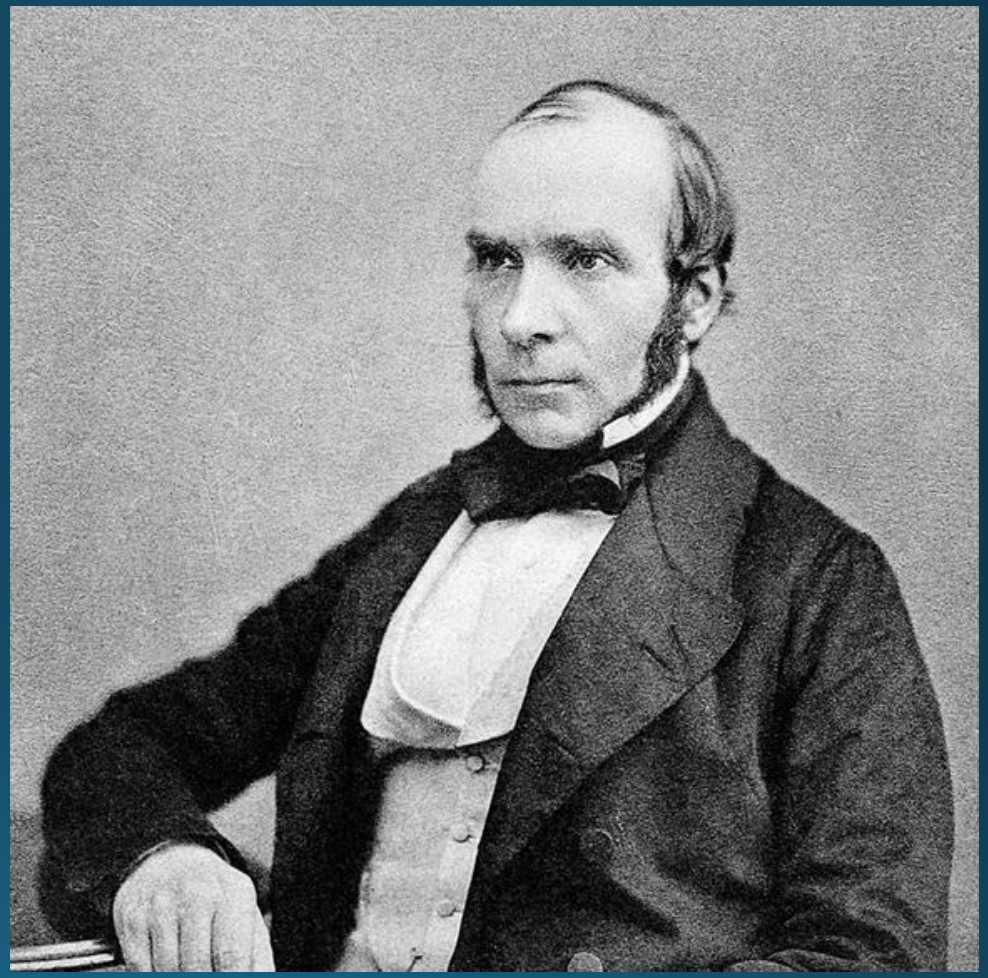
New Developments In Risk Science And Causality

Association of Air Pollution Control Agencies

The 1854 Cholera Epidemic



Broad Street Pump

Artist rendition c. 1850

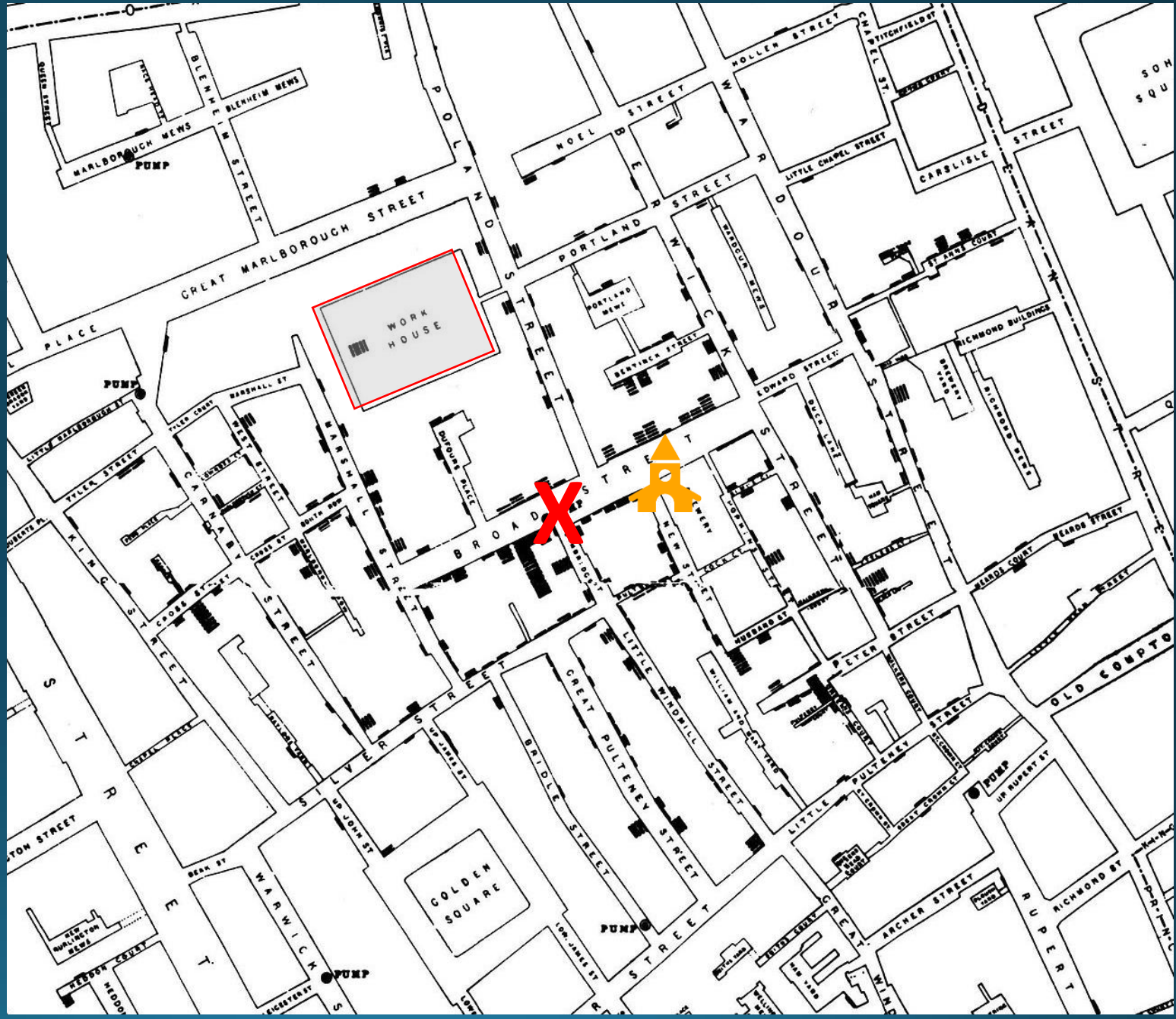
Map showing the areas within walking distance of the Broad Street pump.

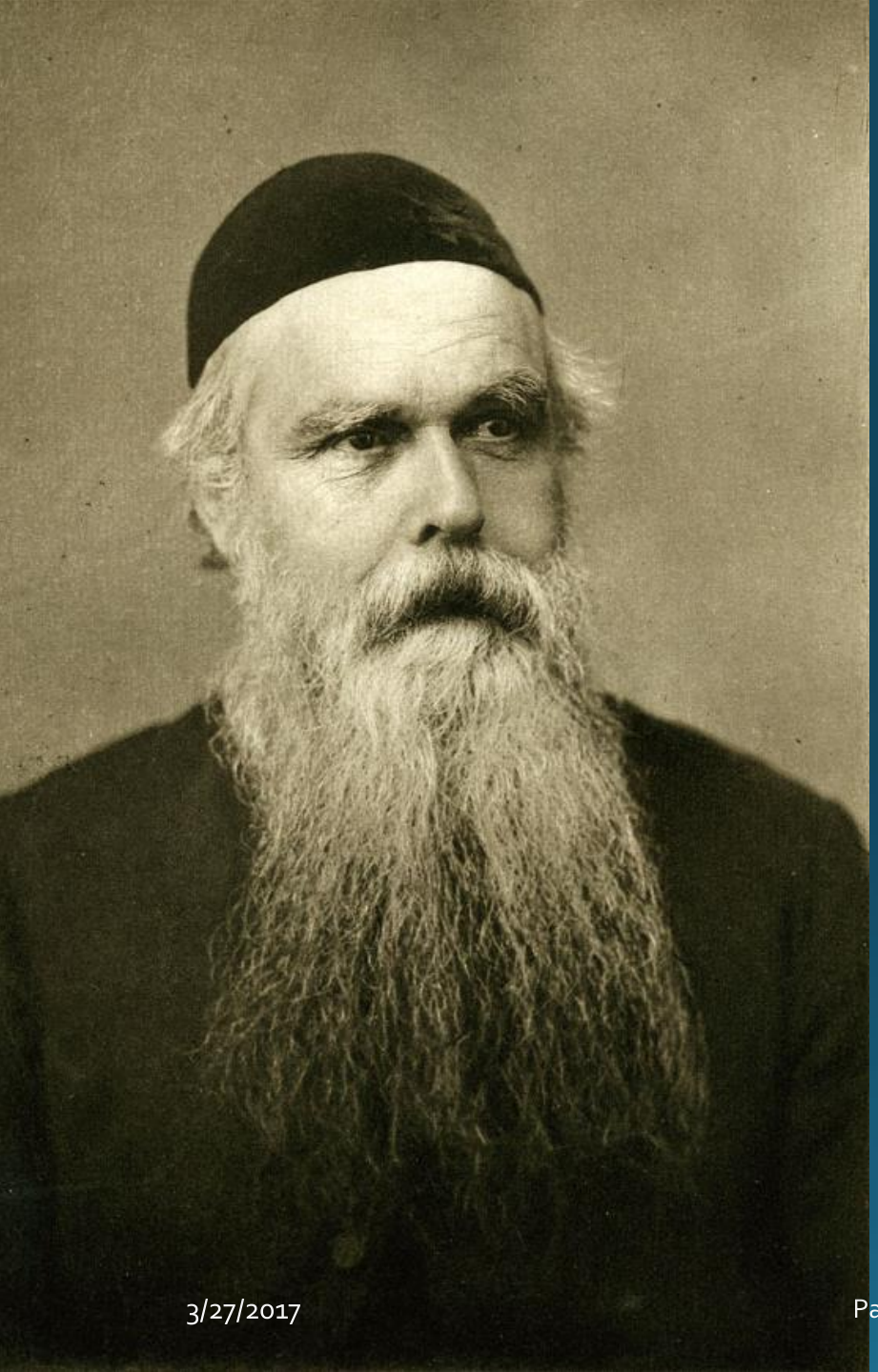
Spatial distribution of cases.

- Workhouse/prison

X - Focus of infection

- St. Like's Church



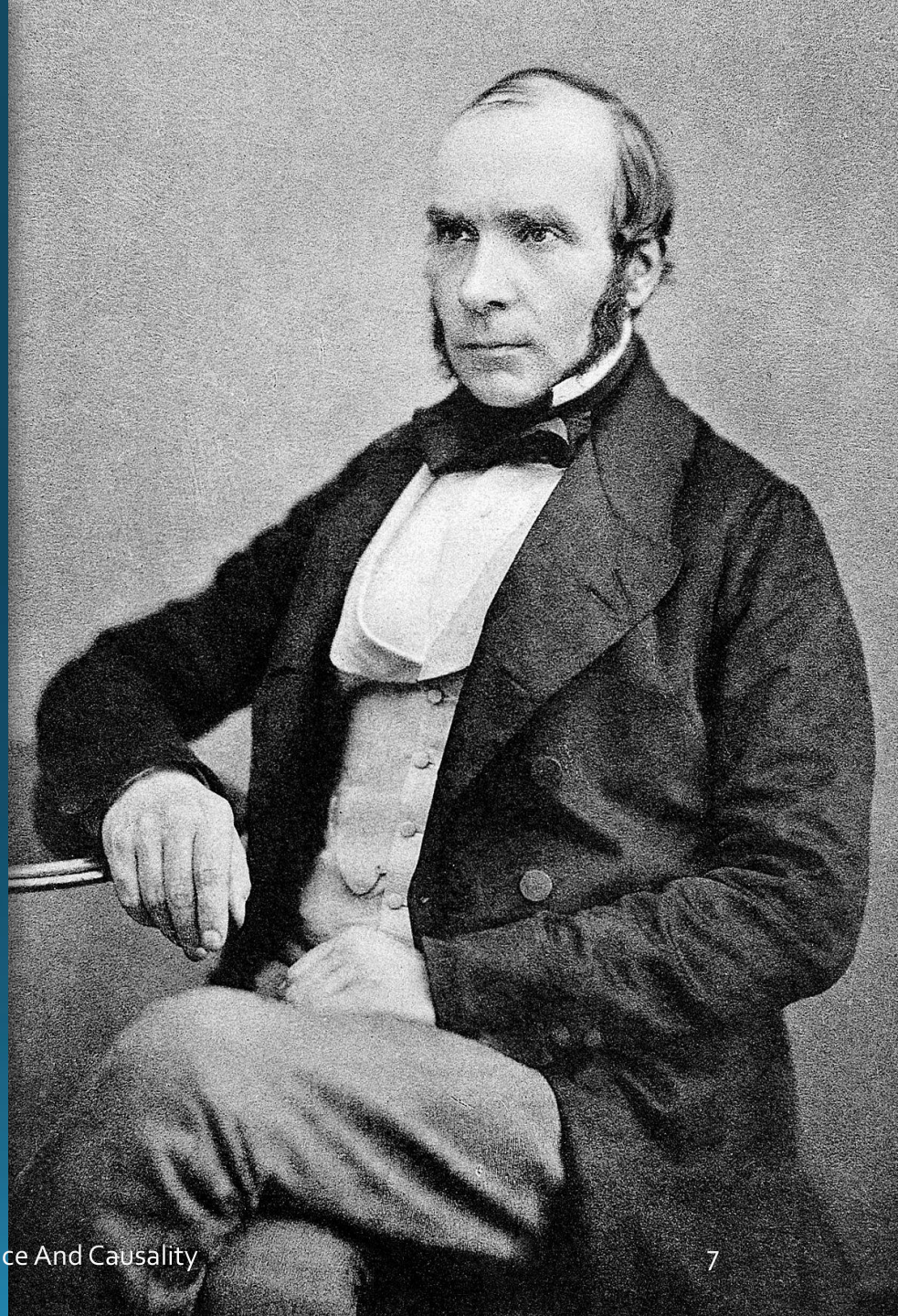


Reverend Henry Whitehead

- The Reverend Henry Whitehead was an assistant curate at St. Luke's church in Soho
- He worked with Snow During the 1854 cholera outbreak.
- They combined demographic information with scientific observation
- Set an important precedent for epidemiology.

John Snow
1813 - 1858

Considered one of the fathers of epidemiology

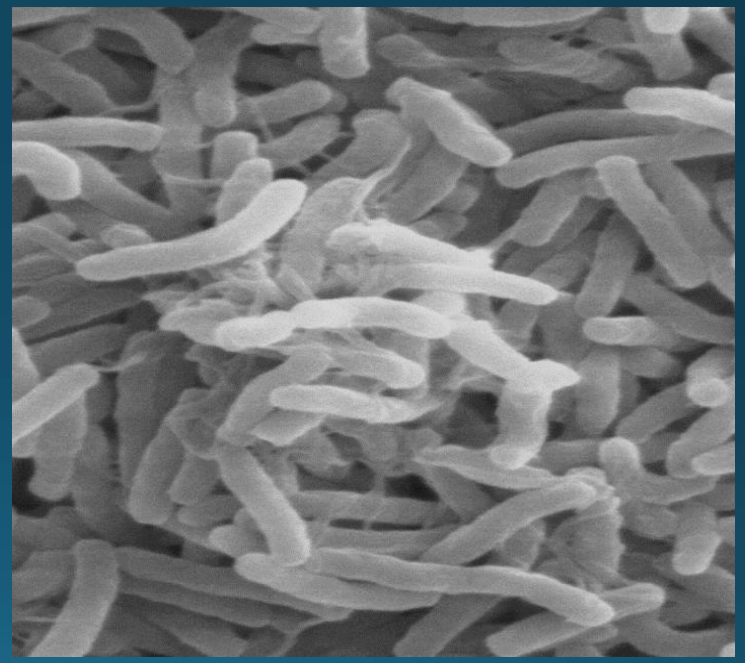


Broad Street Pump July 2014

1854 Science of causality was divided

Miasma Theory

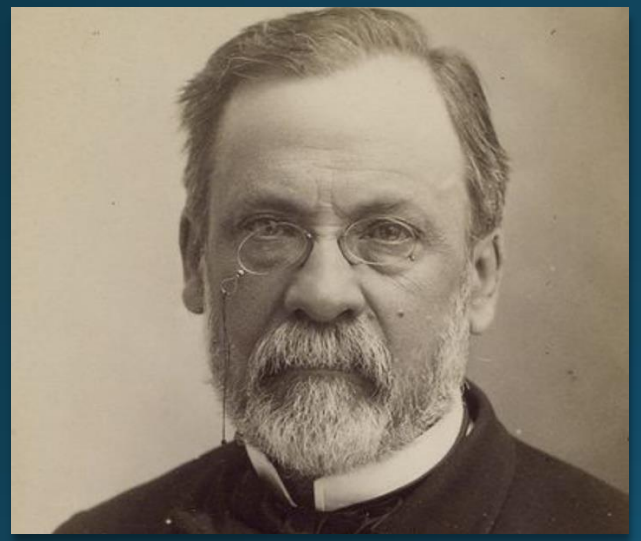
Germ Theory



Public Health Act 1848

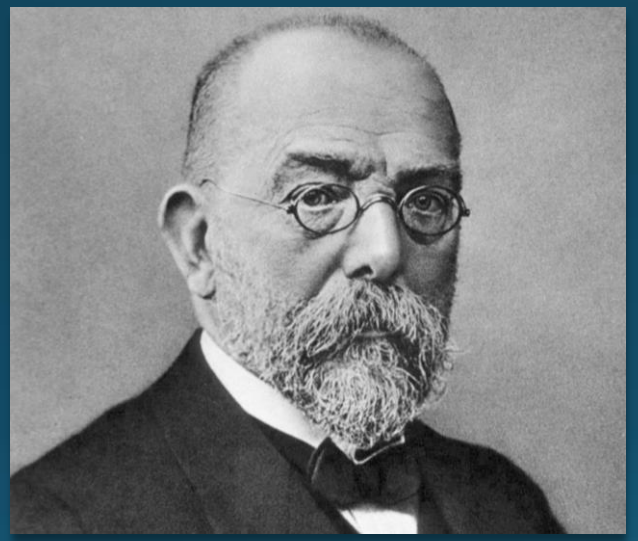
- The aim of the 1848 act was to improve the sanitary condition of towns and populous places in England and Wales by placing: the supply of water; sewerage; drainage; cleansing; paving, and environmental health regulation under a single local body.
- The act could be applied to any place in England and Wales except the City of London and some other areas in the Metropolis already under the control of sewer commissioners.
- Seven more Public Health Acts were past before the end of the 19th century.

Science eventually led to supremacy of the Germ Theory



Louis B. Pasteur

1822-1895



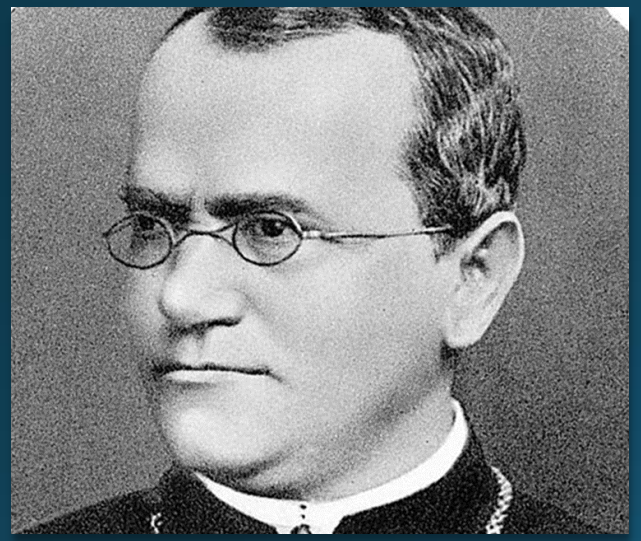
Robert Koch

1833 - 1910

Dmitri Ivanovsky

1864 -1920

Other Science of the 19 Century



Gregor J Mendel

1822-1884

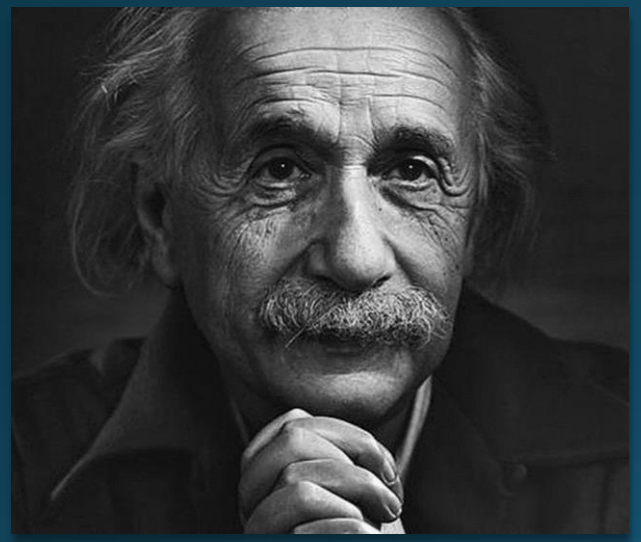
Martinus Beijerinck

1851 - 1931

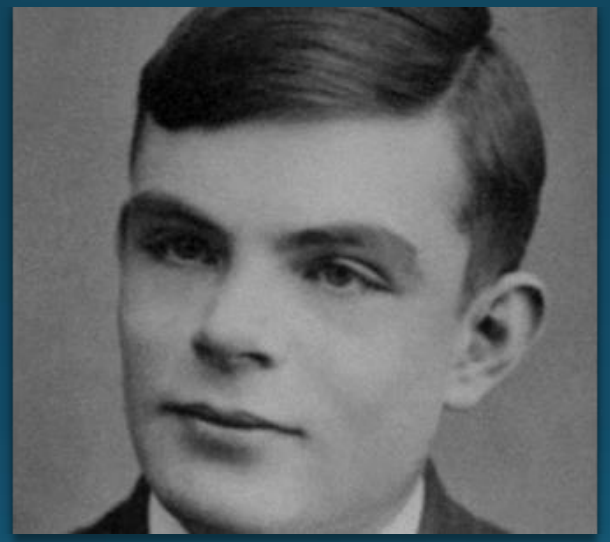
James Clerk Maxwell

1831-1879

Science of the 20th Century



Albert Einstein
1879-1955

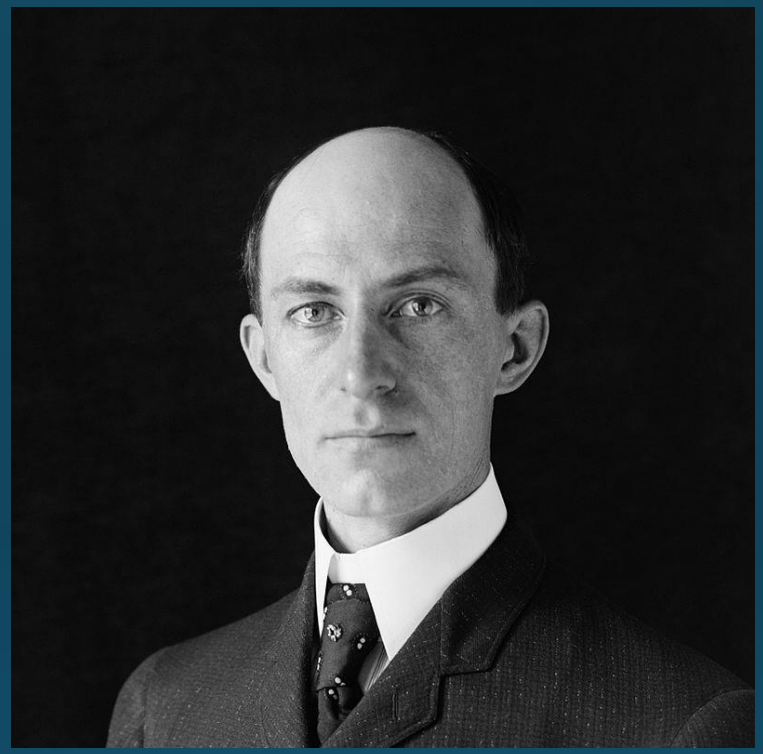


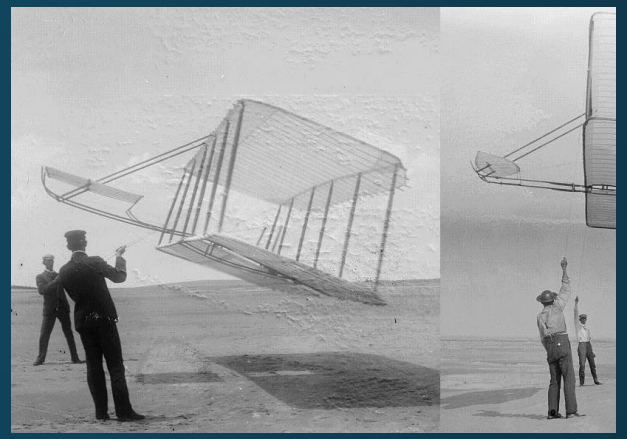
Alan Turing
1912 - 1954

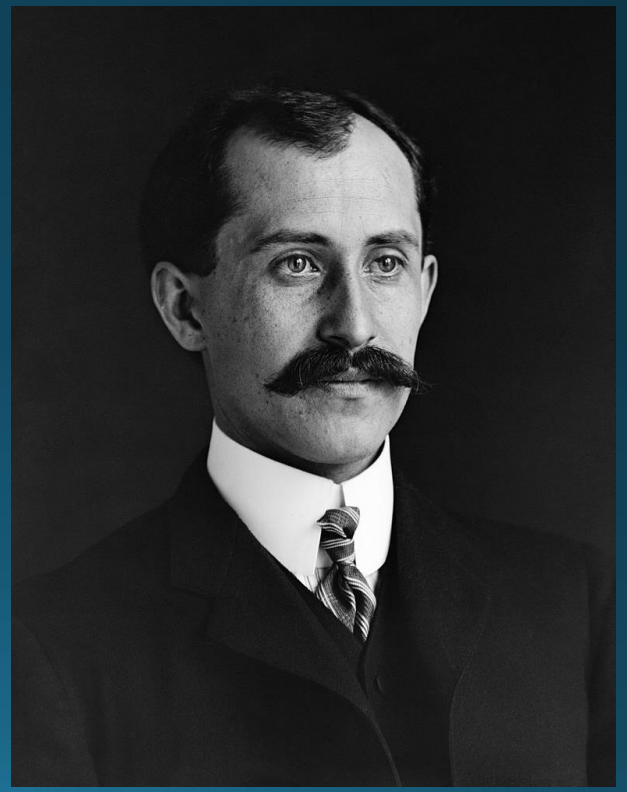
Gertrude B Elion
1918 - 1999

Wright Brothers

Made the first controlled, sustained flight of a powered, heavier-than-air aircraft on December 17, 1903, four miles south of Kitty Hawk, North Carolina.

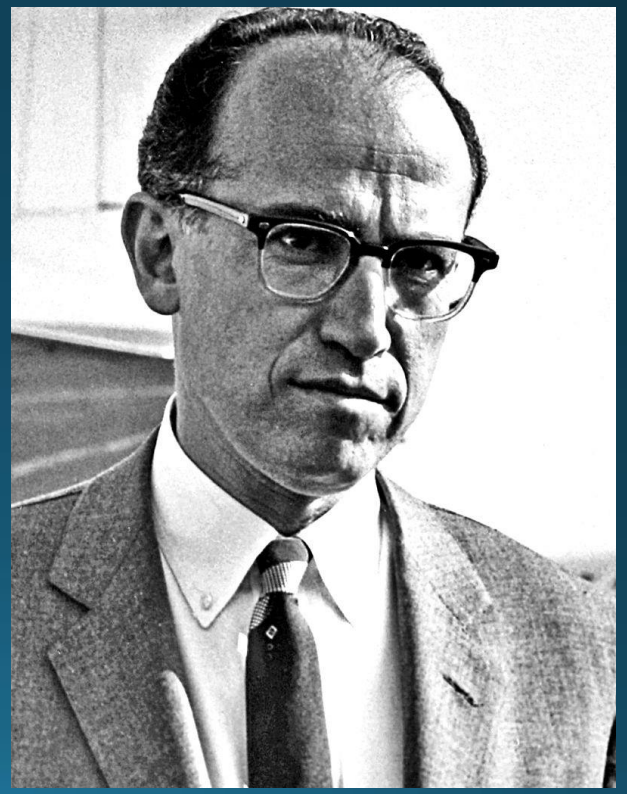






Jonas E Salk 1914-1995

The field trial set up to test the Salk vaccine was the most elaborate program of its kind in history, involving 20,000 physicians and public health officers, 64,000 school personnel, and 220,000 volunteers



Watson - Crick
Nature 1953

James D. Watson and Frances H.C. Crick announce that they have determined the double-helix structure of DNA, Cambridge University

When Crick and Watson won the Nobel Prize in 1962, they shared it with Wilkins, and Rosalind Franklin, who died in 1958 of ovarian cancer

They shared their Nobel Prize with Rosalind Franklin

Helen Keller & Ann Sullivan

Helen's breakthrough in communication came when she realized that the motions her teacher was making on the palm of her hand, while running cool water over her other hand, symbolized the idea of "water“.

The Importance of Words

- Words connect the experience people, including scientists, have with the physical world.
- There was interest early in the last century to philosophies of science that would continue to yield verifiable knowledge.
- The Vienna Circle, etc.
- Helen Keller is exhibit A, for the essential role of well defined terms in all fields of science.

Empirical knowledge:

A body of knowledge of the natural world produced through observations, empirical evidence, and experimentation.

Theoretical knowledge:

Knowledge of theories, rules, laws, and models (*e.g., statistical, conceptual, descriptive, predictive, etc.*), of the natural world based on systematic observations, empirical evidence, and experimentation.

Practical knowledge:

Empirical and theoretical knowledge that improves human conditions through an understanding of the natural world.

John Snow's investigation of the 1854 Cholera Epidemic incorporated *all three* forms of scientific knowledge.

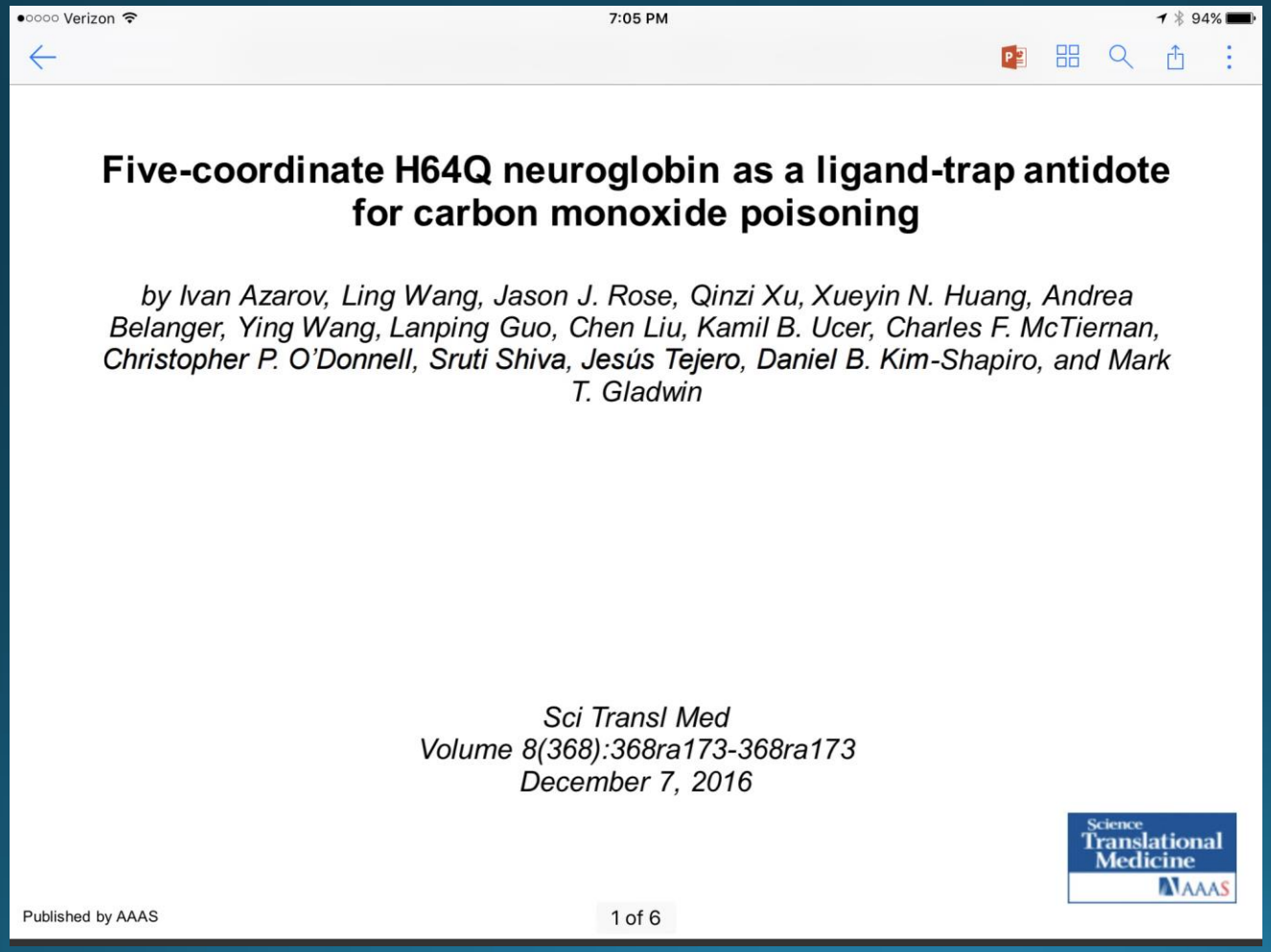
Cause / Causality

- Causality is the relationship between causes and effects.
- It is considered to be fundamental to all natural science, especially physics.
- Causality is also a topic studied from the perspectives of philosophy and statistics.
- Causality means that an effect cannot occur from a cause which is not in the past.

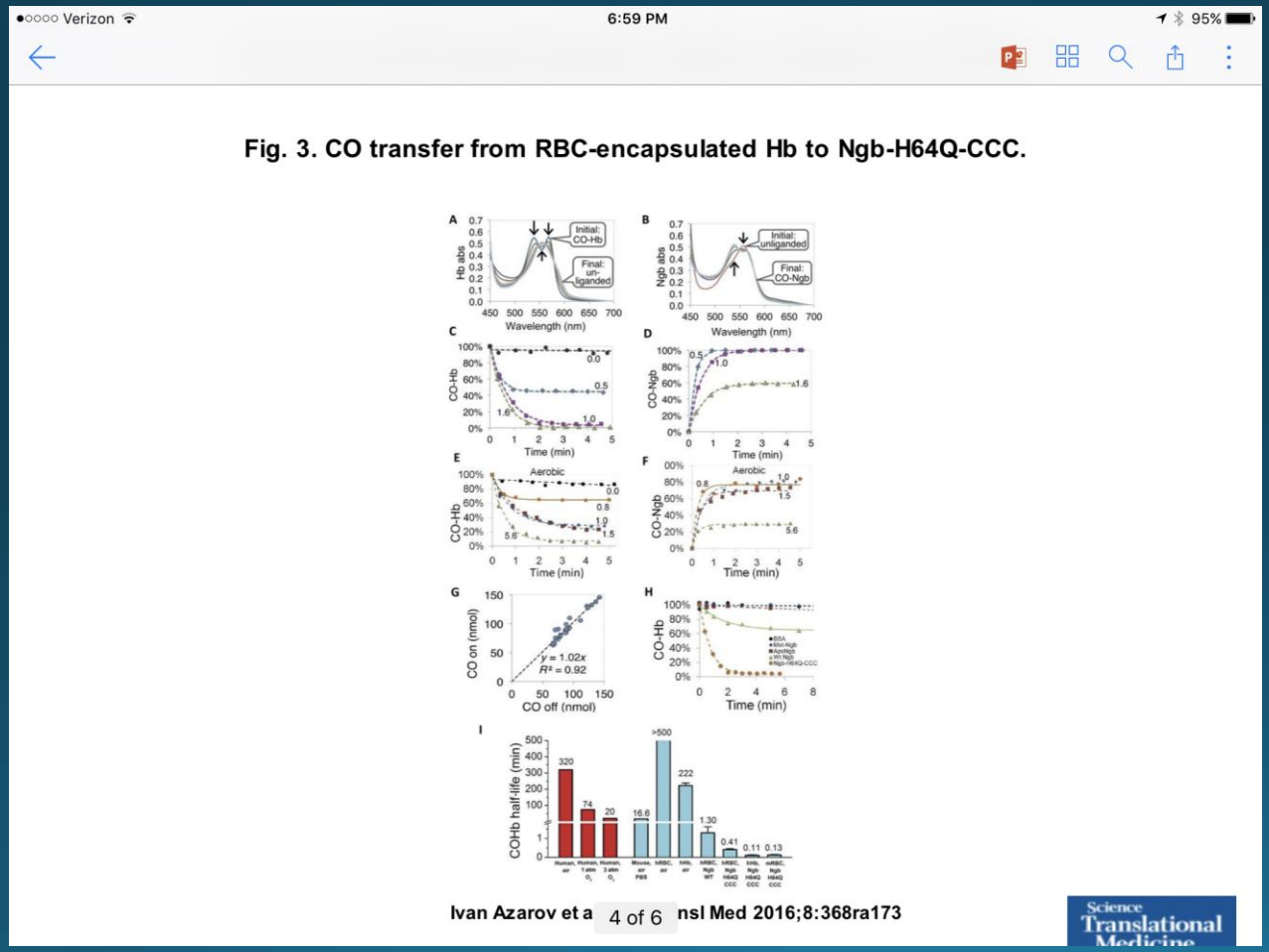
Sir Bradford A Hill

"Amongst the objects of this newly-founded Section of Occupational Medicine are firstly 'to provide a means, not readily afforded elsewhere, whereby physicians and surgeons with a special knowledge of the relationship between sickness and injury and conditions of work may discuss their problems, not only with each other, but also with colleagues in other fields, by holding joint meetings with other Sections of the Society'; and, secondly, 'to make available information about the physical, chemical and psychological hazards of occupation, and in particular about those that are rare or not easily recognized'.

An Antidote for CO Poisoning



CO transfer from Hg to Ngb



From the perspective of an environmental toxicologist.

Sciences relating to human biology are essential in establishing cause.

Risk, alone, cannot establish “cause” comparable to that achieved by Stone.

Causation requires a coherence between risk and a knowledge of human biology mechanism.

Risk, Science, and Causality

Public health is best served when researchers use methods that advance all three forms of scientific knowledge: Empirical, Theoretical and Practical.

Risk Science and Causality
Don’t forget the science of the human body