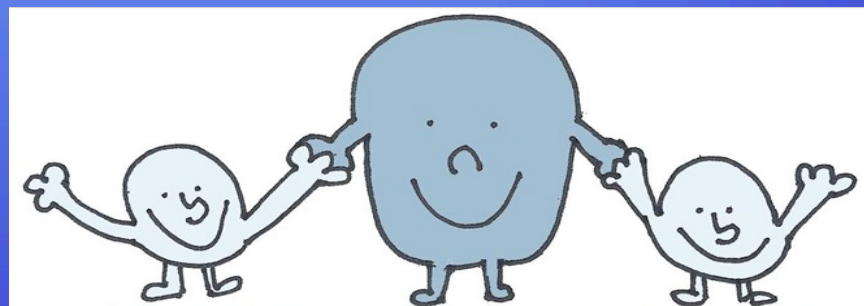
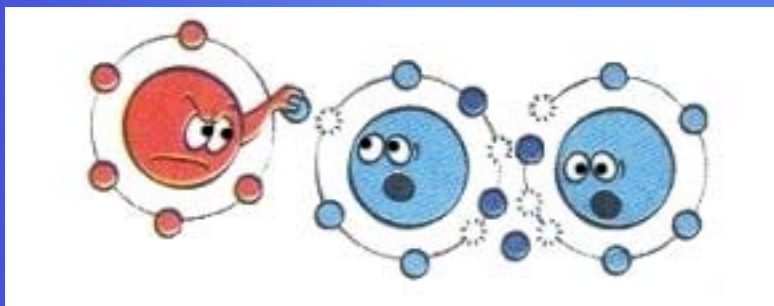


“Molecule say ‘hello’ to molecule”: Technological Innovation under the Microscope

Andelka Phillips, Oxford University

I. S. Mian, University College London

Jan Charbonneau, University of Tasmania



Traditional Communication

Information transmitted from senders to receivers via acoustic or electrical signals

What if information could be transmitted from senders to receivers by molecules?

with particles both *carriers* of information & the *information* itself?

Example of a communication system

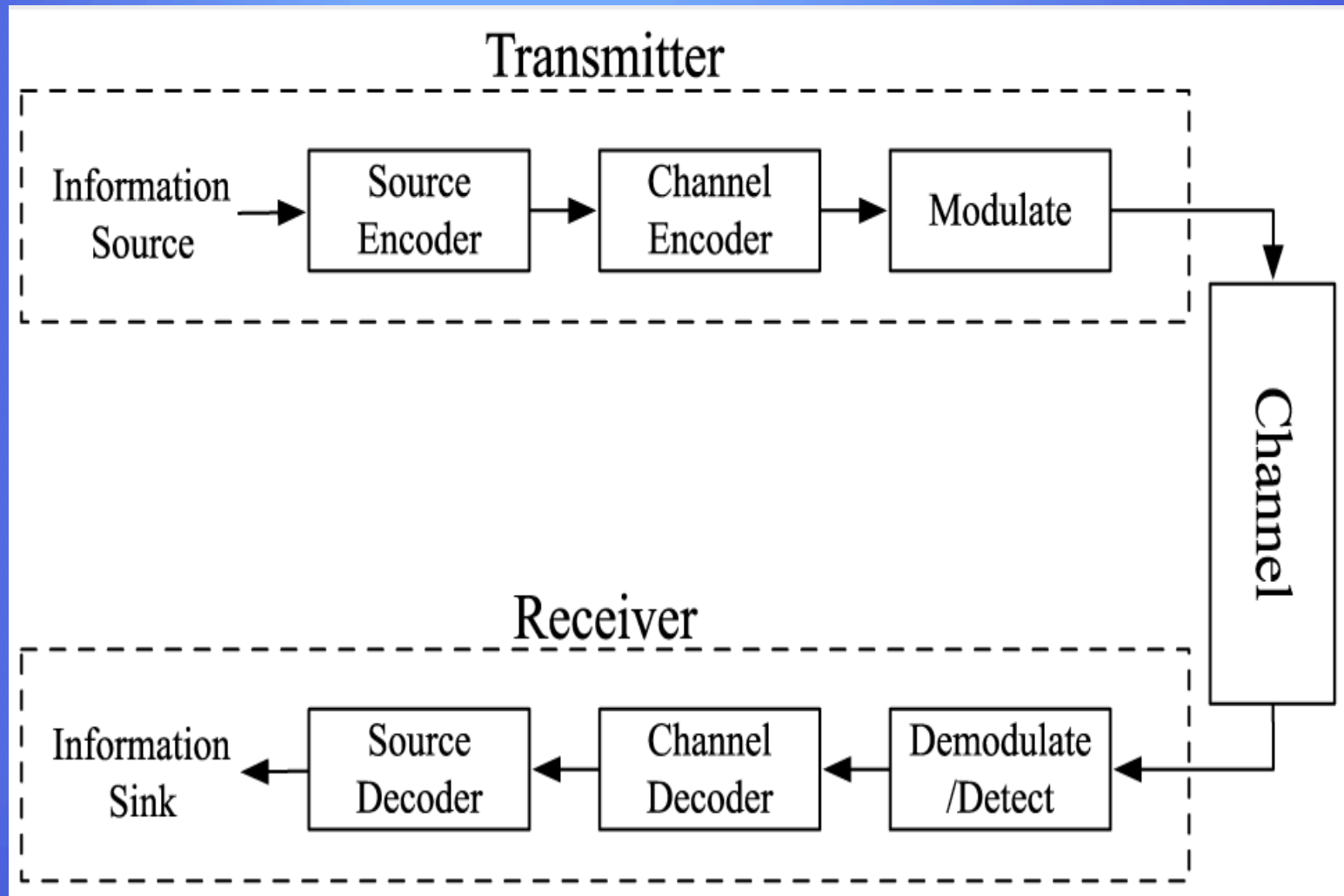
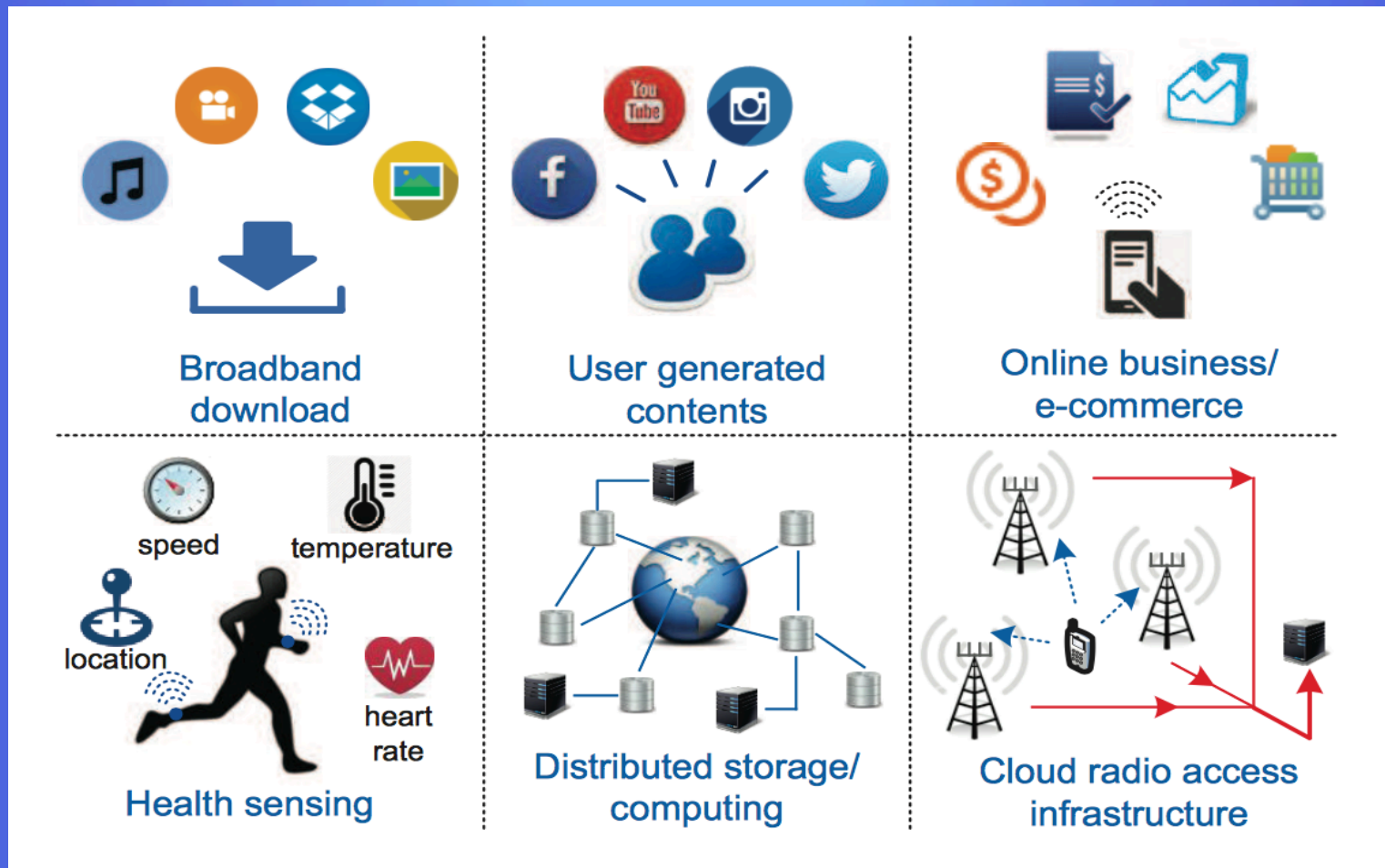


Figure taken from Nariman Farsad , Weisi Guo, Andrew W. Eckford, 'Tabletop Molecular Communication: Text Messages through Chemical Signals' Published: December 18, 2013 DOI: 10.1371/journal.pone.0082935

Big Data Traffic



Suzhi Bi, Rui Zhang, Zhi Ding, Shuguang Cui, 'Wireless Communications in the Era of Big Data' <http://arxiv.org/abs/1508.06369>

So ... is Molecular Communication

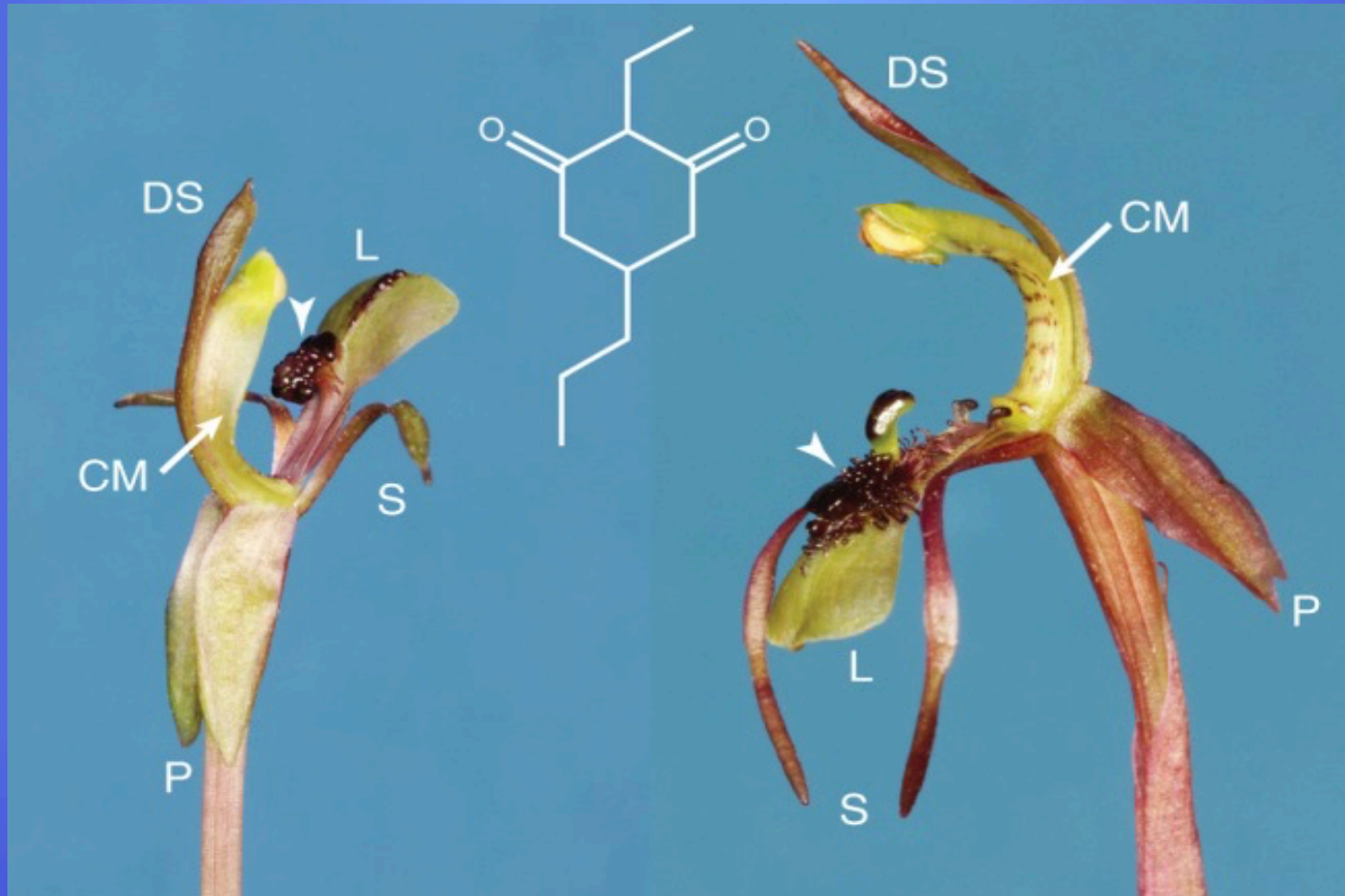
Science fiction? Something from a Hollywood blockbuster?

... or old news in the biosphere?

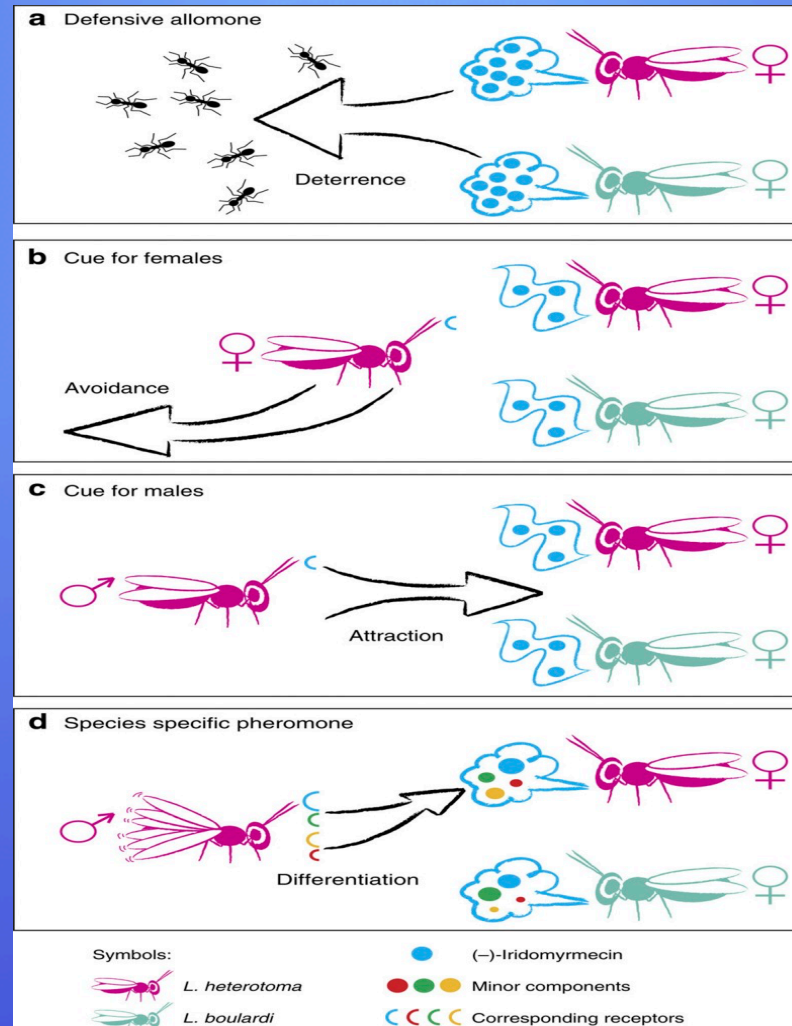
Bacteria, plants & animals have used semiochemicals (molecules!) to communicate with their own & other species ... forever!



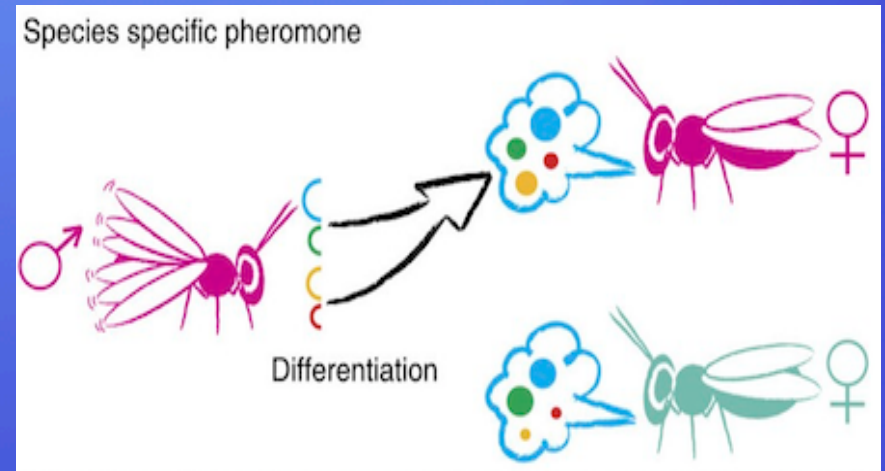
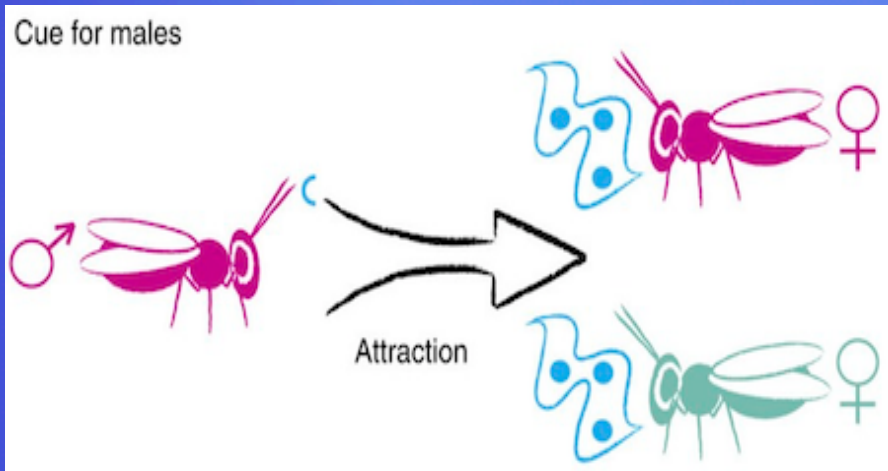
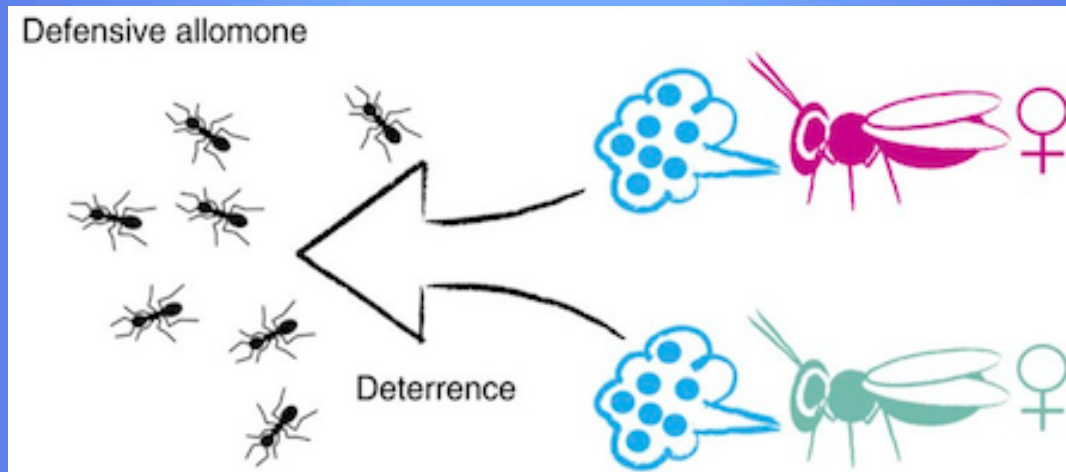
Orchids communicating



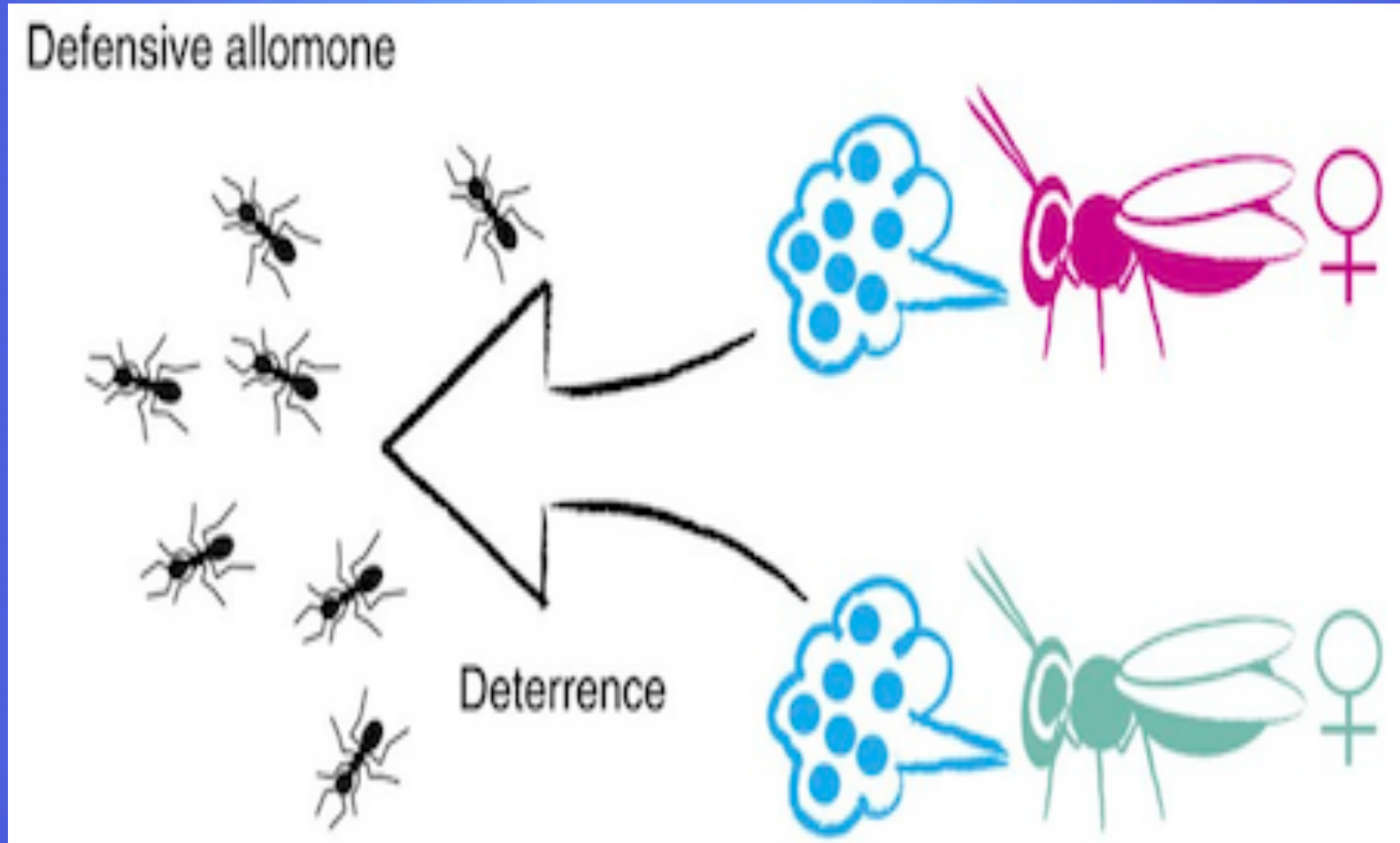
What's out there



What's out there



What's out there



Communication Beyond Waves

Inspired by Biology

Prototypes using new signalling modality
Communication by colour – ‘infochemistry’
Communication by bacteria – ‘infobiology’
and

Imagine the military, engineering, biomedical &
agricultural applications!

London Life

Want to wake up to the smell of bacon? The new wave of smell-o-vision gadgets set to change how we live

Now you really can wake up smelling the coffee — or the bacon. Tom Bailey sniffs out the trend for 'olfactory' gadgetry

TOM BAILEY | Thursday 10 September 2015 11:23 BST | [0 comments](#)



NEWS

TRENDING Election | Leader tracker | Polls | Apple | Kurdi | Blue

How Canadian scientists used a mist of alcohol to develop a new pheromone-inspired way to send text messages

JOSEPH BREAN | December 18, 2013 | Last Updated: Jan 25 6:41 AM ET
More from Joseph Brean | @JosephBrean

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SCIENCE

Researchers sent a text message using only vodka and a fan

By [valentina.palladino](#) on December 20, 2013 02:15 pm



THE
LATEST

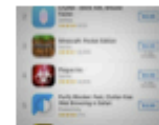
HEADLINE



Star Fox
coming to
until next



Nextbit's
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Verizon a
\$1M on R



Ad blockers
top of App
charts



Chromecast
support S
according
document

Scent messaging: Gadget brings smell-o-vision to smartphones

By James Plafke (<http://www.extremetech.com/author/jplafke>) on May 13, 2013 at 2:19 pm

Comment (http://www.extremetech.com/electronics/155615-scent-messaging-gadget-brings-smell-o-vision-to-smartphones#disqus_thread)



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AROMA R-EVOLUTION

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ENSEMBLE D'AROMATISATION VOLATILE

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Reference : 831835000824

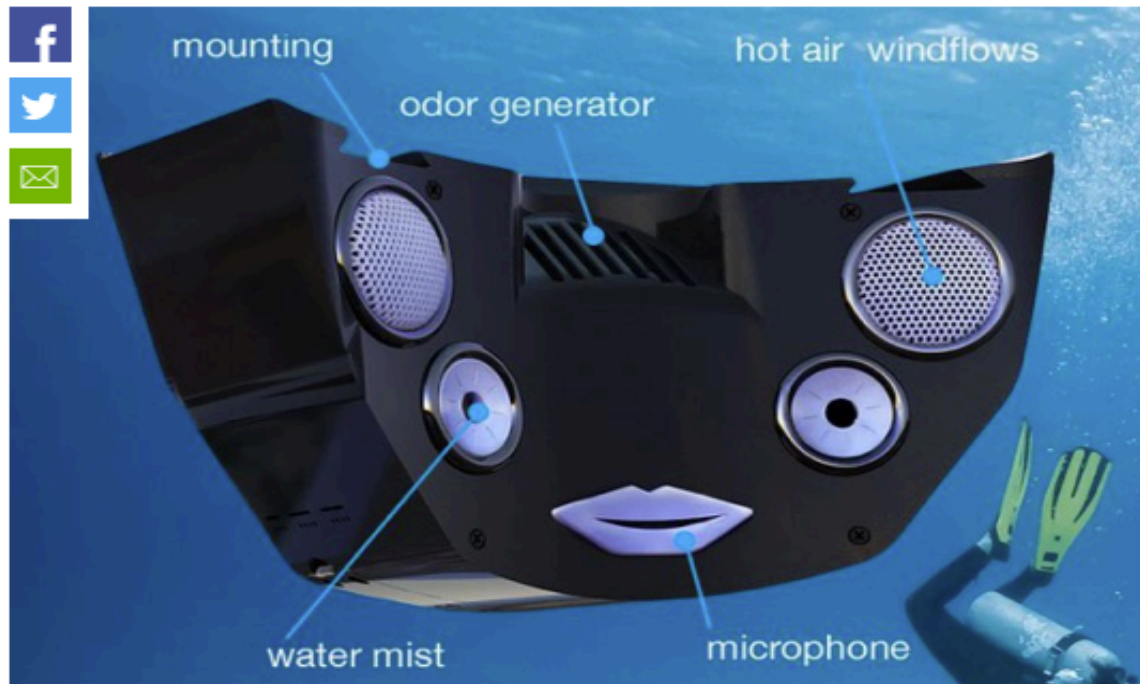
Quantity :

ADD TO CART

Virtual reality add-on brings smell-o-vision to games



GameCentral for Metro.co.uk Tuesday 10 Mar 2015 10:14 am



FeelReal – the idea smells a bit iffy

New video game peripheral FeelReal can emit seven different smells, blow hot air, and squirt your face with water – but is that something you'd want?



TRENDING NOW

Ahmed Mohamed says he's going to the White House — and then he's transferring schools



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PREVIOUS STORY
Samsung's curved all-in-one PC will be available March 8th for \$1,299

NEXT STORY
How League of Legends could make the internet a better place

TL;DR

6 COMMENTS

Smellovision masks are here, and they're basically implements of torture

By [Adi Robertson](#) on March 6, 2015 01:07 pm [Email](#) [@thedextrichy](#)



EVEN MORE TL;DR



Watch Jaguar's new F-Pace drive through the world's biggest vertical loop



Kit Harington does not really know what secrets are



The long, strange, maddening history of instant replay in sports



The infinite loneliness and crushing reality of the Taylor Swift corn maze

Molecular Communication – possible applications

Networks of autonomous nanomachines (‘medical drones’) injected into humans, acting as *in situ* surgeons.

- Nanonetworks: A New Frontier in Communications
 - <http://cacm.acm.org/magazines/2011/11/138218-nanonetworks-a-new-frontier-in-communications/fulltext>
- Security and Privacy in Molecular Communication: Opportunities and Challenges
 - <http://dx.doi.org/10.1109/TNB.2014.2349111>

And...

Using molecules to disrupt normal communication amongst people, plants & animals.

What about (bio)hacking/safety/security?

Food for thought

What are the FLE⁵SH issues raised by new and emerging technologies?

F = Financial

L = Legal

E = Economic, Ethical, Equity, Environmental & Ecosystem

S = Social

H = Historical

Food for thought

We want to apply the FLE⁵SH lens to other emerging technologies, such as:

- AI Robotics
- Gene Editing (CRISPR)
- Synthetic Biology

Responsible Innovation

*Jack Stilgoe's thoughts on science,
innovation and society*



[Home](#) [About](#)

Acknowledging AI's dark side

Posted on [September 7, 2015](#)

This is the text of a recent letter published in Science, for those who can't get behind the paywall

Science 4 September 2015:

Vol. 349 no. 6252 p. 1064

DOI: [10.1126/science.349.6252.1064-c](https://doi.org/10.1126/science.349.6252.1064-c)

The 17 July special section on Artificial Intelligence (AI) (p. [248](#)), although replete with solid information and ethical concern, was biased toward optimism about the technology.

Twitter

- [@RichardMoorhead](#) ... mean you only end up getting more stuck, like quicksand (2/2) [1 hour ago](#)
- [@RichardMoorhead](#) I can see the pragmatic case for it, but the attempt to extricate oneself from politics of science can... (1/2) [1 hour ago](#)
- Would be so very hard to do, but I'd be fascinated to watch the attempt [@philippesands](#) [twitter.com/guardianscienc...](#)

Our Goal To:

Initiate

Generate

.. and stimulate a democratic debate around:

- The appropriate regulation of new and emerging technologies
- Opportunity costs: not every problems has a high-tech solution
- The responsibilities of researchers and funding agencies

Smart meters, smart homes, a world of constant surveillance...



<http://utilityweek.co.uk/news/with-smart-meters-its-time-to-get-real-about-data-protection/1096522>

CYBERCRIME

M2M

NETWORKS

SECURITY

SECURITY MANAGEMENT



Beware – Your Smart Home Might Be A Massive Security Risk

Michael Moore, August 5, 2015, 7:15 pm



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No Comments

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Internet Of Things



M2M



Secure-It



Security



Smart Home



Smart Home Hubs



Tripwire

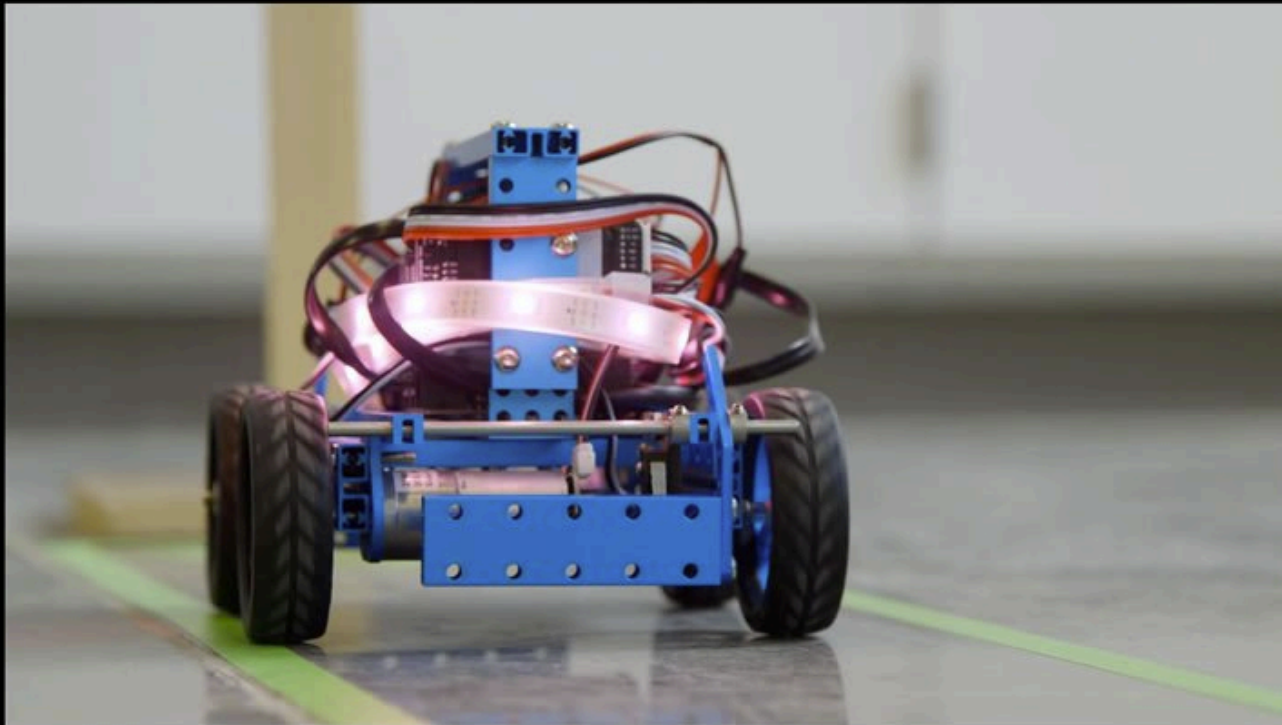


<http://www.techweekeurope.co.uk/security/cyberwar/smart-home-hub-security-tripwire-174231>

“Robot brain could soon have bacteria controlling its movements”



Robots with bacterial brains



Warren Ruder used a mathematical model to demonstrate that bacteria can control the behavior of an inanimate device like a robot. Adapted from the Vimeo video. Image credit: The researchers/Virginia Tech.

A Loeffler, 'Mathematical Model for Robots with 'Bacterial Brains' <http://neurosciencenews.com/robotics-bacterial-brain-math-2334/>

Growing Concern about the Rise of the Robots

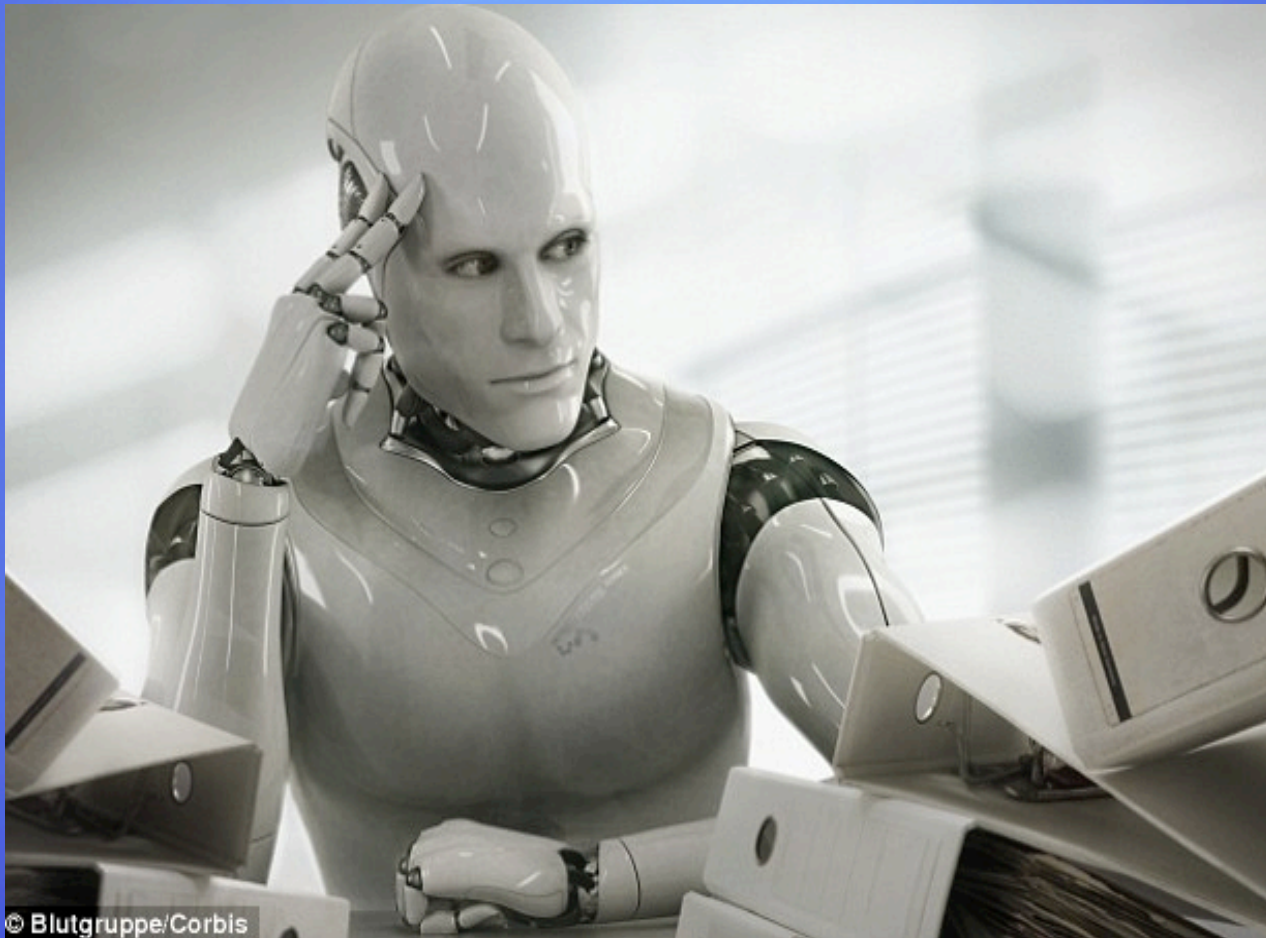
“Don’t let AI take our jobs (or kill us):
Stephen Hawking and Elon Musk sign open
letter warning of a robot uprising”

- <http://www.dailymail.co.uk/sciencetech/article-2907069/Don-t-let-AI-jobs-kill-Stephen-Hawking-Elon-Musk-sign-open-letter-warning-robot-uprising.html>

“Rise of the Machines: The Future has Lots of
Robots, Few Jobs for Humans”

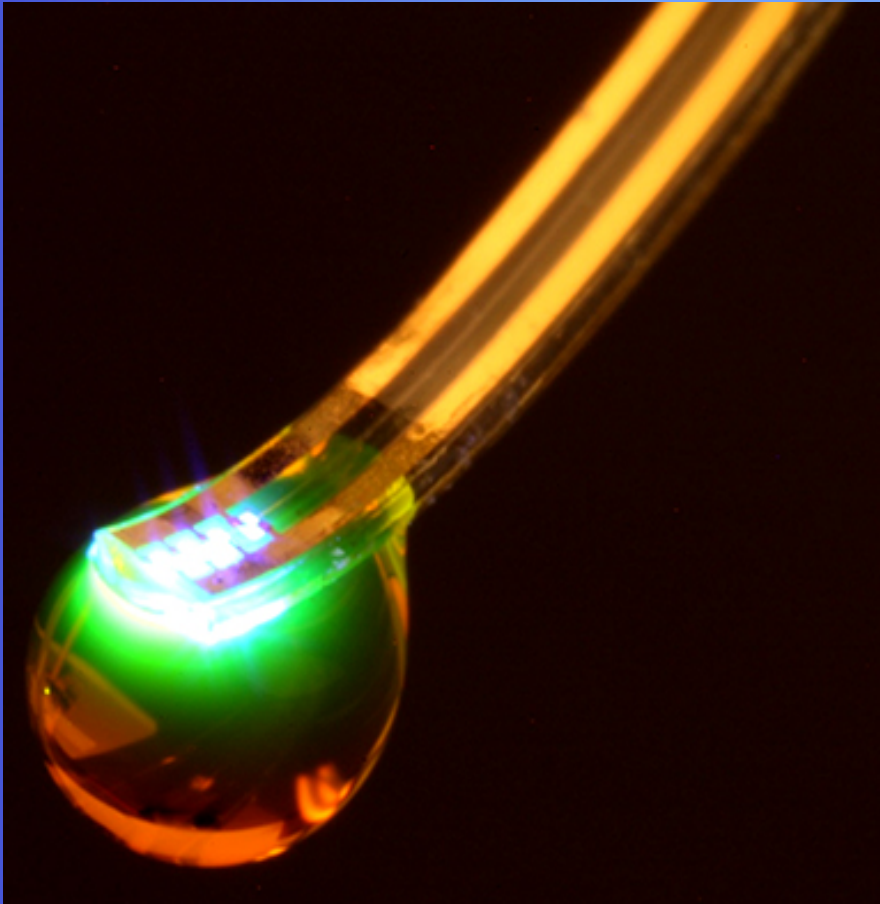
- <http://www.wired.com/brandlab/2015/04/rise-machines-future-lots-robots-jobs-humans/>

Will killing robots be unethical?



<http://www.dailymail.co.uk/sciencetech/article-2640778/Will-killing-robots-unethical-future-Artificial-brains-blur-lines-man-robot-warns-expert.html>

Mind bending probe



Scientists used soft materials to create a brain implant a tenth the width of a human hair that can wirelessly control neurons with lights and drugs.

Courtesy of Jeong Lab, University of Colorado Boulder.

<http://www.nih.gov/news/health/jul2015/ninds-16.htm>

Technology under the Microscope

Should progress be pursued as an end in itself?
And at what price?

Is progress neutral (is technology?) or are there
winners & losers, vested interests & concentrated
power?

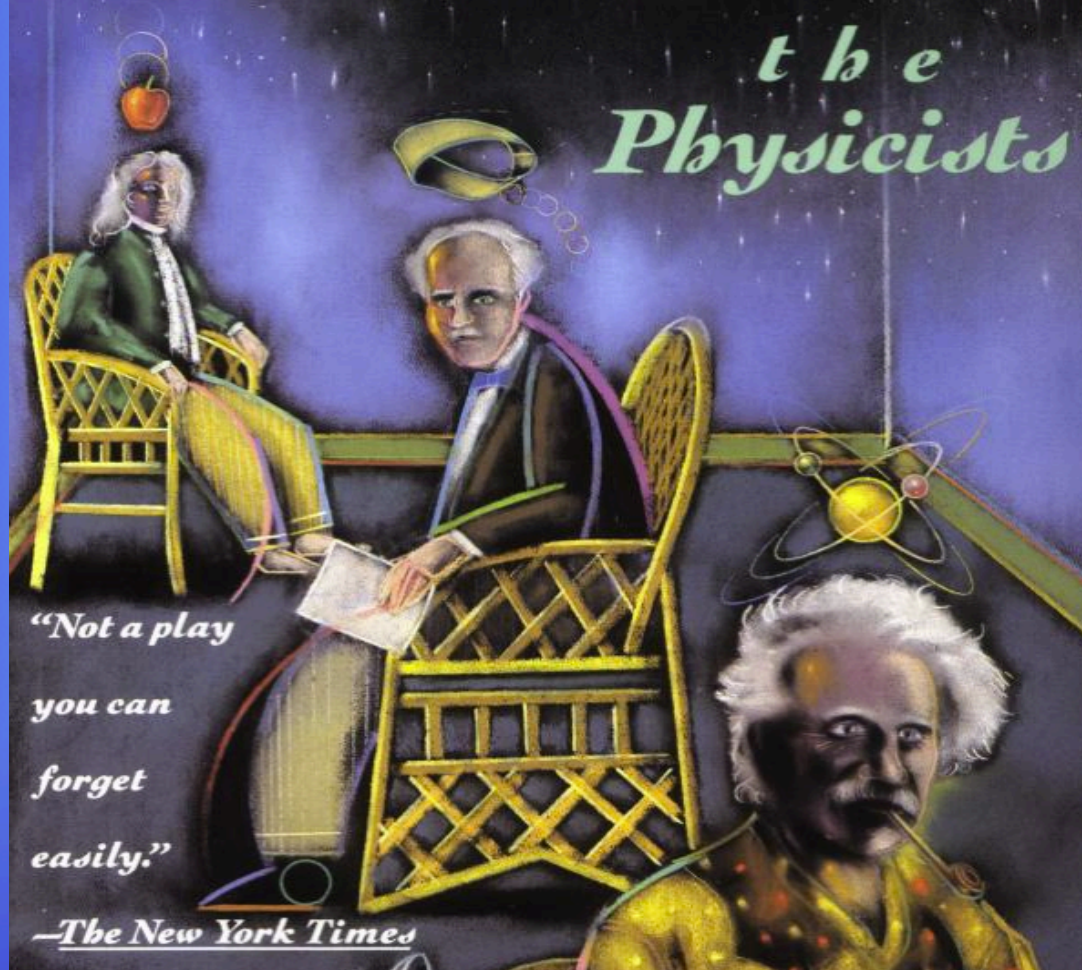
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DÜRRENMATT

*the
Physicists*

*"Not a play
you can
forget
easily."*

—The New York Times



Research and Development (R & D) and Researchers under the Microscope

What is the role of research?
within society – locally, nationally &
internationally?

Should researchers be responsible for how society
-- including their startups -- uses ... or abuses ...
their discoveries?

Who should be in charge?

Who should assess, approve or not as the case may be, and regulate new and emerging technologies?

Can the law & regulators ever keep ahead of the technological curve?

More food for thought

- <http://luddites200.org.uk> - historically, the Luddites opposed only technology ‘hurtful to Commonality’; today, a call for scepticism about the dogma of technology as progress
- <http://breakingtheframe.org.uk> - aimed at democratizing decisions about technology



The Luddites at 200

for action against technology 'hurtful to Commonality'

Friday Sep 18, 2015

- Home

- Our heritage, the
Luddite rebellion
1811-1813

- 21st century
Technology debates
& politics

- The Luddites
and Biopolitics
Now
- Ned Ludd and
the antiGM
movement
- The rise of the
Drone
- Geoengineering

21st century Technology debates & politics

The Luddites' 200th anniversary comes at a timely moment, because, at the beginning of the 21st century, the consequences of the whole industrial capitalist path of development that began with the Industrial Revolution are becoming so severe that millions of people are coming to doubt its mythology of progress. From global warming, resource depletion and biodiversity extinction to epidemics of mental and stress-related illness, drug addiction and crime, these inevitable products of industrial society are becoming impossible to ignore. Now, as then, along with their benefits science and technology often empower the powerful and marginalise the weak, create unemployment, deskilling and dependency, destroy whole ways of life and communities based upon them and create massive environmental and health damage, generally to the most vulnerable.

Whilst many of the problems mentioned above are widely understood as being the result of our free-market/industrial society, the crucial role of science and technology within that system is often not well understood. What makes the Luddite revolt so important was that it highlighted the crucial importance of technology. As the great apologist for industrialism, Andrew Ure, wrote in 1835, 'This invention confirms the great doctrine already propounded, that when capital enlists science in her service, the refractory hand of labour will always be taught docility.'

Because the Luddites so shockingly exposed this best-kept secret of industrial capitalism they have been subjected to the harshest ridicule, and have been painted not just as another bunch of upstart troublemakers, but as idiotic opponents of progress, people who 'want to go back to the stone-age'. Yet capital intensification, ie. the displacement of labour by capital (machines) relentlessly continues to create unemployment.

In the 21st century, through digital technology, it is set to create major social and economic problems.

In celebrating the Luddites' anniversary, therefore, we are trying to shine a spotlight on technology itself. But of course, what the Luddites were facing was not merely new machines but a whole new political and socio-economic regime built around them, the Industrial Revolution. The key

Should nature have rights?

Proposal for Universal Declaration of the Rights of Mother Earth Preamble

- <https://pwccc.wordpress.com/programa/>

Should Trees Have Standing?

- http://isites.harvard.edu/fs/docs/icb.topic498371.files/Stone.Trees_Standing.pdf

Further reading:

- A Comprehensive Survey of Recent Advancements in Molecular Communication
 - <http://arxiv.org/abs/1410.4258>
- The Physicists at Fifty
 - <http://www.thenewatlantis.com/publications/the-physicists-at-fifty>
- Responsible Innovation
 - <https://jackstilgoe.wordpress.com>

And more

- Technology assessment
 - <http://etcgroup.org/issues/technology-assessment>
- Smart meters
 - <http://stopsmartmeters.org/>
 - <http://emfsafetynetwork.org/smart-meters/>
- Low-Technology
 - <http://www.lowtechmagazine.com/>