Science, Open Science, Covid and Climate

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“From Tackling the Pandemic to Addressing Climate Change”

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Science, Open Science, Covid and Climate

1. Some Scientific Fundamentals

2. Open Science: How did we get to here?

3. Covid: seizing the Open Science opportunity

4. Why it matters: the wake-up call for science and society
Scientific Fundamentals and Practices

The fundamentals do not change as we enter a new era of open science:
- maintaining rigour by sceptical scrutiny of accessible concepts and evidence
- communicating and disseminating understanding

But:
the way science is done and its contribution to the public good are changing because:
- digital technologies have enlarged opportunities for discovery, communication and dissemination
- social and political expectations of science and of the global public good have evolved

Consequence:
The Open Science Movement
No amount of experimentation can prove me right. A single experiment can prove me wrong.

Albert Einstein

The progress of science is strewn, like an ancient desert trail, with the bleached skeletons of discarded theories that once seemed to possess eternal life.

Arthur Koestler

The purpose of science is not to open a door to infinite wisdom, but to set a limit to infinite error.

Bertholt Brecht
2. Open Science: How did we get here?
edifices, even though in science at least, electronic access anywhere, any time, is the norm, dispersed support from appropriately trained e-librarians is the need, and few scientists now darken the door of a conventional library.

The data explosion and our capacity to combine, integrate and analyse data offer powerful new ways of unravelling complexity, improving forecasts of system behaviour and detecting patterns in phenomena that have hitherto been beyond our capacity to resolve. They offer the opportunity to reuse, to combine and to recombine data in ways that deepen these capacities. Exploiting these opportunities will depend upon access to and linking between many data sets, requiring that research data should be made routinely open and readily accessible. It will depend upon developing an ethos of data sharing and facilitating new modes of collaboration that increase the creativity of the scientific enterprise through interaction of many brains and many communities unbounded by institutional walls. These changes would also enable scientific concepts and the evidence that underlies them to be more effectively disseminated through society and in education, in ways that could change the social dynamics of science, contributing towards the evolution of science as a public enterprise rather than one conducted behind closed laboratory doors.

There is, however, a downside to the ‘data explosion’, of which we have only recently become aware. Such are the magnitudes of much of the data that provide the evidence for scientific concepts, that traditional habits of rigorous inclusion of data, and the metadata that describes their genesis, in conventionally published work have fallen away in recent decades. As a consequence, science may have been sleepwalking into a crisis of credibility. This was exemplified two years ago by a paper in which the authors reported attempts to replicate the results of 50 benchmark papers in pre-clinical oncology. They succeeded in doing so in only 11% of cases. The failure in 89% of cases reflected in part failures of scientific logic, but in many it reflected the failure to include adequate data or metadata, such that even if the conclusions had been logically...
The digital revolution

Storage – analysis – communication

Global information storage capacity
In optimally compressed bytes

1986

1993

2000

2007

Analogue Storage

Digital Storage

0.02 Zettabytes

2020 – 7 Zettabytes

1 Zettabyte = 10^{21} bytes
The technologies by which knowledge is acquired, stored and communicated have always been essential drivers of human material and social progress.

A World Historical Event

Johannes Gutenberg
1400-1468

The Digital Revolution – 1990 - ?

- vast data streams
- vast source diversity
- vast computational capacity
- learning algorithms
- instantaneous communication
- access anywhere anytime
- low cost

A NETWORKED EARTH

TRANSFORMATION OF THE HUMAN?
Open Science Act 1: Open Access

The Budapest Open Access Declaration – 2002

“An old tradition and a new technology have converged to make possible an unprecedented public good.

The old tradition is the willingness of scientists and scholars to publish the fruits of their research in scholarly journals without payment, for the sake of inquiry and knowledge.

The new technology is the internet.

The public good they make possible is the worldwide electronic distribution of the peer-reviewed journal literature and completely free and unrestricted access to it by all scientists, scholars, teachers, students and other curious minds.”
“....the next [21st] century will be the century of complexity”

general availability of findable, accessible, interoperable re-useable (FAIR) data

scientific rigour demands: data, meta-data and code that provides the evidence for a published claim to be concurrently available for scrutiny.
Science in Africa must become a more public enterprise that engages actively with business, policymakers, governments, communities and citizens as knowledge partners in jointly framing questions and jointly seeking solutions rather than one conducted behind closed laboratory and library doors.

The Platform will work to:
• enable scientists and communities to create actionable knowledge;
• enhance the credibility, practical relevance and socio-political legitimacy of science in and for Africa;
• strengthen the pan-African voice in global science.
Act 4: Defining Open Science (2020/21)

PURPOSE

• Open Access
• Open Infrastructure
• Open Data
• Open Source
• Open Evaluation
• Citizen Science
• Open Notebook
• Open Labs
• Open Educational Resources
• Open Innovation
• Open Hardware

PROCESS

• scrutinise and challenge truth claims (rigour)
• serve the knowledge needs and interests of wider publics (democratisation)
• maintain the record of science, its evolving stock of knowledge, ideas and possibilities accessible and free to all, irrespective of geography, gender, ethnicity or financial circumstance (efficiency)
• open the data and evidence of science to be accessible and re-usable by all, subject to constraints of safety, security and privacy (complexity)
• engage with other societal actors in the common pursuit of new knowledge, and in supporting humanity in achieving sustainable and equitable life on planet Earth (sustainability)
A Barrier to Open Science
how not to Assess Science – use proxy metrics

Proxy measures
• citation indices
• journal impact factors
• university rankings

A dysfunctional market
• paper productivity not science productivity
• drive predatory journal market
• drive price inflation
• fragment the science community
• undermine education
• places record of science behind paywall
• strategic data about science in private hands

Goodhart’s Law
“When a measure becomes a target, it ceases to be a good measure”.

Richard Goodhart
3. Covid: seizing the Open Science Opportunity
The Open Science in Action

Communicating to diverse audiences
- Clarity – Credibility
- Communicate uncertainty and risk – a basis for trust
- Context and relevance to varied audiences

Delivering access to knowledge
- Websites & data platforms
- Sharing and rapid release of results

Co-production of knowledge
- Science & civil society
- Supporting community action
The big lesson for science from Covid

A stress test for Open Science. The utility of broad-spectrum Open Science has largely been a matter of conjecture - no longer:

- Spontaneous response from a great diversity of sciences
- Unrivalled sharing, and across the public/private interface
- Agile release of emergent science
- New open data resources
- Rapid publication and pre-prints
- Effective communication of science in the public domain
- Revelation of the richness and relevance of scientific knowledge over a wide spectrum

The Director of the US National Institute of Health: “we have never seen anything like this”
“the phenomenal effort will change science – and scientists – for ever”

The opportunity for this be the new normal for science?
What would make it so?
The Challenge for Science

“Never waste a Good Crisis!”

W.S. Churchill
Priorities for change

I. Affordable, universal open access
II. Open licensing
III. Rigorous, efficient, timely peer review
IV. Data publication
V. Maintaining the record of science
VI. Inter-operation between disciplines
VII. Digitally enabled publication & dissemination
VIII. Governance in scientific hands
Urgent reforms

Normalise:
• Pre-prints, servers, overlay review
• Open Licenses
• Citable data publication

Implement:
• Novel peer review
• Platform-agnostic discovery services
• Global curation infrastructures for the Record of Science

Governance
• Within the science community
• Incentives from bibliometric to open science
• Globally inclusive/nationally efficient
• Distributed functions/common standards

Exploit the Digital

“The Journal is dead, but if its not, it should be. Journals are unnecessary with online publishing. Using a journal to restrict access is outrageous.”
Governance and inclusivity are vital: common standards, distributed functions

e.g. International response to the 2014-2016 Ebola Crisis

Only a selection of international responders is shown. There were many more.
At the end of the outbreak, international institutions left, and took the data with them.
4. Lessons from COVID: the wake-up call for science and society
Lesson 1:

We’re all in this together
COVID and CLIMATE are predictable parts of the planetary economy.

They are not, in any rational meaning of the term, “externalities”.

The human economy is also part of the planetary economy, but not, in the short term, so predictable.

Do we have to monetise the environment in order to deal rationally with it?
Lesson 3: Act early, act Hard

A tale of two islands

Confirmed cases

Early

Australia

Taiwan

Inbound quarantine

Inbound quarantine

Hard

Fewest control measures

Mass.  
Vt.  
Del.  
Calif.  
Conn.  
Hawaii  
Maine  
R.I.  
N.Y.  
N.M.

March 1  
Nov. 16
Emerging Scientific consensus

Carbon Dioxide: the global thermostat
It’s getting late

Warming & CO₂ 100x faster than the end of Ice Age warming

Emerging Scientific consensus

Lost opportunity
Why do we fail to act?

- Populist politics – don’t be a bringer of bad news?
- Credibility – it’s only a theory?
- Hard wired for the immediate?
- Lack of imagination?
- Cheating?

We need to understand these psychologies in an age of pandemics, of climate change and looming planetary boundaries.
Lesson 4: Where does all this science come from?

“because of capitalism, because of greed”

“I’m mainly motivated by greed”
It comes from efficient national science systems

Self-organizing Triad

- Government
  - Jobs/growth/innovation
  - Knowledge exchange
- Funding agencies
  - Strategic Excellence
- Universities
  - Highly competitive
  - Strategic research
  - Academic freedom as enabler of broad-spectrum research

Public Good Motivation
A quartet?

Governments
- Jobs/growth/innovation
- Knowledge exchange

Funding agencies
- Strategic priorities
- Excellent research

Universities
- Highly competitive
- Strategic research
- Curiosity-driven research

Institutes
- Strategic Research

System disruption?

Public
- Good
- Motivation

Commercial
- Platform
- Shareholder value
Lesson 5: There is no silver bullet

The Swiss Cheese Respiratory Virus Pandemic Defence

Recognising that no single intervention is perfect at preventing spread

Physical distance
Stay home if sick
Masks
Hand hygiene, cough etiquette
Avoid touching your face
If crowded, limit your time
Fast & sensitive testing & tracing
Ventilation, outdoors, air filtration
Government messaging & financial support
Quarantine & isolation
Vaccines

Personal responsibilities

Shared responsibilities

Each intervention (layer) has imperfections (holes).
Multiple layers improve success.
Final Lesson: no vaccine for climate change