

# Mathematical models: Uses, abuses, and non-uses

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All models are wrong, but  
some models are useful.

George Box

Earlier:

- Eric Temple Bell: “The map is not the thing mapped.”
- Alfred Korzybski: “A map *is not* the territory.”

## A wrong mental model:

The goals of the advertising business model do not always correspond to providing quality search to users. ... we expect that advertising funded search engines will be inherently biased towards the advertisers and away from the needs of the consumers. ... we believe the issue of advertising causes enough mixed incentives that it is crucial to have a competitive search engine that is transparent and in the academic realm.

## One can be wrong and still succeed:

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Sergey Brin and Larry Page, 1998

# Historical episode with possible relevance for today

- British railway mania of the mid-1830s: equivalent to about £200 billion of real capital investment for UK today as fraction of GDP
- British Railway Mania of the mid- and late-1840s: equivalent to about £400 billion
- mania of the mid-1830s: the only episode in history of gigantic and wildly speculative frenzy that was successful
- Mania of the 1840s: giant disaster, involved famous people such as Charles Darwin, John Stuart Mill, the Brontë sisters, and many others



THE RAILWAY JUGGERNAUT OF 1844.

*Note: The locomotive has been moved to the right of the picture, and the track has been extended to the right.*

# A very light introduction

a hilarious satirical 1845 short story by William Aytoun

google/bing *The Glenmutchkin Railway*

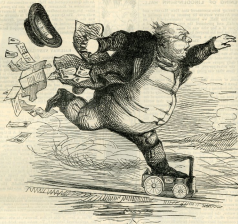


THE MOMENTOUS QUESTION.

"TELL ME, OR THOU WILT, DEAREST JAMES, HAVE YOU ANY BARNET'S REMEDY?"



# JOHN BULL'S LOCOMOTIVE LEG.

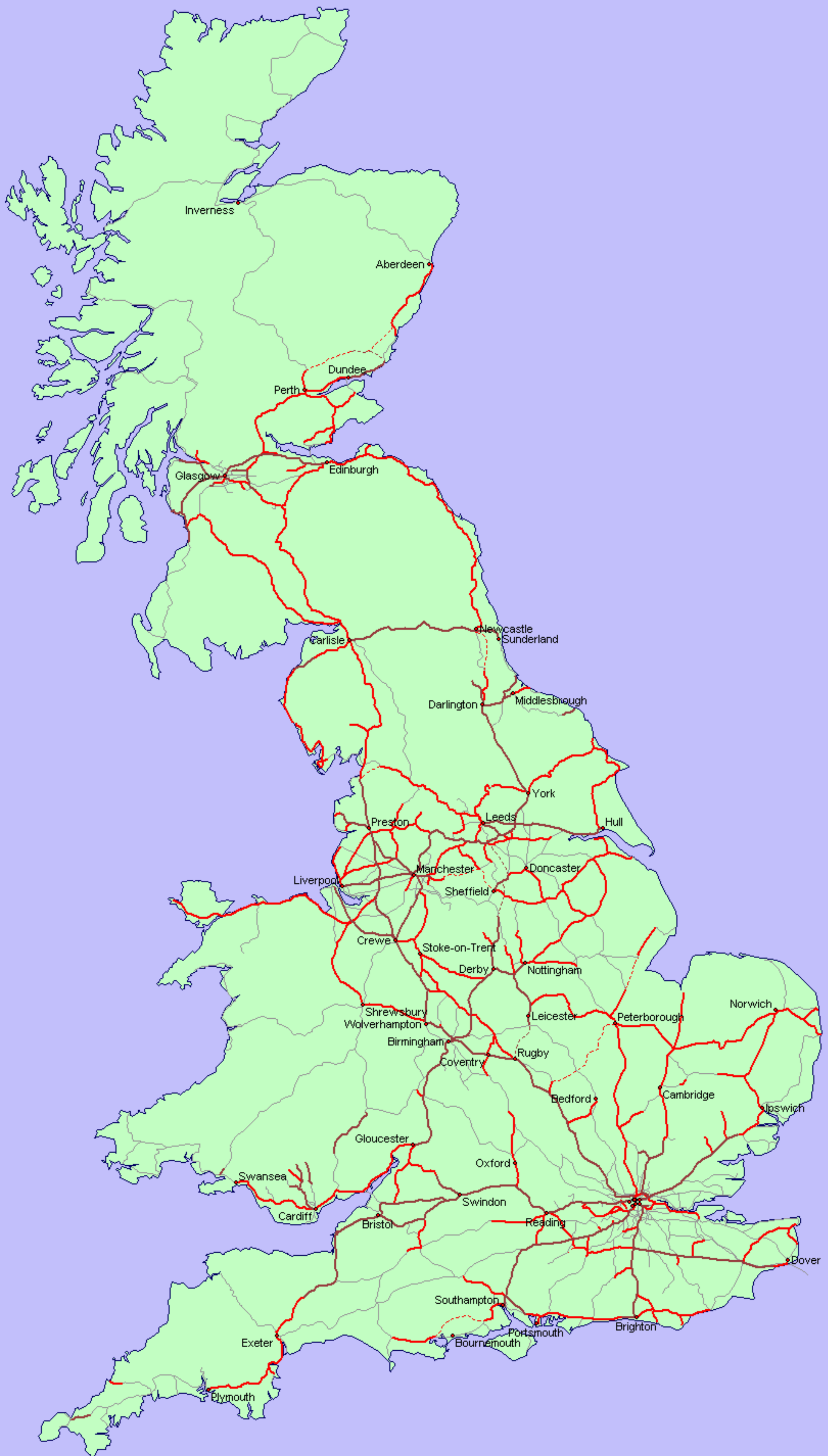


# Railway Mania of the 1840s

- interesting instance of misuse and non-use of quantitative models
- during the mania of 1830s, had no track record for the revolutionary new technology being deployed on a massive scale
- by the mid-1840s, extensive evidence available, but not used properly







- Peel and many of the most powerful opponents of the Railway Mania were enthusiastic about direct lines
- Direct London and Exeter Railway
- two competing direct lines from London to Manchester
- anecdotal account of engineer and railway secretary:
  - This line has the disadvantage that it goes right over the top of Snowdon!
  - That is nothing, my dear Sir, compared to the disadvantage which we would labour under if the line was not advertised as a *direct* one!

“The Earth is flat,” except when it isn’t  
(which is almost always)

General importance of locality

Gravity models:

two populations  $P_1$  and  $P_2$  at distance  $D$  apart interact  
with intensity proportional to

$$\frac{P_1 P_2}{D}$$

- much evidence in UK, almost universally ignored
- important publications of Charles Joseph Minard in Paris in 1842–43
- forgotten discovery of gravity models by Henri Guillaume Desart in Brussels in 1846
- ignored (with interesting exceptions) in UK



# Carte Figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.

Dressée par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite. Paris, le 20 Novembre 1869.

Les nombres d'hommes présents sont représentés par les largeurs des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en travers des zones. Le rouge désigne les hommes qui entrent en Russie, le noir ceux qui en sortent. — Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. Thiers, de Ségur, de Fezensac, de Chambray et le journal inédit de Jacob, pharmacien de l'Armée depuis le 28 Octobre. Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Jérôme et du Maréchal Davout qui avaient été détachés sur Minsk et Mohilow et ont rejoint vers Orscha et Witebsk, avaient toujours marché avec l'armée.

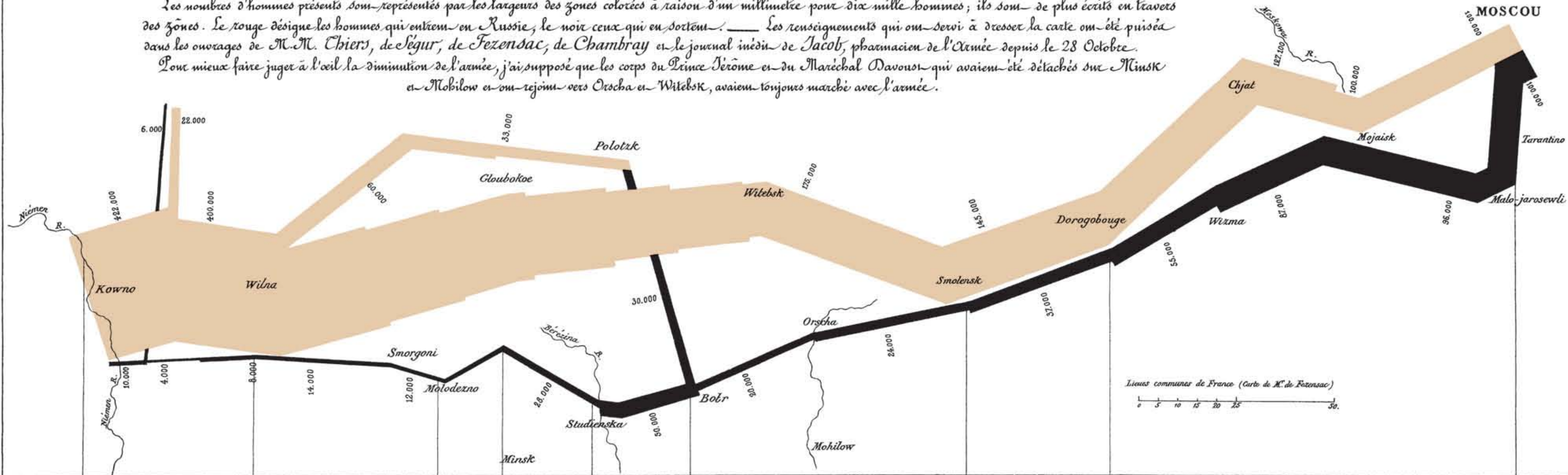
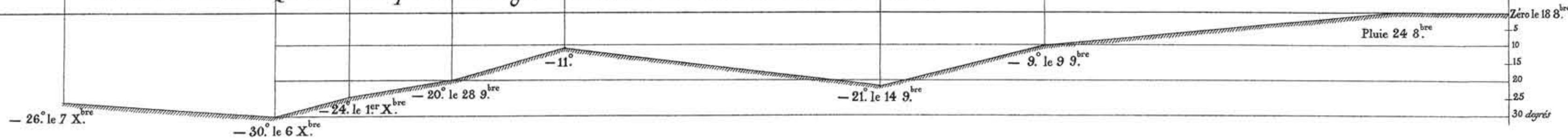
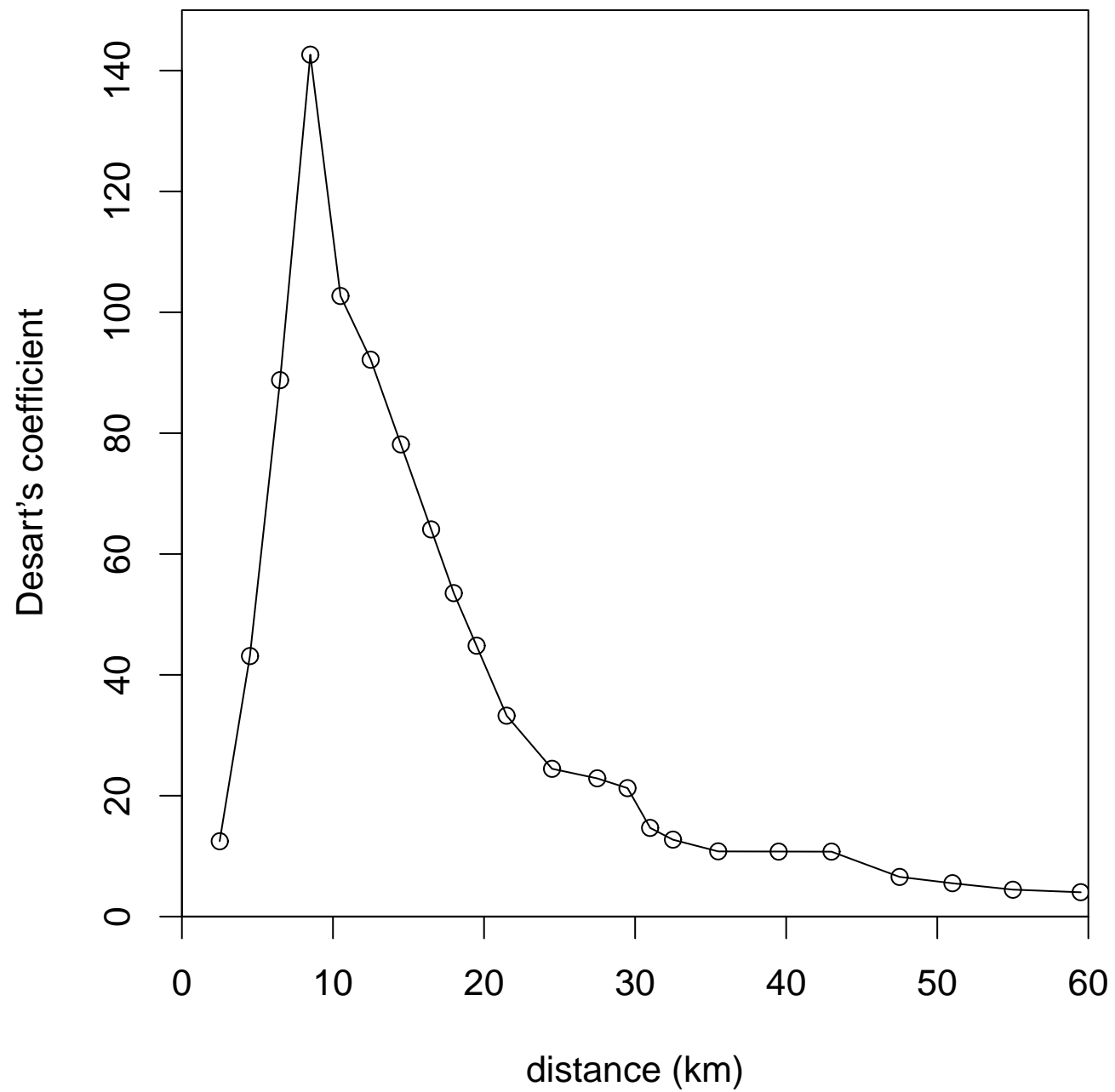


TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessous de zéro.

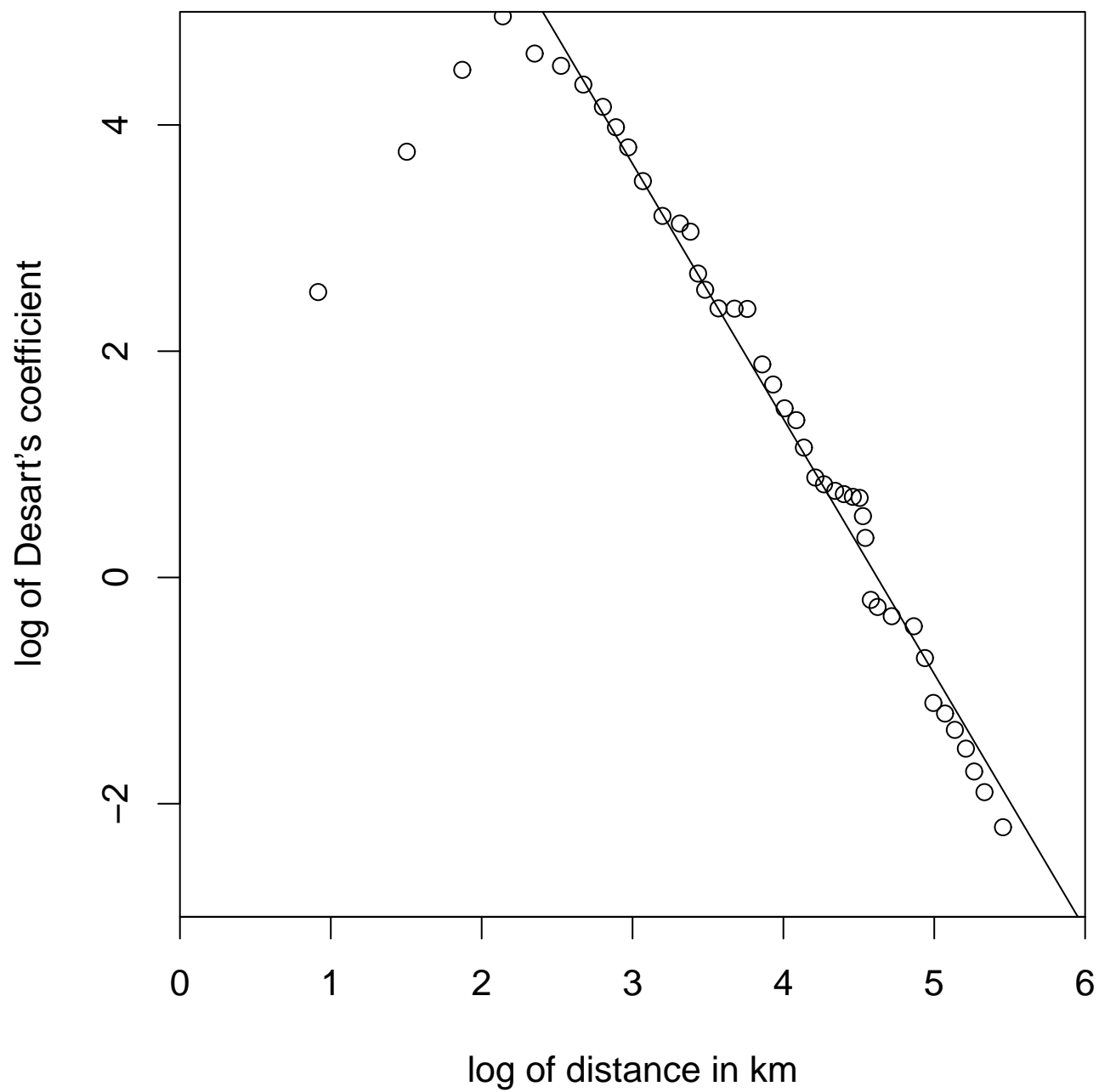
Les Cosaques passent au galop le Niemen gelé.



## Locality of traffic on Belgian railways



## Exponent of Desart's gravity model



## After the collapse of the Railway Mania:

- mistakes of direct lines, as well as of “feeder” branches that became “suckers,” recognized by the 1850s, but never analyzed carefully
- same mistake of neglecting locality repeated in planning the Metropolitan line, the world’s first subway
- even more serious mistakes made by not paying attention to false by useful models

# Varying fates of the two railway manias:

- cost estimates made by engineers, significantly underestimated both times
- revenue estimates made by “traffic takers” using a systematic methodology accepted by Parliament and tested in adversarial proceedings
  - 1830s: amazingly accurate
  - 1840s: far too optimistic

## Missed opportunity:

- amazing accuracy in the 1830s accidental, result of several mistakes cancelling
- actual performance of “traffic taker” methodology never evaluated systematically
- accuracy not understood, railway interest used one measure that resulted from the fallacies of the model to argue “traffic takers” were far too conservative
- explanation of the defects of the “traffic taker” model would have shown the Railway Mania of the 1840s was bound to fail

More information, papers, etc.:

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or just google/bing “odlyzko”

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