum
Mare Caspium
Mare Rubrum
Mare Persicum
Mare Indicum
Mare Arabicum
Mare Aethiopicum
Mare Erythraeum
Mare Barbaricum
Mare Sinicum
Mare Australe
Mare Pacificum
Mare Magellanicum
Mare Antarcticum
Mare Glaciale
Mare Boreale
Mare Occidentale
Mare Orientale
Mare Meridionale
Mare Septentrionale

I A.
veteribus
xl.
asciburgia.xiiii.
novesio.xvi.
agripina.
PARISI.
atuaca.
cortouallio.xii.
iuliaco.xviii.
Meduanto.
Mose.viii.
indesina.xvi.
ES.
I
noviomagus.xxv.
Nasic.
Panomia.xxv.
adfines.v.
Caturices.ix.
Tullio.x.
Mose.
Noviomagus.vii.
essera.xxi.

Piri Reis Map

- Pre-modern world map compiled in 1513 from military intelligence by the Ottoman admiral and cartographer Piri Reis
- Half of the map that survives accurately shows the western coasts of Europe and North Africa and the coast of Brazil
- Emphasizes sailing routes via Portolan compass roses, a network!
- Azores and Canary Islands are depicted, as is the mythical island of Antillia and possibly Japan
- Used 10 Arabian sources, 4 Indian maps sourced from Portuguese and one map of Columbus

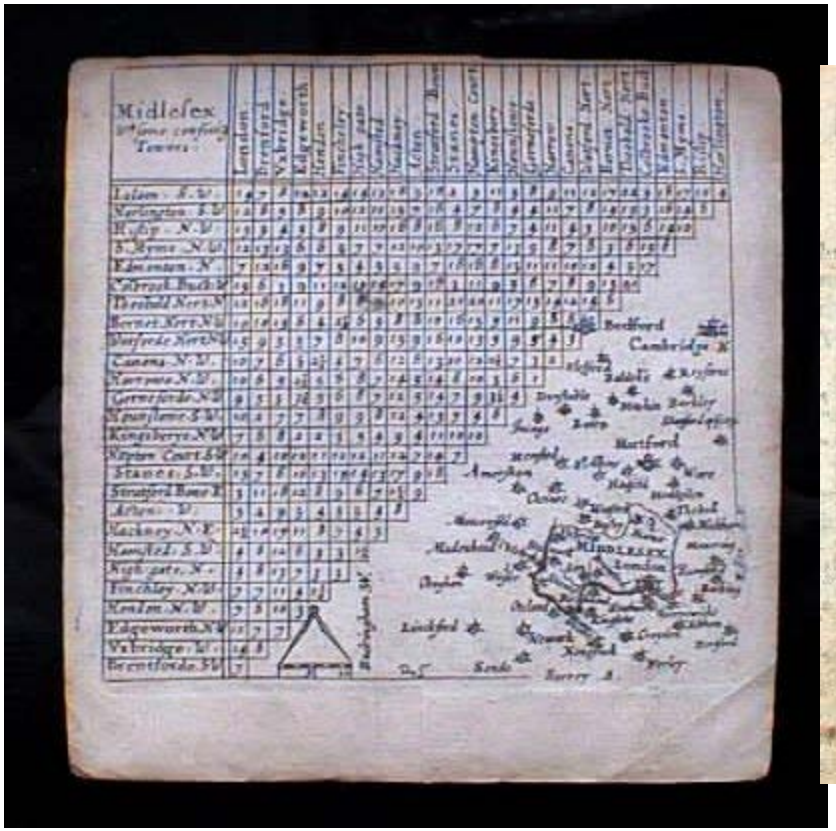
Piri Reis World Map 1513

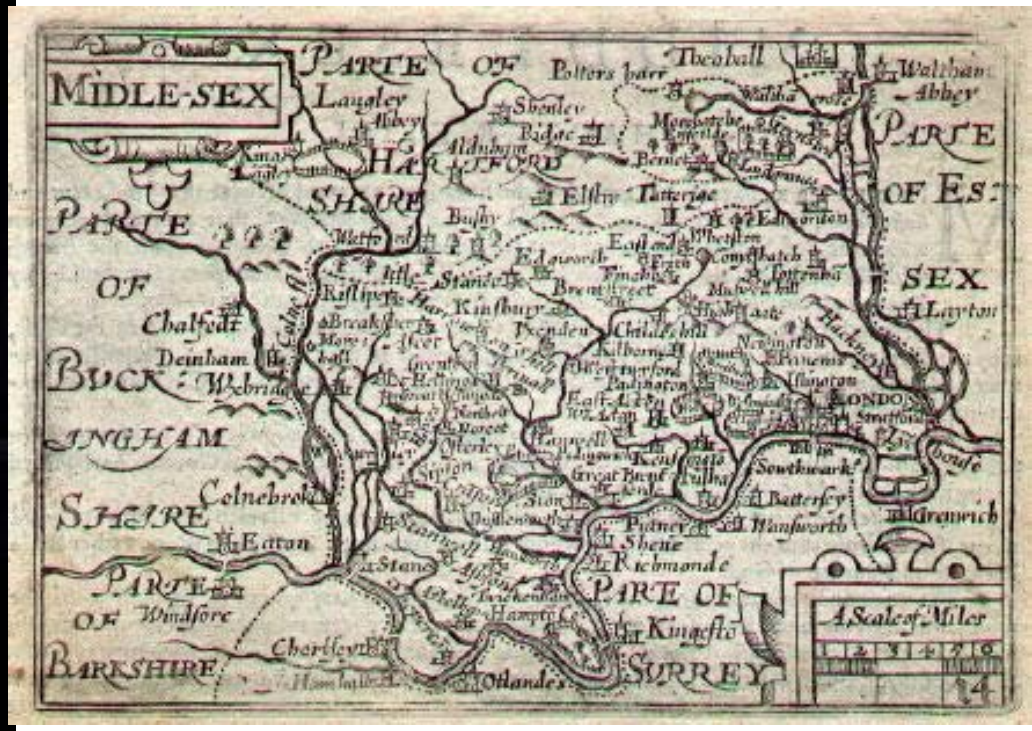
The Vinland Map

- Claimed to be a 15th century mappa mundi with unique information about Norse exploration of America
- Publicity campaign when presented as a "genuine" pre-Columbian map in 1965
- Africa, Asia and Europe, but also depicts a landmass south-west of Greenland in the Atlantic labeled as Vinland
- Claims Vinland as having been visited by Europeans in the 11th century
- Accompanying scholarly book written by British Museum and Yale University librarians
- Suspected a fake as soon as photographs of it became available
- Chemical analysis have shown one of the major ink ingredients is a 20th century artificial pigment
- Individual pieces of evidence disputed most recently at a 2009 conference

Vinland

1643 Matthew Simons in *A Direction for the English Traviller* publ. Thomas Jenner (distance tables by John Norden)





English Cities Strip Maps: 1715

Lewis and Clark 1800-1803

Santa Fe Trail

Zebulon Pike
Map of the "Santa Fe Trail"
St. Louis: ca. 1806
Manuscript map
National Archives,
Washington, D.C.

The First Modern Networks: Railroads

First edition of G.K. Warren's "hurried compilation," indicating the routes of the Pacific railroad surveys. The map was appended to the U.S. War Department's official report to Congress. (1857)

Right Half of James Hayward's 1828 plan of a survey for the proposed Boston and Providence Railway. (horse drawn trains)

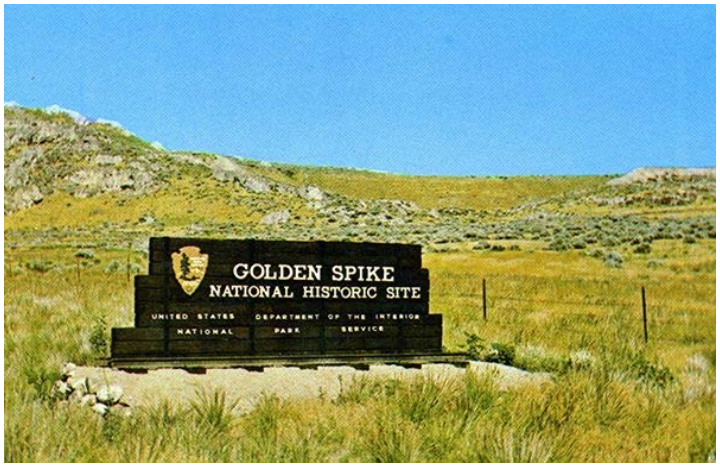
Cross country travel

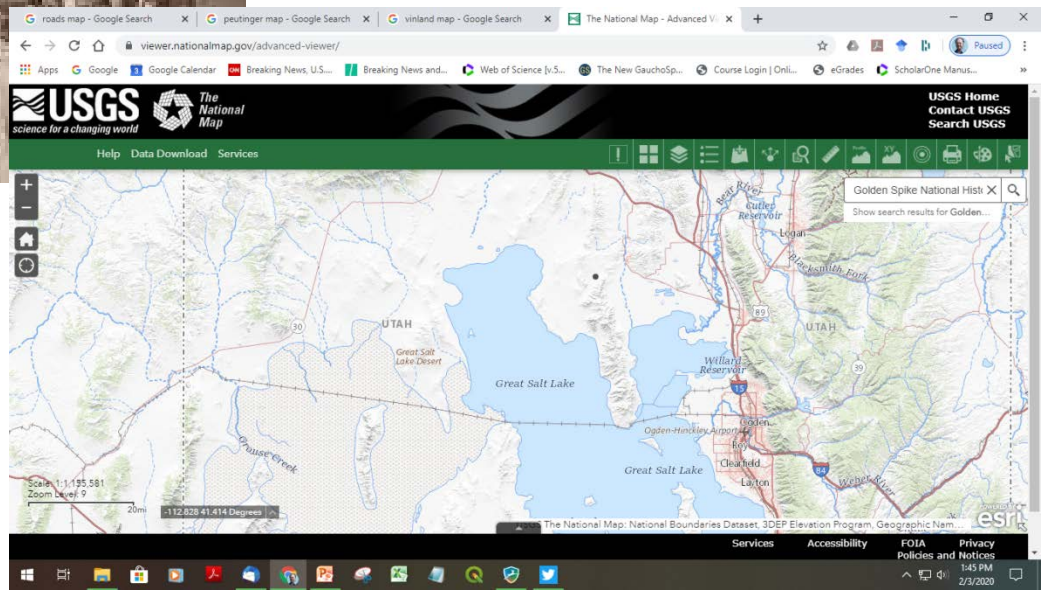
- US Civil War Apr 12, 1861 – Apr 9, 1865
- Central Pacific Railroad authorized by Congress in 1862
- Financed and built through "The Big Four" Leland Stanford, Collis Huntington, Charles Crocker, and Mark Hopkins
- Starting in 1863 12,000 Chinese laborers employed by the Central Pacific Railroad representing 90 percent of the entire work force
- "Golden spike", connecting the western railroad to the Union Pacific Railroad at Promontory, Utah, May 10, 1869
- Coast-to-coast train travel in eight days became possible, replacing months-long sea voyages and lengthy, hazardous travel by wagon trains

The End Game

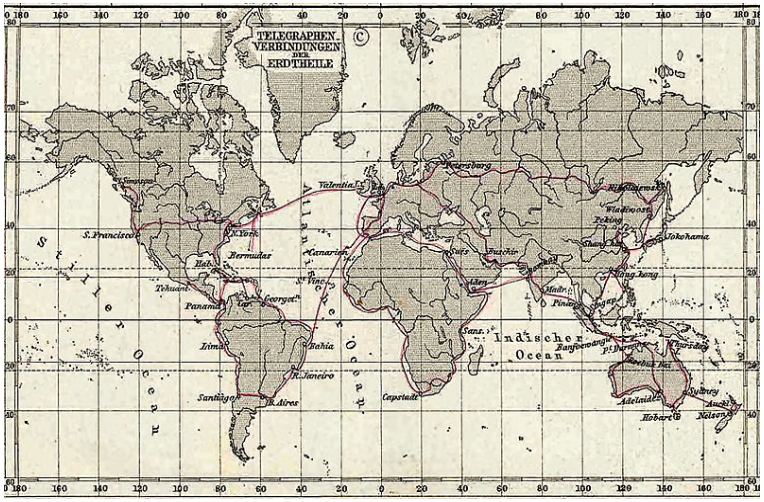
- In 1885 the Central Pacific Railroad was leased by the Southern Pacific Company
- The original right-of-way is now controlled by the Union Pacific, which purchased Southern Pacific in 1996
- The Union Pacific-Central Pacific (Southern Pacific) mainline followed the historic Overland Route from Omaha, Nebraska to San Francisco Bay

Promontary Point UT

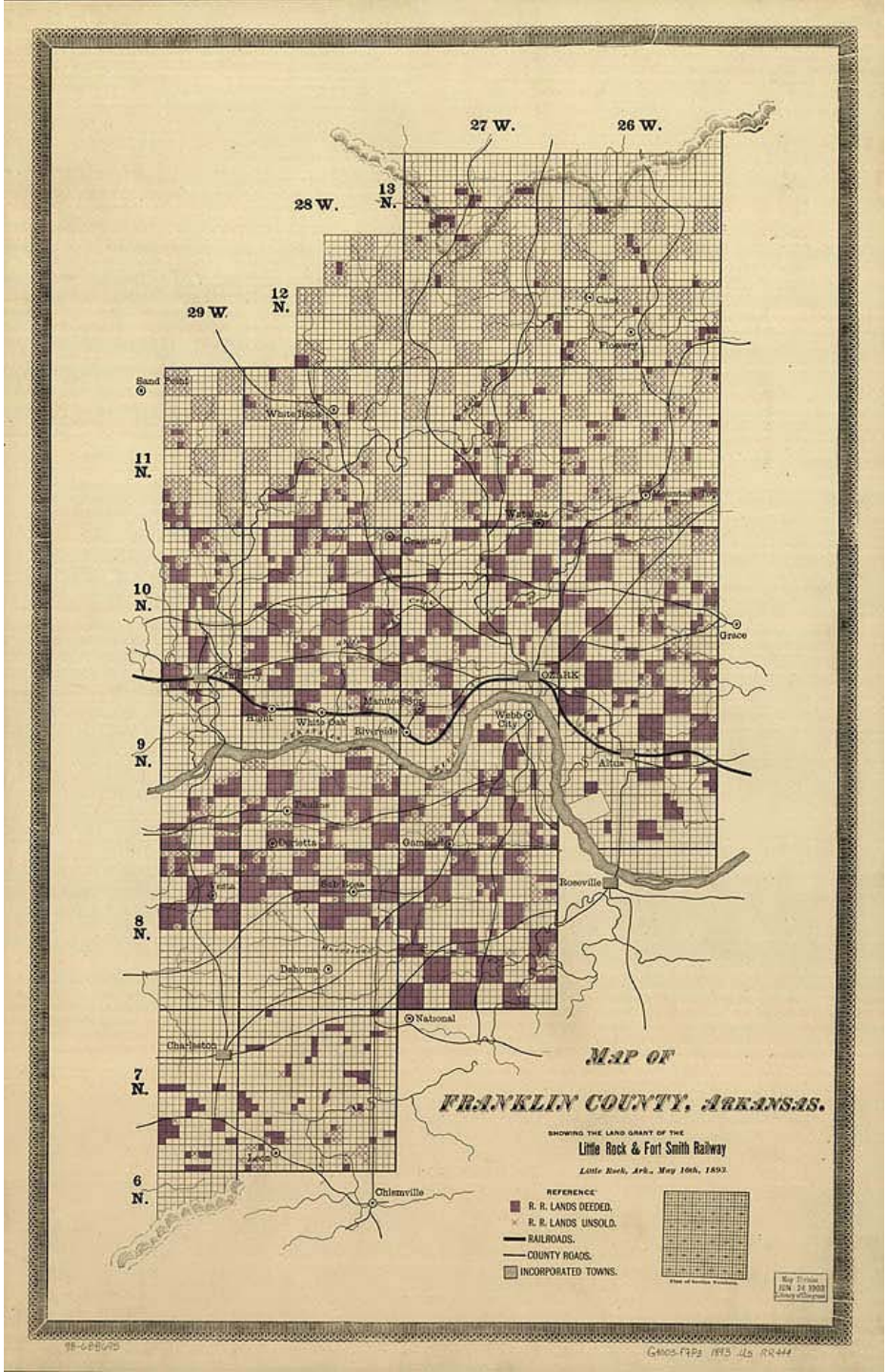




US Time Zones Nov 18, 1883



1891



Congress provided land grants. The land grant railroads, received millions of acres of public land, sold the land to make money, built their railroads, and contributed to a more rapid settlement of the West. Four out of the five transcontinental railroads were built with help from the federal government.

Northeastern portion of a map
of Iowa by
Frank H. Galbraith. 1897

International Meridian Conference 1884

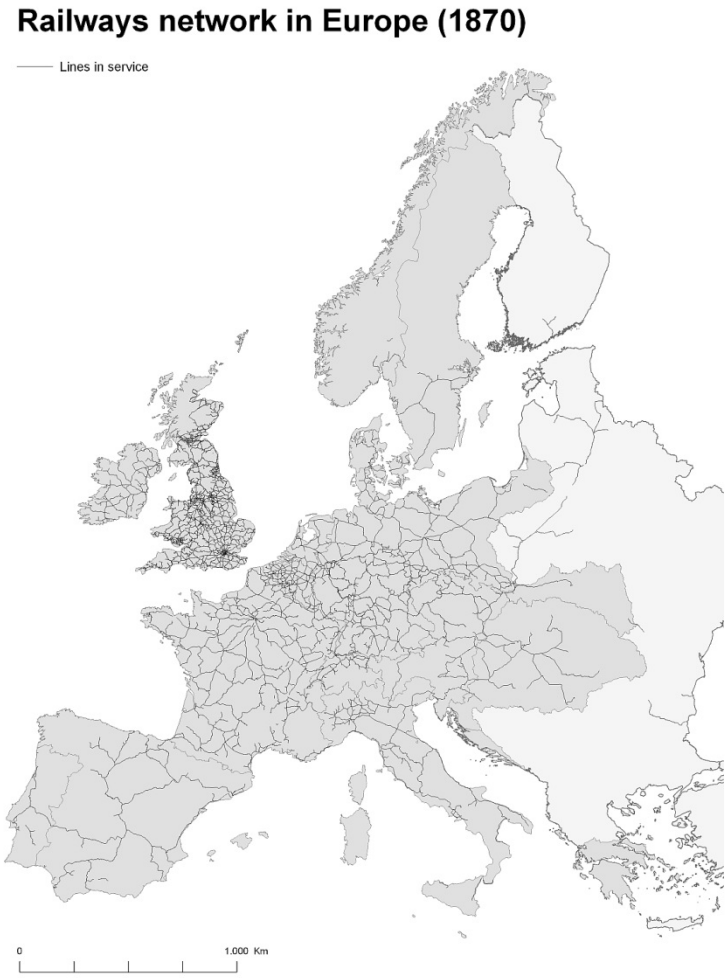
Held in October 1884 in Washington, D.C. At the old State Dept. Building

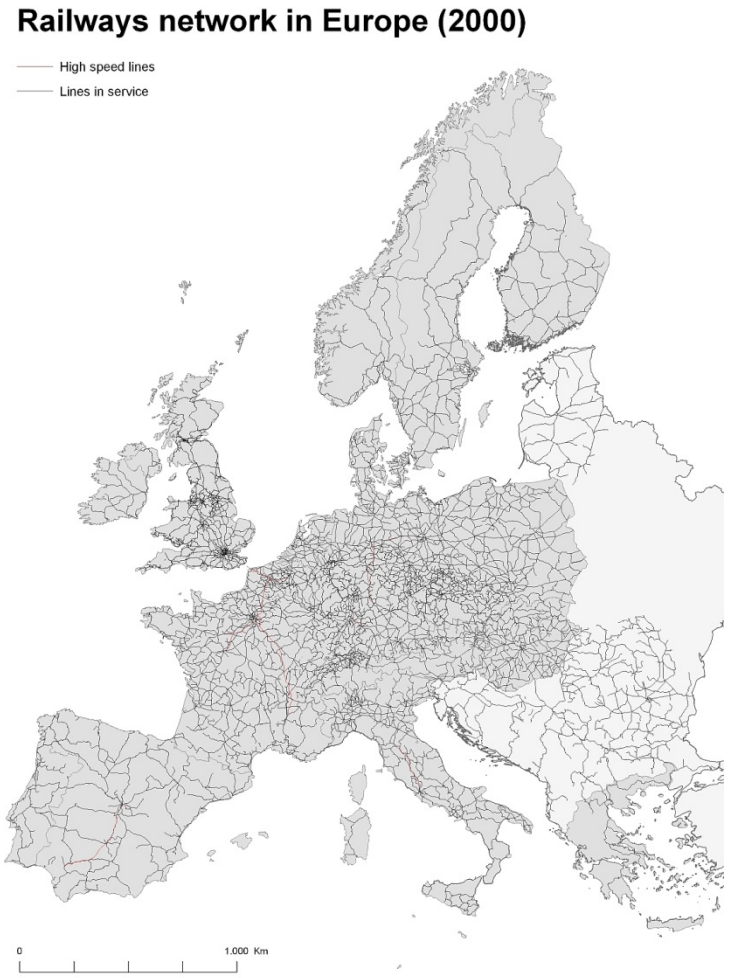
Declaration 4: That the Conference proposes the adoption of a universal day for all purposes for which it may be found convenient, and which shall not interfere with the use of local or standard time where desirable.

Declaration 5: That this universal day is to be a mean solar day; is to begin for all the world at the moment of mean midnight of the initial meridian, coinciding with the beginning of the civil day and date of that meridian; and is to be counted from zero up to twenty-four hours.

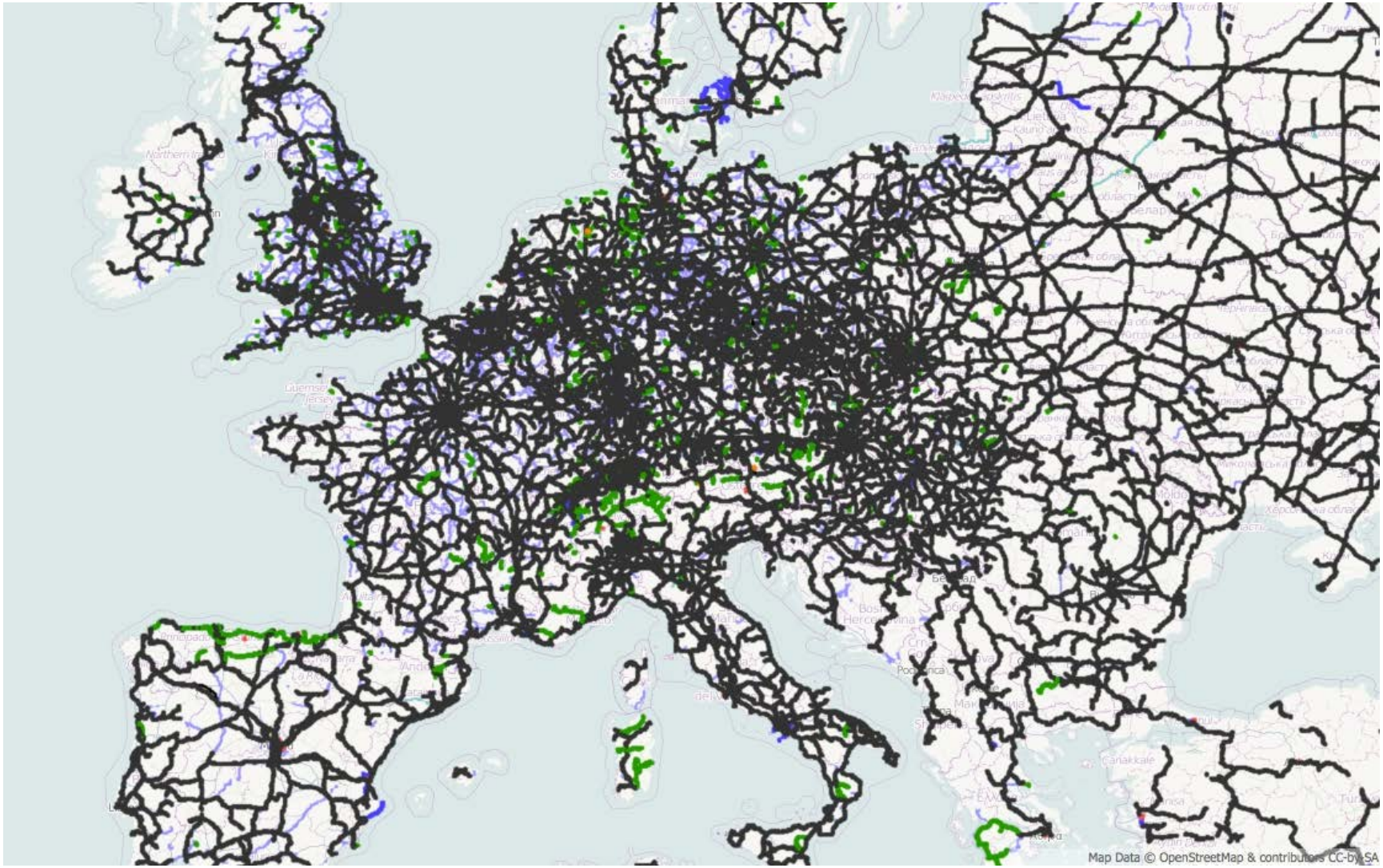
Declaration 6:That the Conference expresses the hope that as soon as may be practicable the astronomical and nautical days will be arranged everywhere to begin at midnight.

European railways





European Expansion



Trans-Siberian Railway

Trans Siberian

- Opened March 1891, by the future Tsar Nicholas II at Vladivostok
- Made notes in his diary about his anticipation of traveling in the comfort of "The Tsar's Train" across the unspoiled wilderness of Siberia
- The main route originates in Moscow at Yaroslavsky Vokzal, runs through Yaroslavl, Omsk, Novosibirsk, Irkutsk, to Vladivostok via southern Siberia
- Built 1891-1916 under the government ministers appointed by Tsar Alexander III and by his son, Tsar Nicholas II.
- Chinese Eastern Railway connected Russia with China and provided a shorter route to Vladivostok
- Moscow–Pyongyang (10,267 km, 6,380 mi)
- Kiev–Vladivostok (11,085 km, 6,888 mi)
- Main Russian segment 9,259 km (5,753 miles), spans seven time zones and takes eight days

India 1893
Bartholemew Atlas

INDIAN RAILWAY MAP

Places of Tourist Interest

1. Delhi	D4	15. Jammu	C3	29. Nainital	D4	40. Samat	F5	51. Pune	B8	62. Nagarjunasagar	D9
2. Agra	D5	16. Srinagar	C2	30. Almora	E4	41. Kushinagar	F5	52. Maabaleshwar	B8	63. Chennai	E10
3. Jaipur	C5	17. Pahalgam	C2	31. Ranikhet	D4	42. Bodh Gaya	F6	53. Maheran	B8	64. Mamallapuram	E10
4. Jodhpur	B5	18. Gulmarg	C2	32. Rishikesh	D4	43. Nalanda	F5	54. Aurangabad	C7	65. Pondicherry	E11
5. Jaisalmer	B5	19. Leh	D2	33. Haridwar	D4	44. Rajgir	F6	55. Ahmedabad	B6	66. Kanchipuram	E10
6. Bikaner	C4	20. Kargil	D2	34. Allahabad	E5	45. Vaishali	F5	56. Vaodara	B7	67. Thirichchirappalli	D11
7. Barmer	B6	21. Amritsar	C3	35. Varanasi	F5	46. Sanchi	D6	57. Patana	B7	68. Chidambaram	E11
8. Udaipur	C6	22. Jallandhar	C3	36. Gwalior	D5	47. Bhubaneswar	G7	58. Madvi	A6	69. Thanjavur	D11
9. Chittargarh	C6	23. Ludhiana	C3	37. Shivpuri	D5	48. Puri	G7	59. Hyerabad	D9	70. Madurai	D11
10. Mt. Abu	B6	24. Kapurtala	C3	38. Orchha	D6	49. Konark	G7	60. Warangal	E8	71. Rameshwaram	D12
11. Shimla	D3	25. Patiala	C3	39. Khajuraho	E6	50. Mumbai	B8	61. Tirpathi	D10	72. Kanniyakumari	D12
12. Kulu	D3	26. Anandpur Sahib	D3								
13. Manali	D3	27. Dehradun	D3								
14. Dharmasala	D3	28. Mussoori	D3								

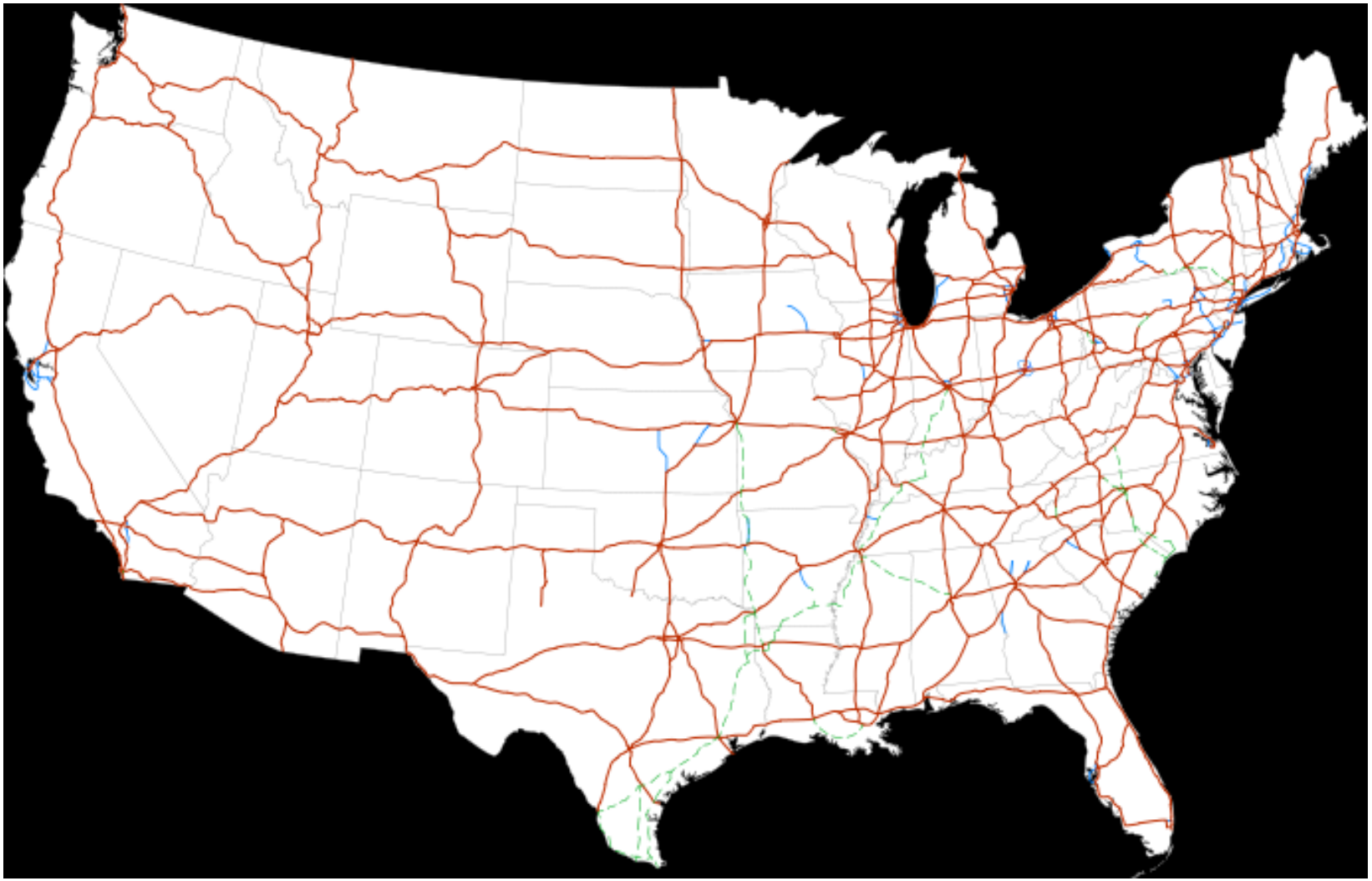
73. Bangalore	D10	87. Kodaikanal	D11
74. Mysore	C10	88. Vercaud	D11
75. Hassan	C10	89. Goa	C9
76. Belur	C10	90. Dos	A7
77. Helibed	C10	91. Kovalam	D12
78. Shravanabelagola	C10	92. Calcutta	H6
79. Badami & Pattadakal	C9	93. Darjeeling	G5
80. Hampi	C9	94. Gangtok	G5
81. Trivandrum	D12	95. Guwahati	I5
82. Cochin	C11	96. Shillong	H5
83. Alleppey	C12	97. Agartala	I6
84. Kottayam	C12	98. Port Blair	I11
85. Quilon	C12	99. Lakshadweep	B11
86. Ooty	C11		

Digital Enhancement & Background Creation: Advent India (P) Ltd.

Dwight D. Eisenhower National System of Interstate and Defense Highways

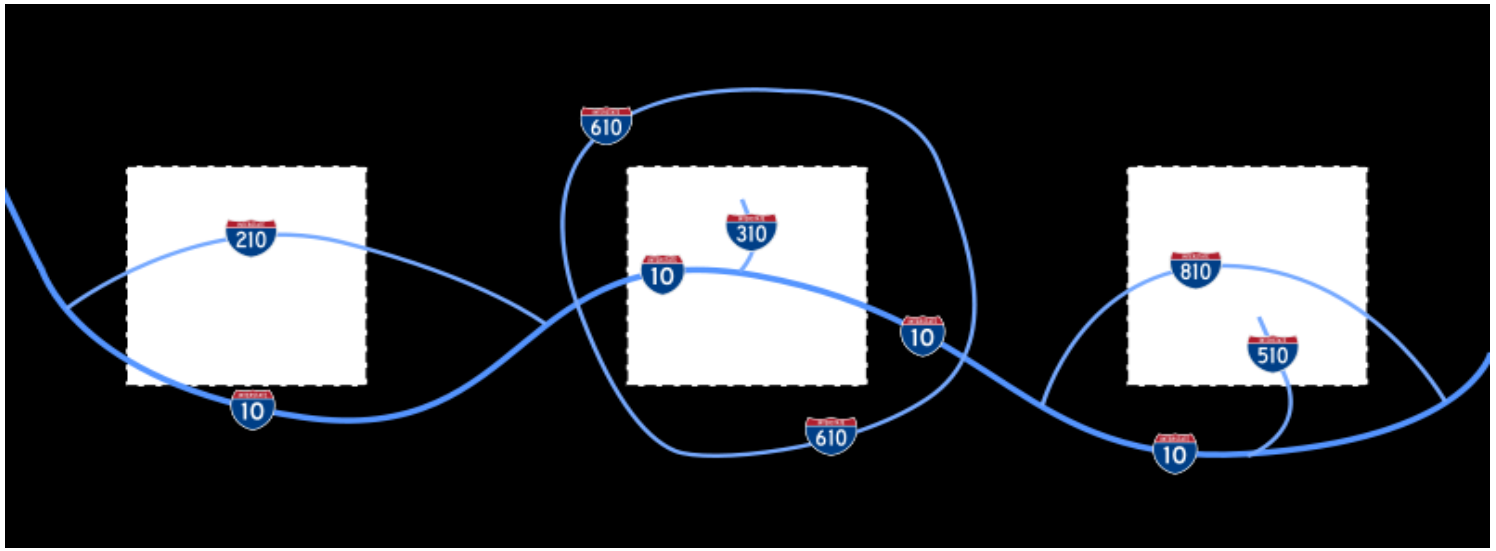
- Commonly known as the Interstate Highway System
- Network of limited-access roads including freeways, highways, and expressways forming part of the National Highway System
- Named for President Dwight D. Eisenhower, who championed its formation
- Serves nearly all major U.S. Cities
- Construction authorized by the Federal-Aid Highway Act of 1956, original portion was completed 35 years later
- As of 2016, about one-quarter of all vehicle miles driven in the country used the Interstate Highway System, which had a total length of 48,191 miles (77,556 km)
- Cost of construction was $425 billion (in 2006 dollars), making it the largest public works project in history.

Interstates



Interstate Numbering

East-west highways assigned even numbers
North-south highways are assigned odd numbers
Odd route numbers increase from west to east
Even-numbered routes increase from south to north
Numbers divisible by five are major arteries on primary routes



Completing the System 1991…

Construction of the first U.S. Interstate in 1956, I-70 in Missouri and Kansas.

First map of the Arpanet: 1967

From Computer Desktop Encyclopedia
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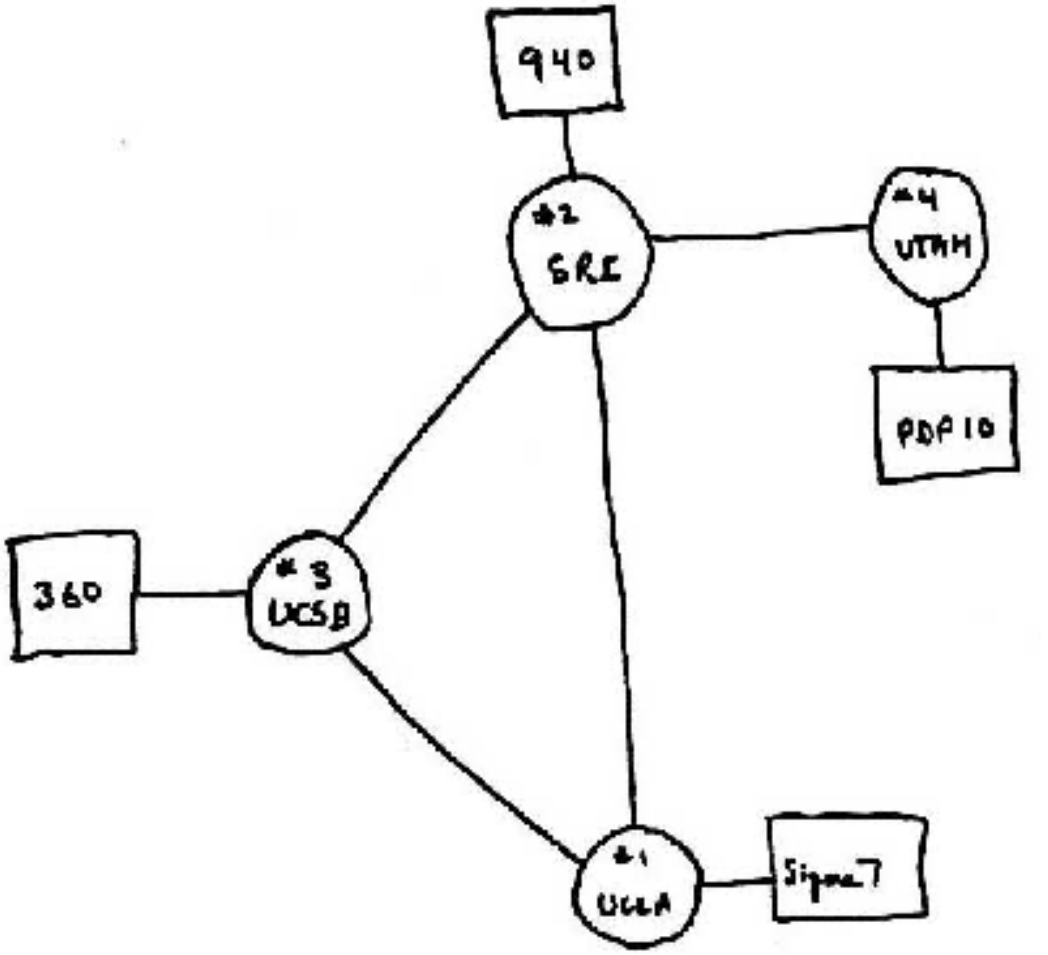
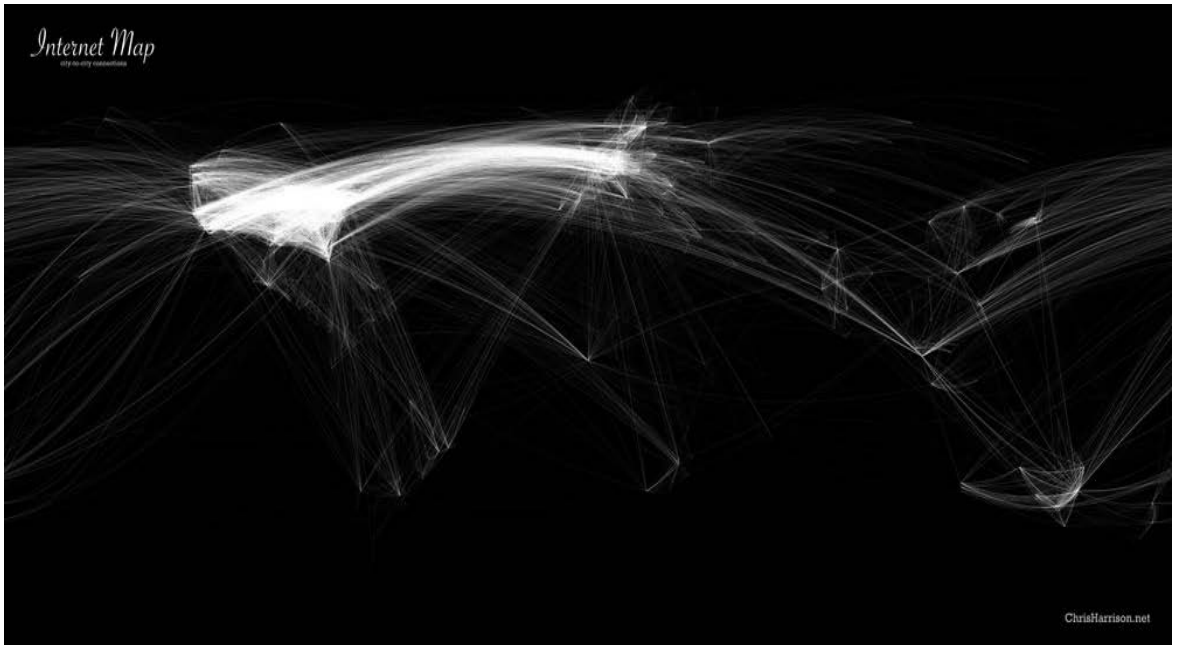
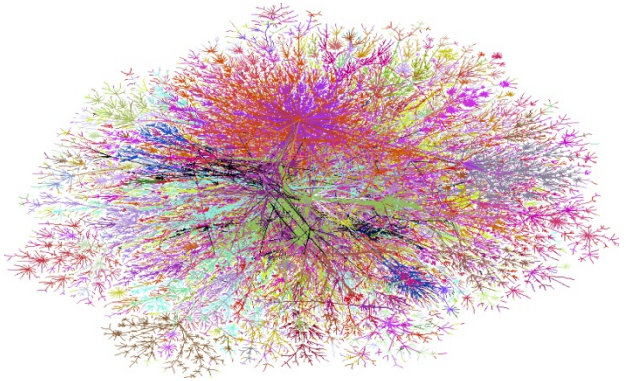
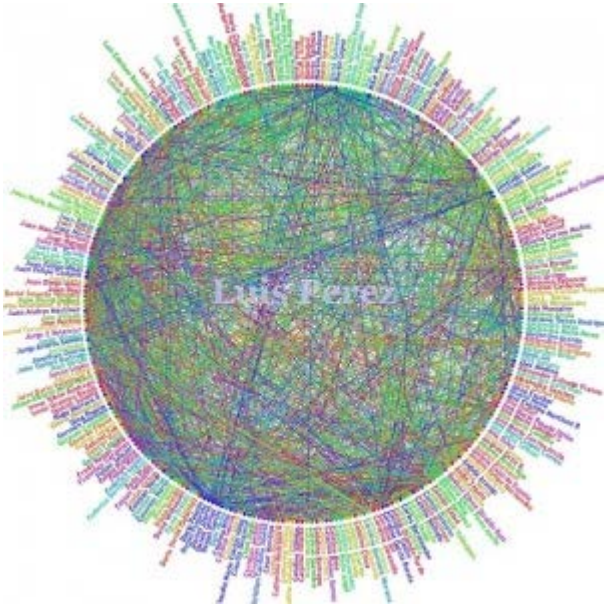


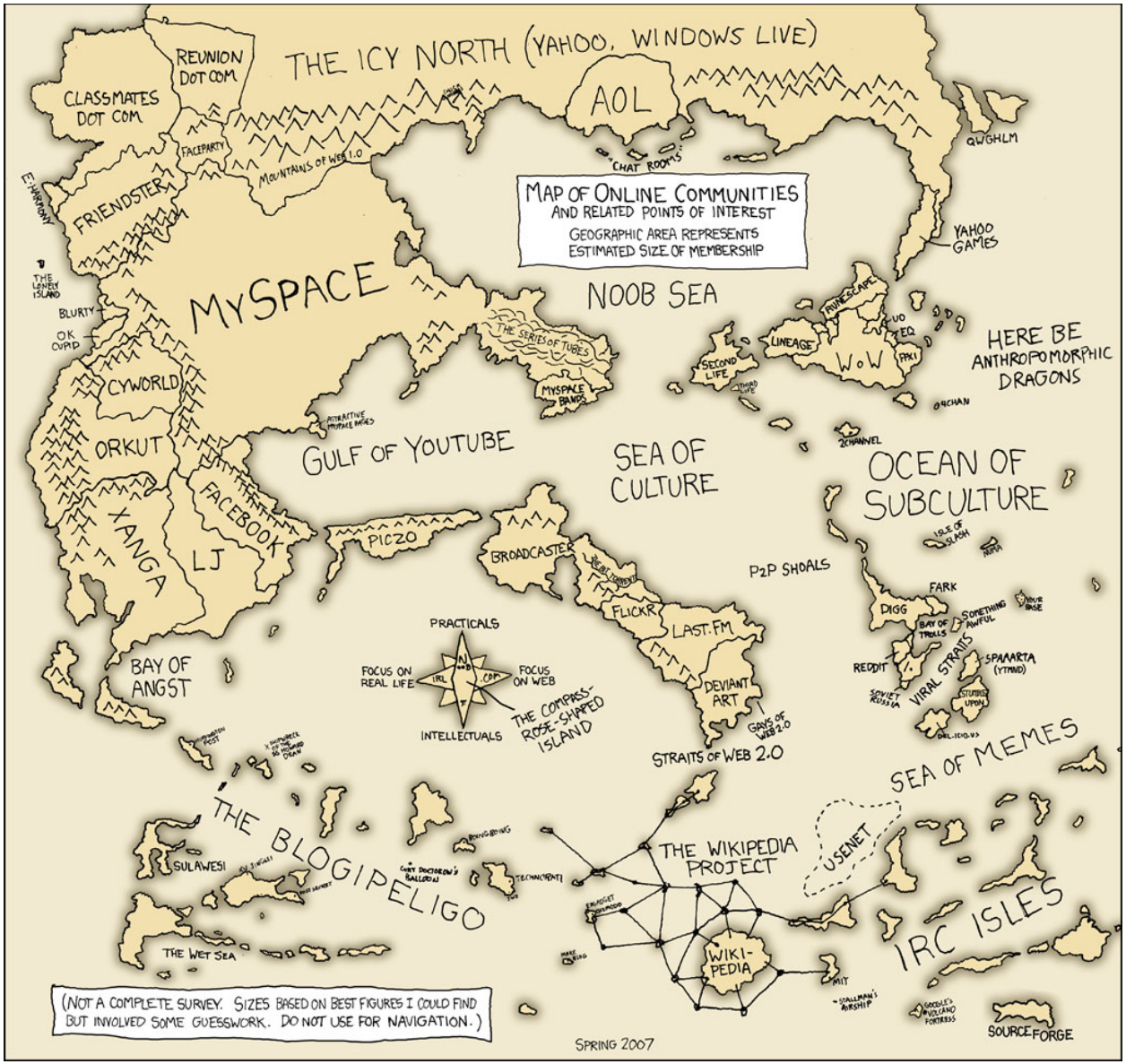
Internet Maps



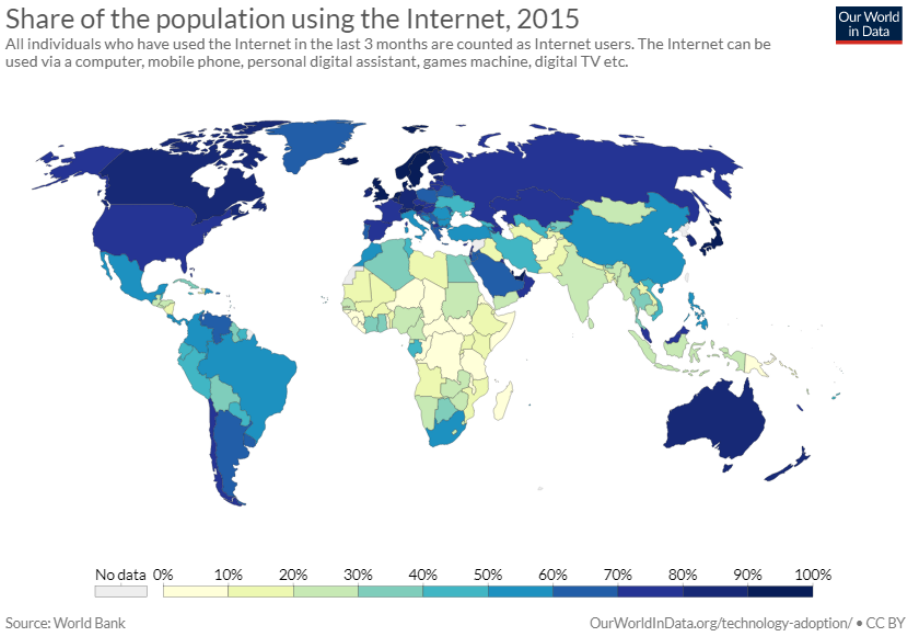




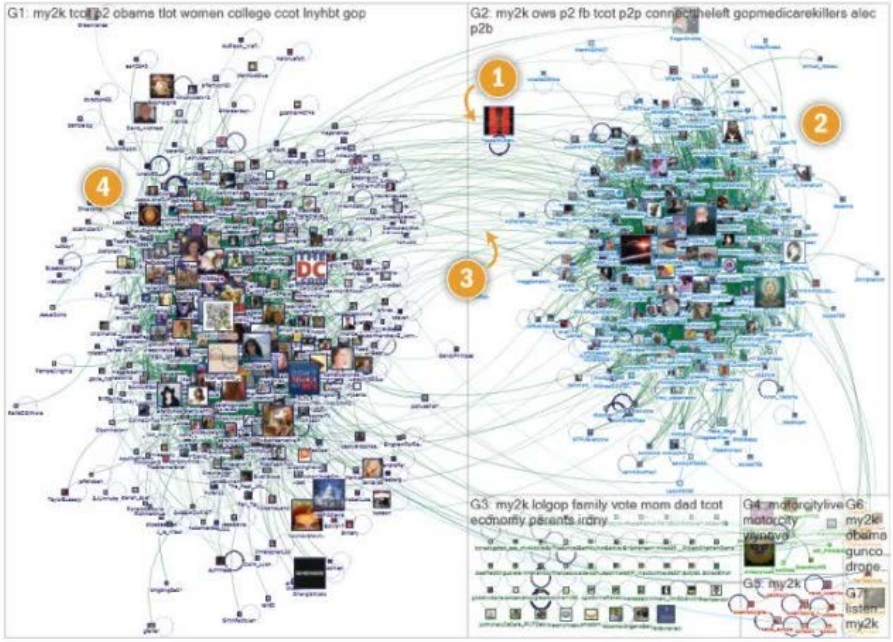
Historical Map of the World Wide Web



Our distorted web maps



The Digital Divide



Polarized cloud

Conclusion

- Graph theory useful when route maps are abstracted
- Route maps have history back to Romans
- Walk, Horse, Sail, Railroad, Car, Internet
- Network cartography expanding!