

Current and Future Trends in Exposure Science

John Cherrie

Summary...

- Be positive, things are getting better
- The role of exposure science in stimulating improvements
- What do we investigate now?
- But what about the future, what does it hold?
- How could exposure science be useful?



The past...

The past was a bad place...

- Nicander of Colophon (130 BC) described the effects of several poisons, including the effects of lead metal



1,000

Around 1,000 new cases of lead poisoning
diagnosed in Britain in 1900

DANGEROUS TRADES

THE HISTORICAL, SOCIAL, AND LEGAL
ASPECTS OF INDUSTRIAL OCCUPATIONS
AS AFFECTING HEALTH, BY A NUMBER
OF EXPERTS

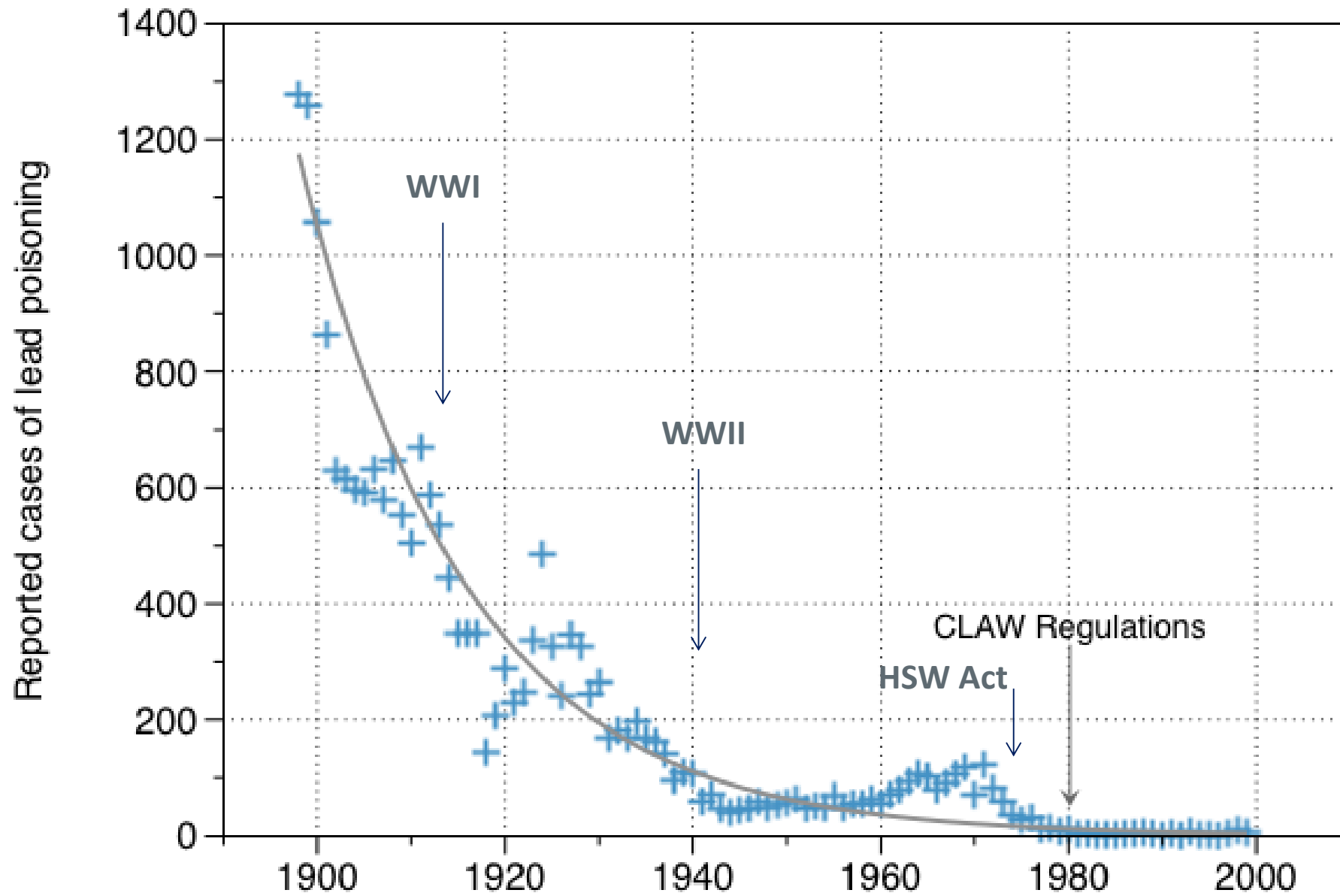
EDITED BY THOMAS OLIVER, M.A., M.D., F.R.C.P.

MEDICAL EXPERT ON THE WHITE LEAD, DANGEROUS TRADES, POTTERY, AND
LUCIFER MATCH COMMITTEES OF THE HOME OFFICE; PROFESSOR
OF PHYSIOLOGY, UNIVERSITY OF DURHAM; PHYSICIAN TO
THE ROYAL INFIRMARY, NEWCASTLE-UPON-TYNE

WITH ILLUSTRATIONS

LONDON
JOHN MURRAY, ALBEMARLE STREET
1902





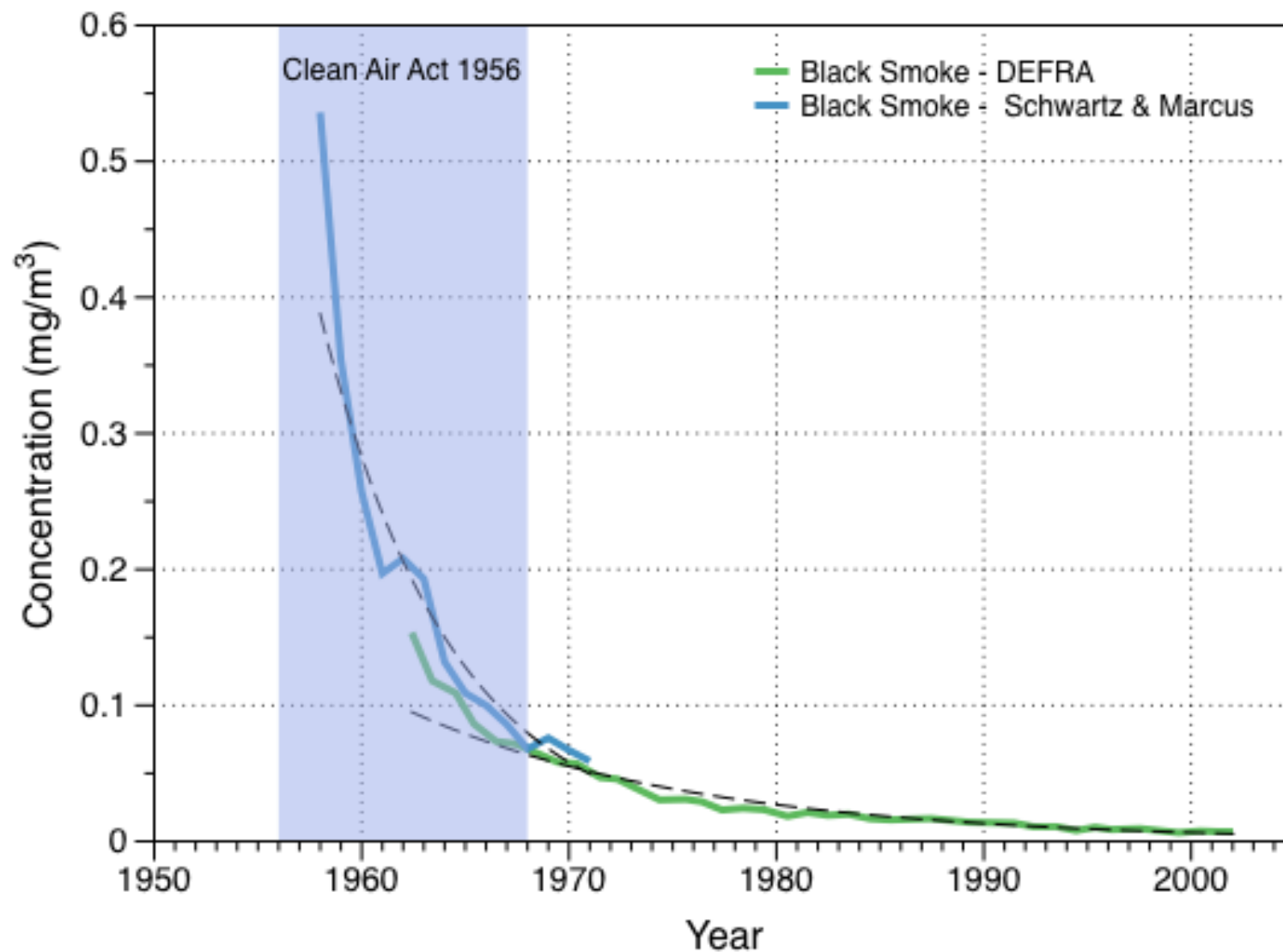
6% per annum
reduction over
the last century



HACKNEY WICK
6
CREATING ORBIT
ENGINE NO

6

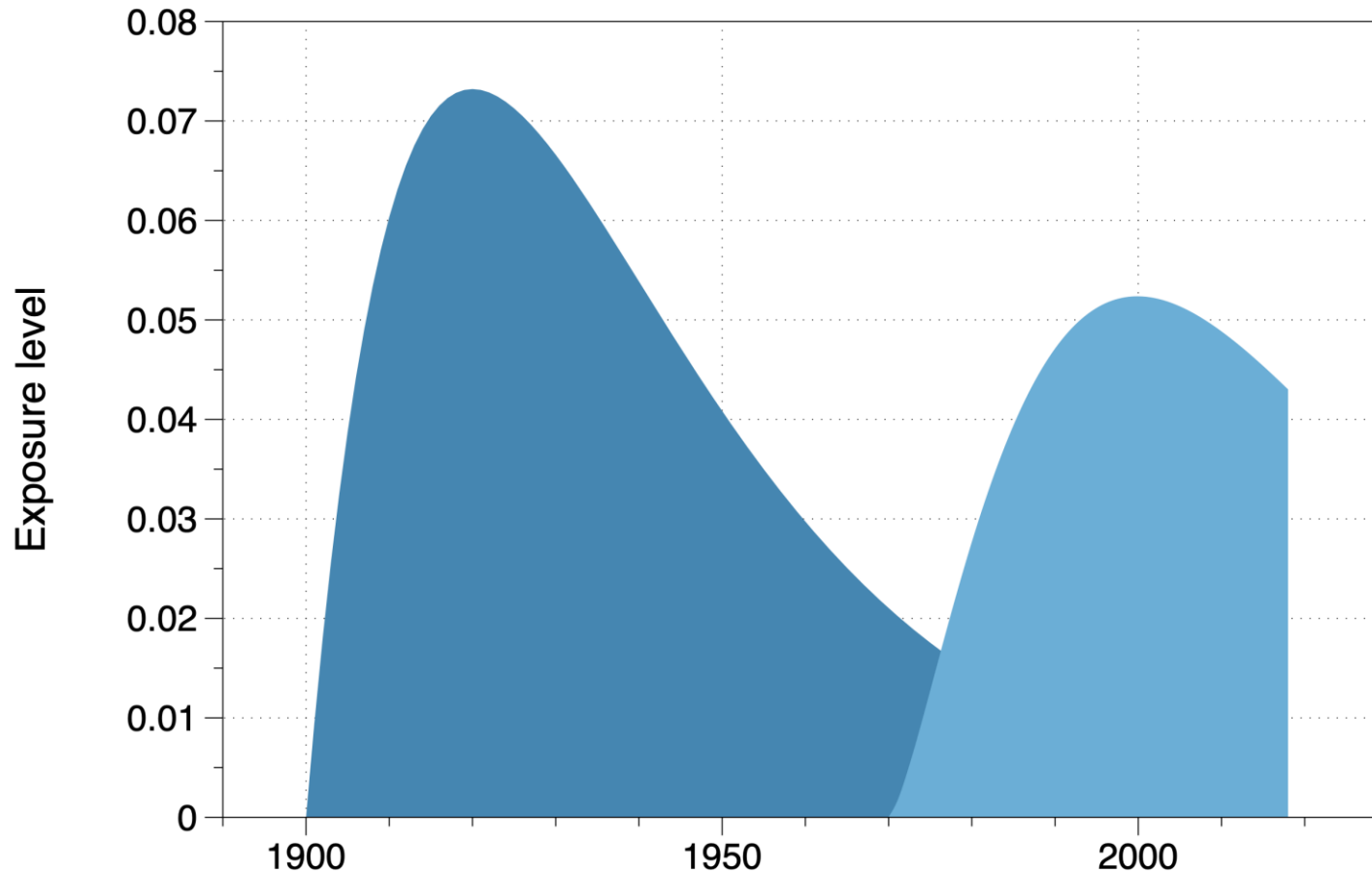
UK particulate matter...



9%

PM concentrations decreasing by
around 9% per annum in London

Most harmful exposures are decreasing...

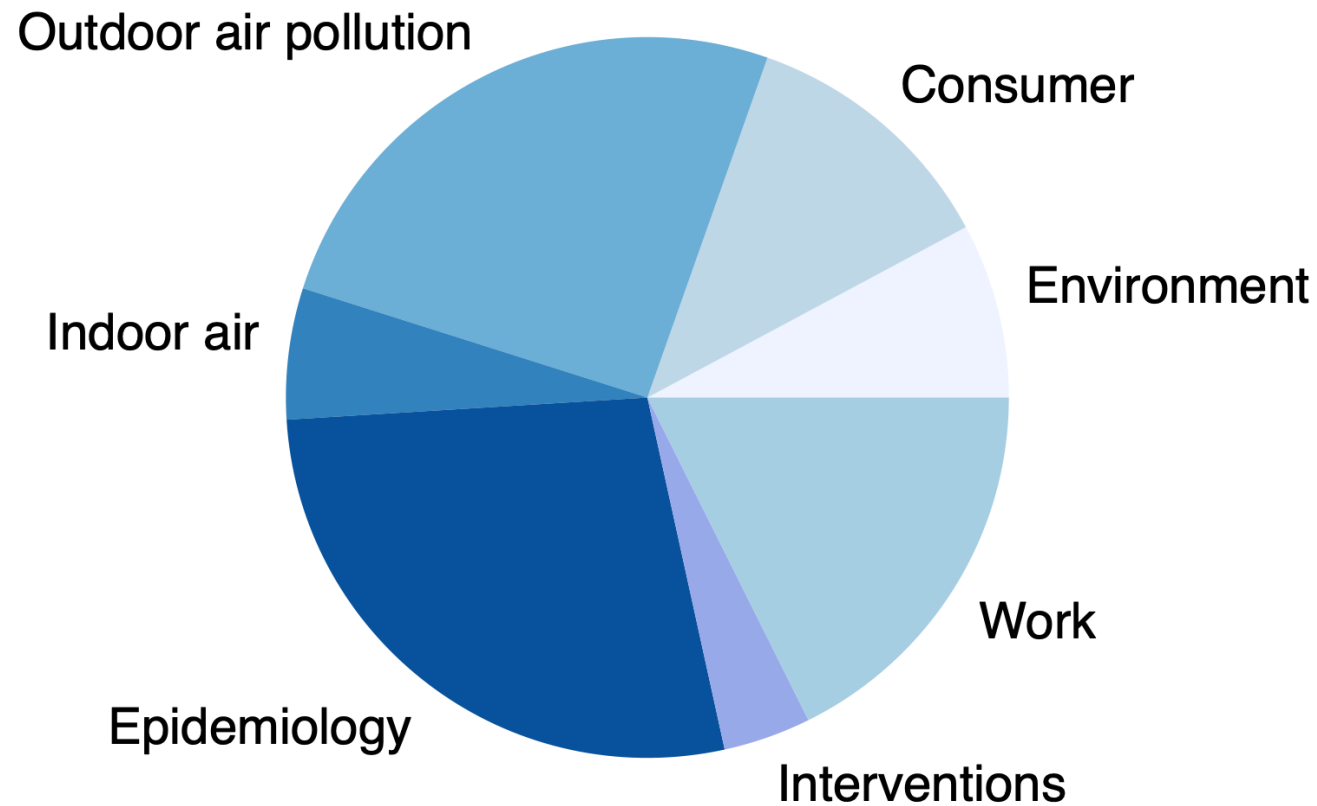


Present...

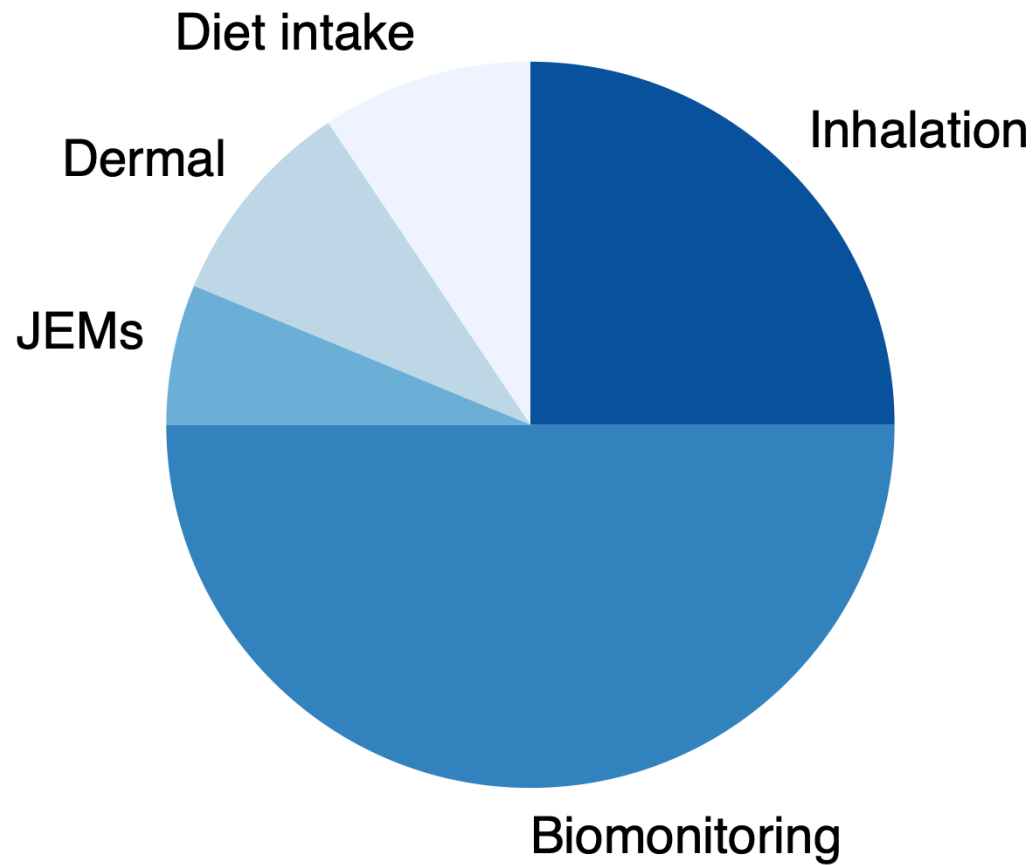
The role of exposure science...

- Exposure science plays an important part in the identification and management of health risks from environmental and workplace hazards
 - Epidemiology
 - Regulatory risk assessment
 - Risk management
 - Development of interventions
 - etc.

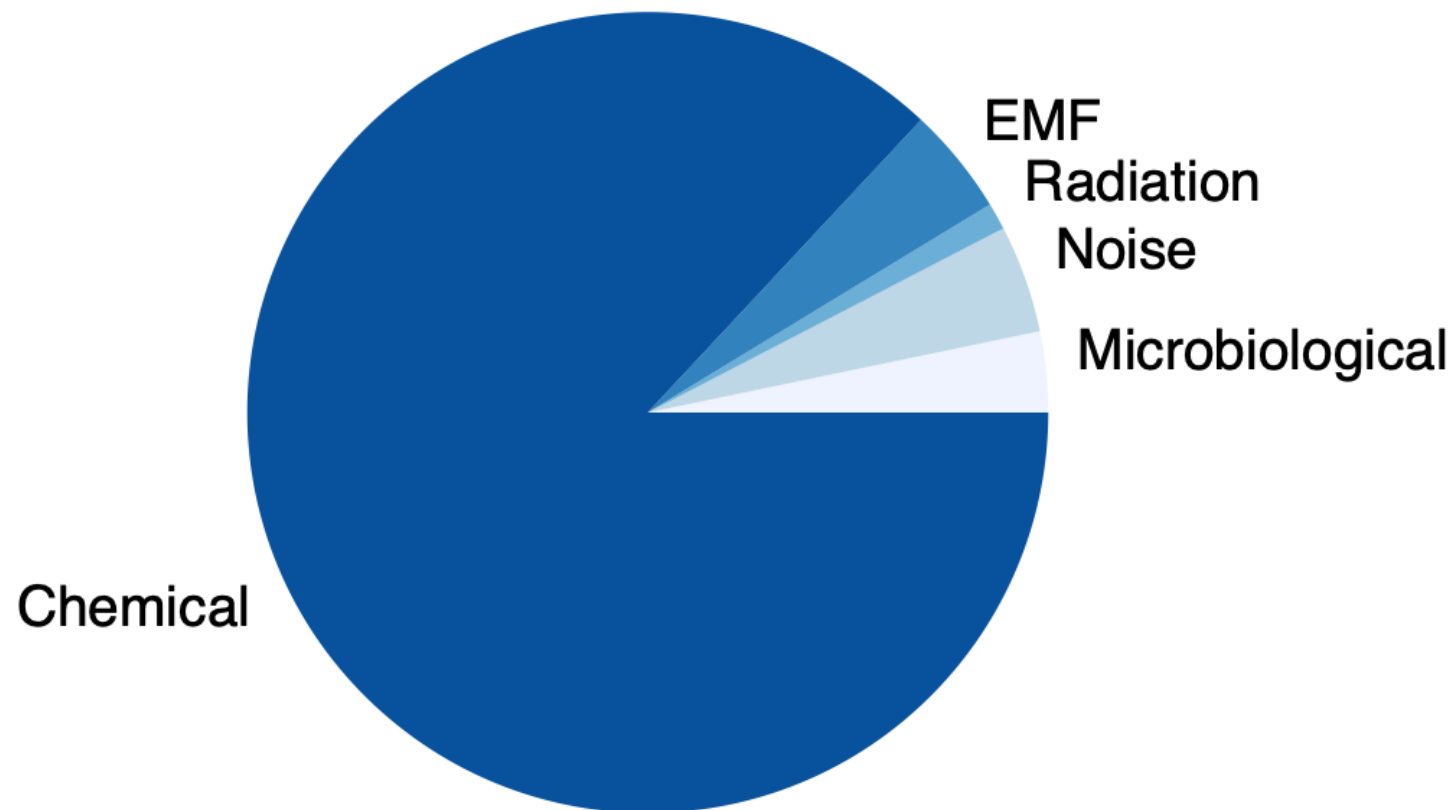
JEESEE papers...



JEESEE papers...



JEESEE papers...



Future...

“I think there is a world market for maybe five computers”.

Thomas Watson, President of IBM, 1943

"There is no reason anyone would want a computer in their home".

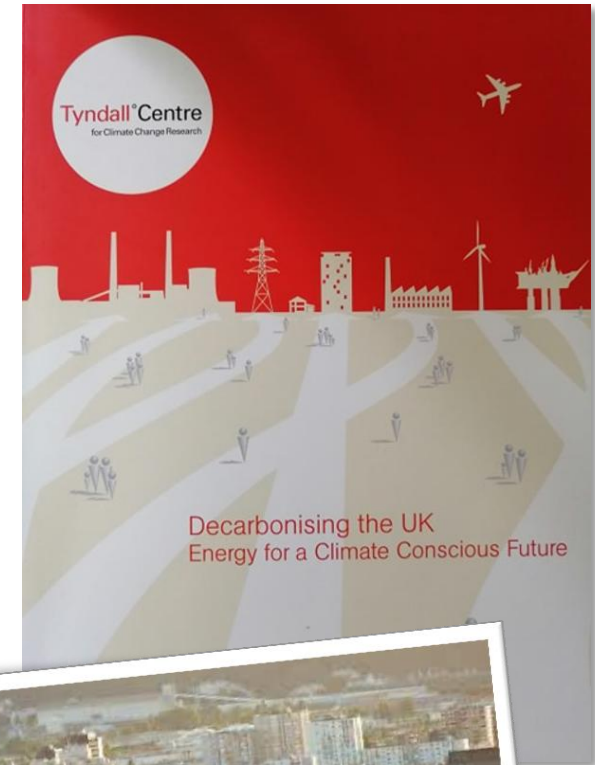
Ken Olsen, founder of Digital Equipment Corporation, 1977





Society is changing...

- Climate change – decarbonisation of society
- Urbanisation
- Aging population
- Greater diversity
- Greater deprivation
- Personal isolation
- Specific AI, big data and the internet of things
- ...



Work is changing...

- Transition to a service-based economy
- More frequent change in employment
- Work into older age
- Less job security
- Temporary migration for work more common
- Boundary between work and life blurred
- ...



Two-thirds of the deaths in the world are caused by noncommunicable diseases, especially cancer and cardiovascular disease

Only about 10% of this mortality attributed to genetic variation

Genome



Steve Rappaport

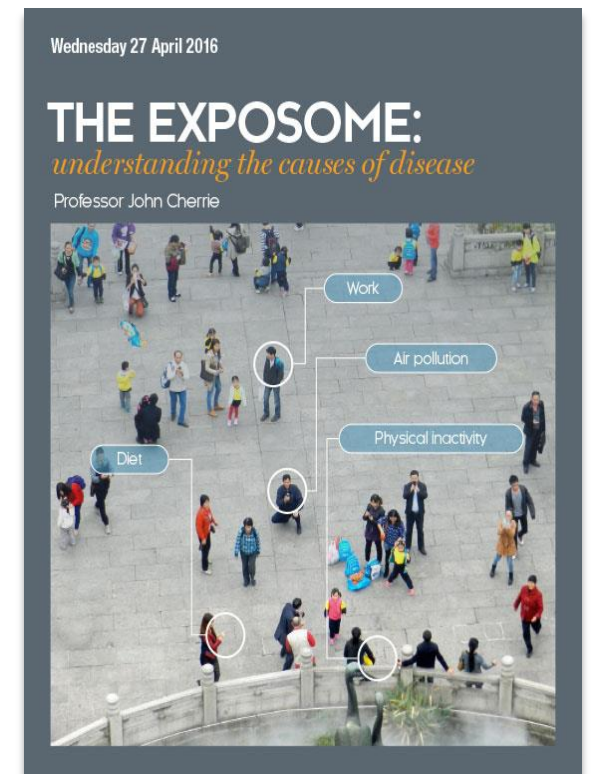
The exposome is composed of every exposure to which an individual is subjected from conception to death.



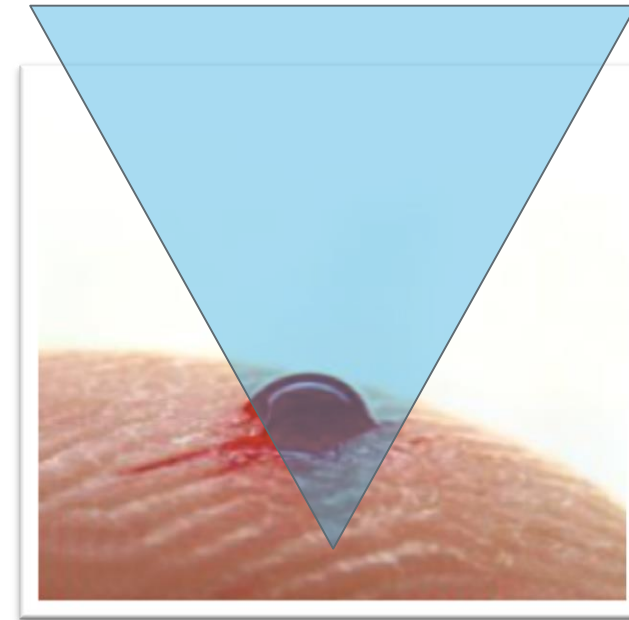
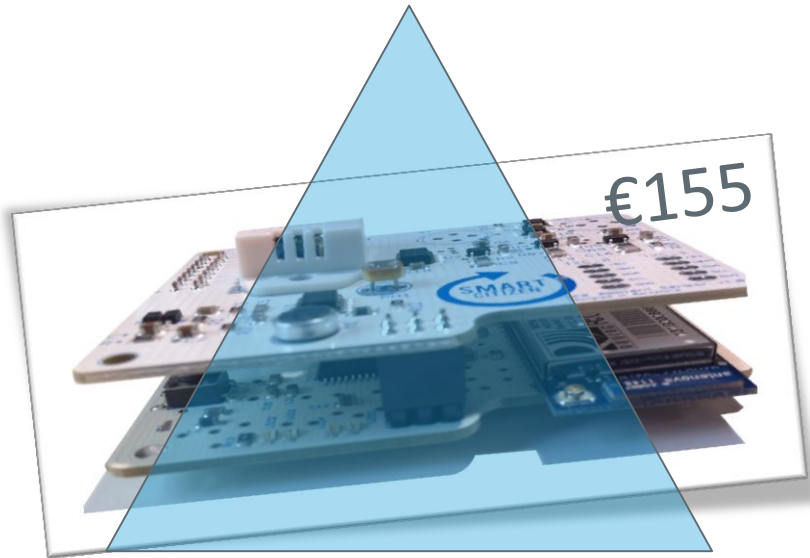
Exposome

The Exposome comprises...

- processes internal to the body such as metabolism, gut microflora, inflammation...
- external exposures including infectious agents, chemical contaminants, diet...
- social, economic and psychological influences.



Bottom-up or Top-down



Or a more use a more integrated approach?

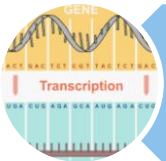
Omics...



Epigenome

DNA methylation
Histone modification

Microarrays
Sequencing



Transcriptome

mRNA

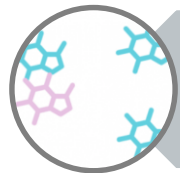
Microarrays
RNA sequencing



Proteome

Proteins

Microarrays
Mass spectrometry

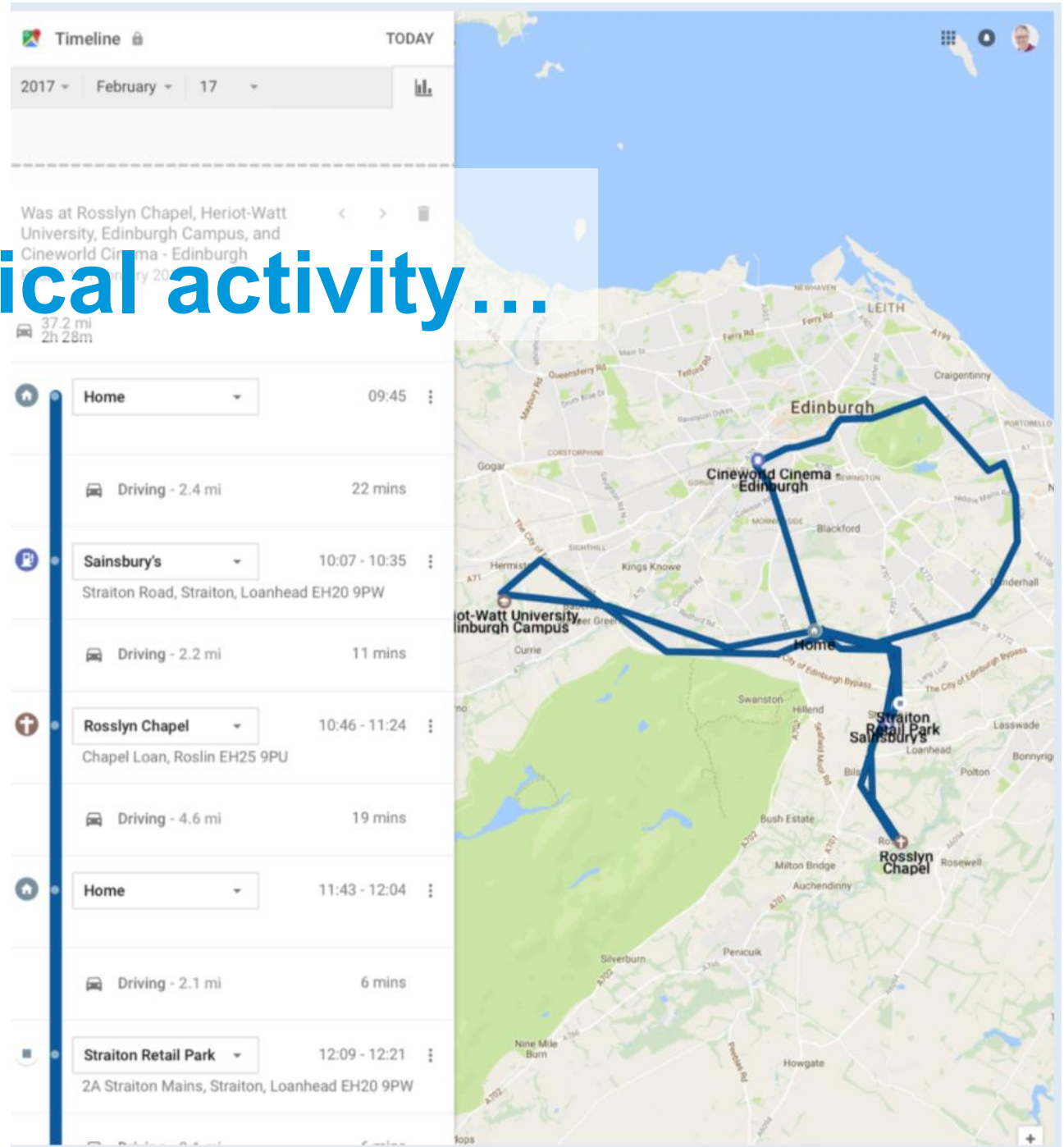


Metabolome

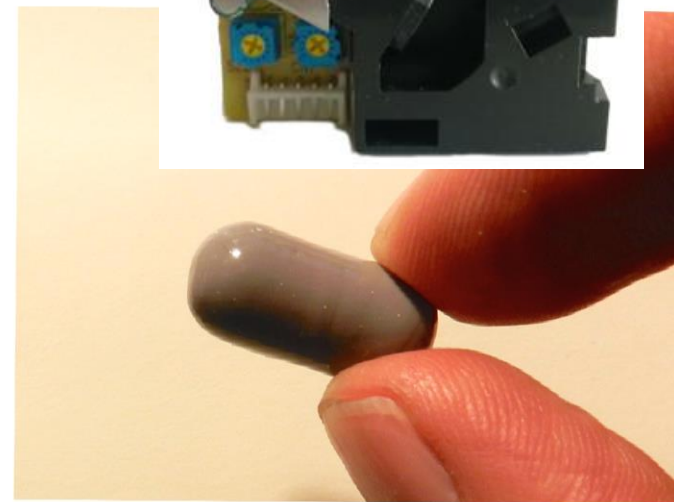
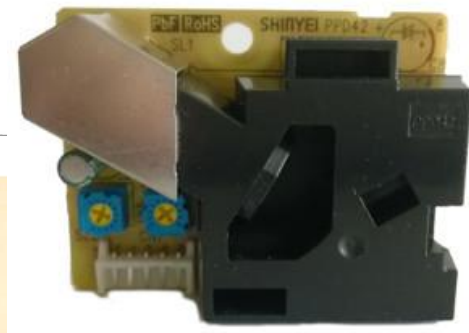
Small molecules

Mass spectrometry
NMR spectroscopy

Location and physical activity...



Sens



Air Quality



Measure different exposures...

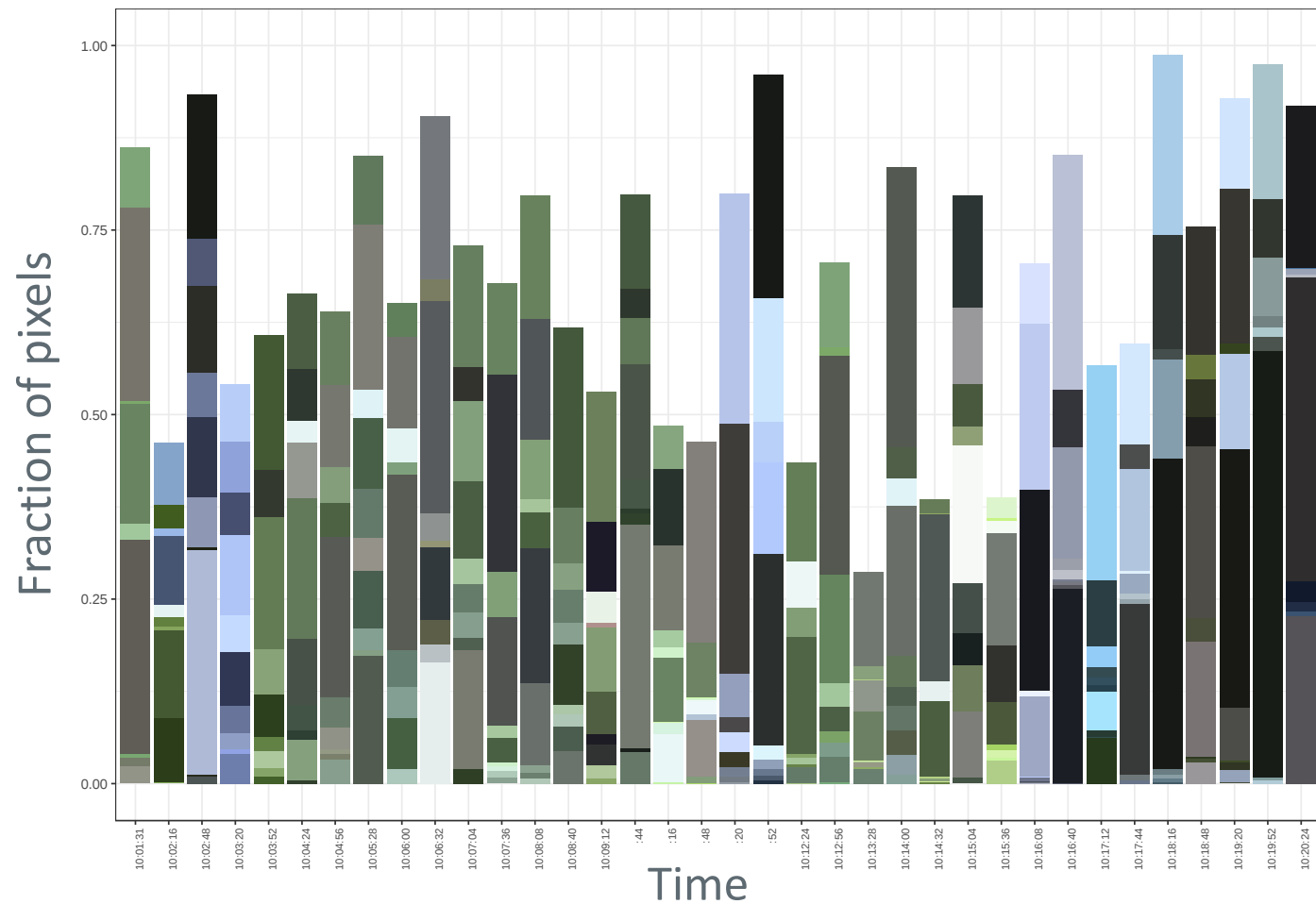
- Ambulatory EEG
- Audio content analysis of background sounds
- Body position, movement and physical loads
- Visual analysis people and landscape





Life-logging cameras...

Green space...



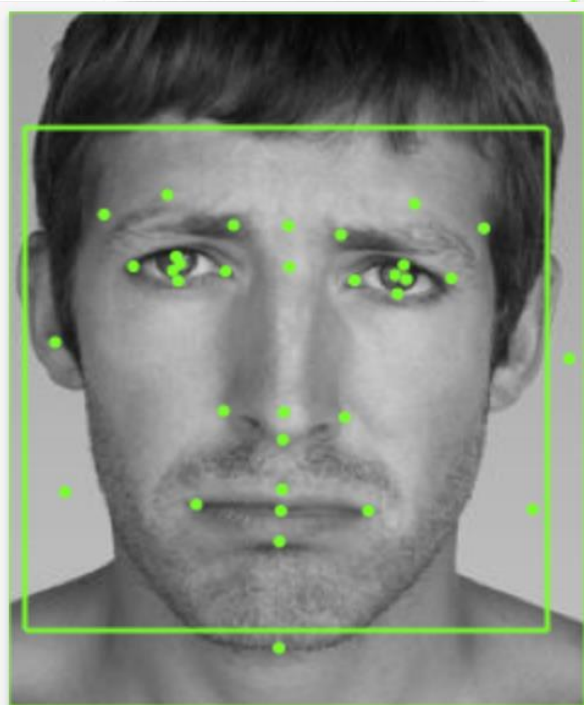
Food analysis...



IMG_3433.jpeg

Dish	88%
Food	83%
Roasting	73%
Vegetable	67%
Animal Source Foods	62%
Cuisine	55%
Recipe	54%
Meat	51%

Sens



Screenshot 2018-10-25 at 19.50.28.png

Joy	■	Very Unlikely
Sorrow	■ ■ ■	Possible
Anger	■	Very Unlikely
Surprise	■	Very Unlikely
Exposed	■	Very Unlikely
Blurred	■	Very Unlikely
Headwear	■	Very Unlikely

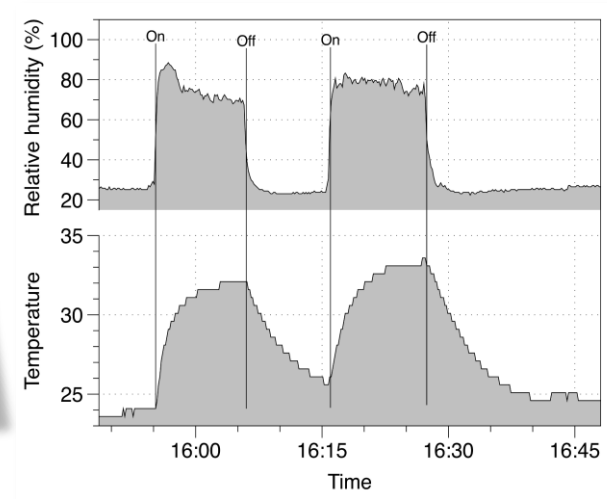
Roll: 2° Tilt: -7° Pan: -4°

Confidence 81%



Sensor for mask wearing...

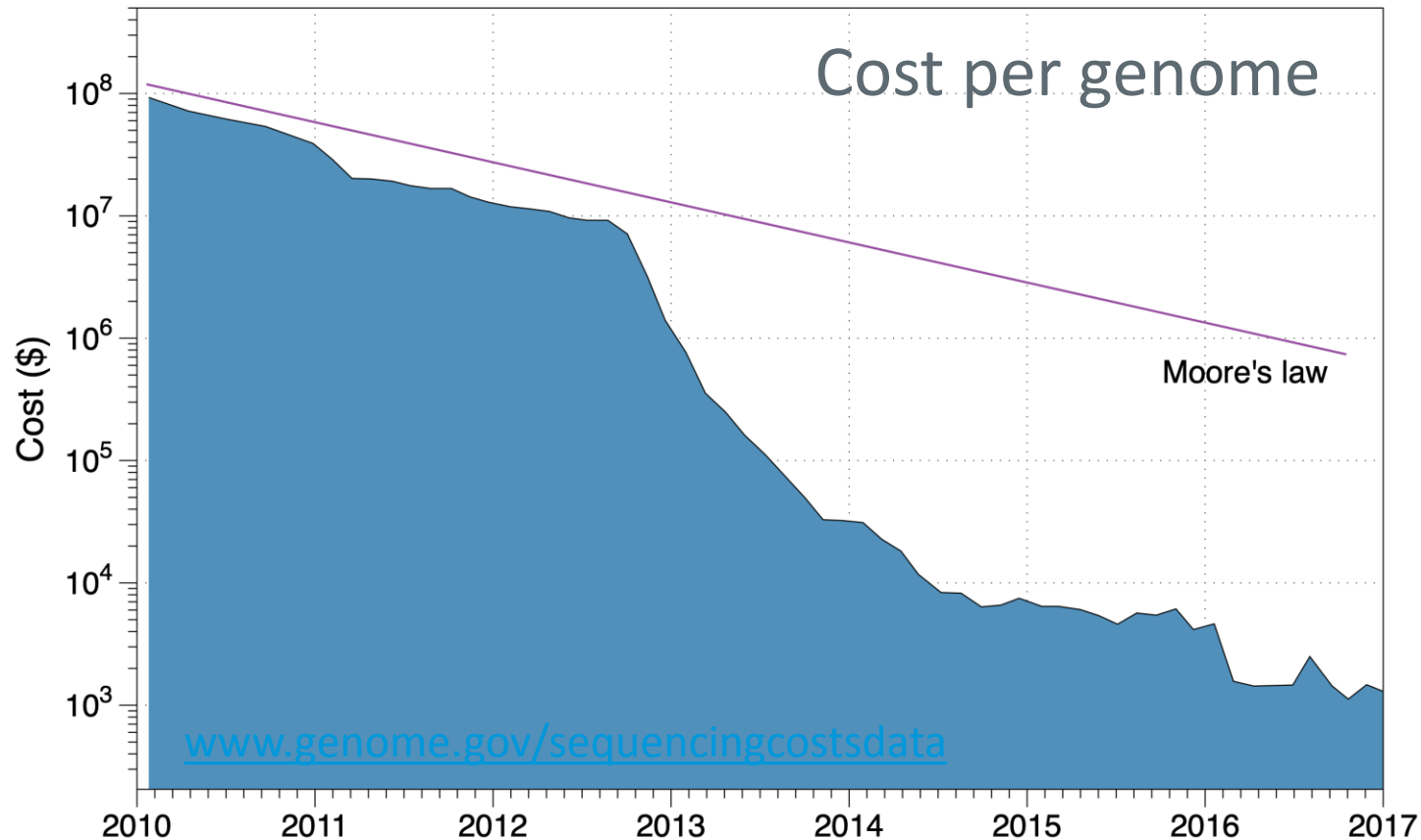
- Used data logging temperature and humidity sensor (iButton) inside mask
 - Laboratory assessment comparing with exhaled breath temperature (EBT) and time on/off
 - Field trials



Big data...

- Workplace training/competence records
- Worksite access data
- Supermarket loyalty card records
- Travel pass records
- Social media posts
- Data from the internet of things (IoT)

Gene – Environment interactions...





Prospective
epidemiological
studies...

Conclusions...

- The world is changing
- There are many new risks and probably many unknown risks
- Traditional approach to exposure assessment is inadequate
- The exposome offers new opportunities
- However, we need to start new prospective cohort studies



Acknowledgement...

Miranda Loh, Martie van Tongeren and many others



The HEALS project received funding from the EU Seventh Programme for research, technological development and demonstration under grant agreement No 603946.

EXPOSOGAS was funded under the EU H2020 programme. Grant No 810995