Department of Political Economy

Global Biopolitics Research Centre

State strategies for bioinformatics in BRICs and the UK

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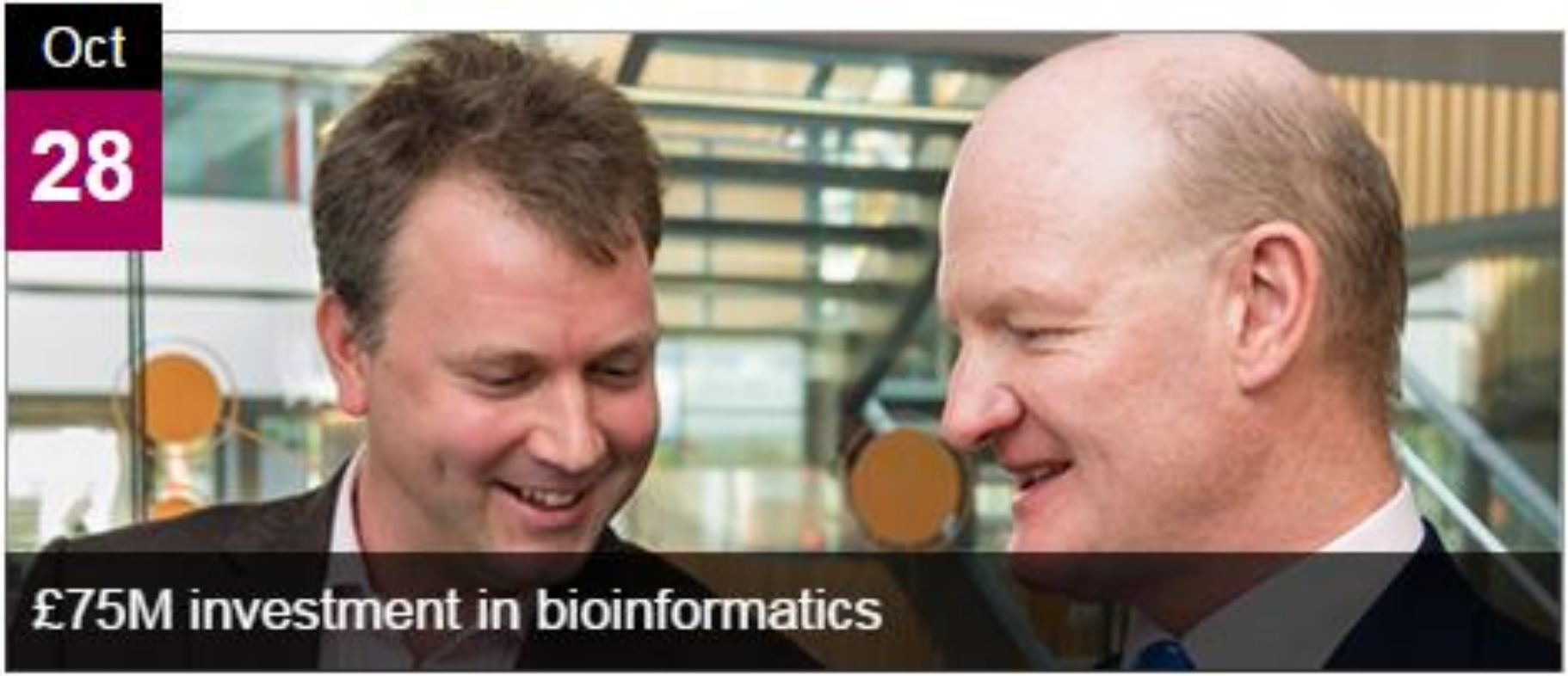


UK Minister for Universities and Science David Willetts joined key stakeholders in the Cambridge biotechnology cluster today to celebrate the opening of a new Technical Hub for bioinformatics.

‘This new facility is the embodiment of our investment in big data and bioinformatics. We are not only ensuring that people will receive better services and resource security, we are also maintaining UK leadership in the global science race.’

February 2014, David Willetts announcing a £32 million investment in bioinformatics emphasised that it is:

‘Huge priority for government’ and has the ‘potential to drive research and development, increase productivity and innovation and ultimately transform lives.’

India, Department of Biotechnology: Bioinformatics Programme:

‘to ensure that India emerges a key international player in the field of bioinformatics; enabling a greater access to information wealth created during the post-genomic era and catalysing the country’s attainment of lead position in medical, agricultural, animal and environmental biotechnology’

Outline of presentation

- What is the political value of bioinformatics?
- What is the role of science and the state in the emergence of bioinformatics in the UK, China and India?
- What is the balance of power between the three countries in terms of their ability to exploit the contribution of bioinformatics to life sciences innovation?

The political problem

- Political expectations generated by the field of genomics particularly Human Genome Project
- Matched with reality that 'the computers, algorithms, and software, let alone the support infrastructure, are not keeping up with the exponentially rising tide of data in biomedical research' (US NIH, 1999)
- 'Painfully slow' translation of scientific research into 'patient benefit' (House of Lords Science and Technology Committee, 2001)
- Assertion that 'it will be the biomedical informatics that will allow translations from knowledge and research into medical practice' (Professor Dame Janet Thornton, House of Lords)

Bioinformatics is the key to progress in life sciences innovation

The science-state concordat: an exchange of political benefits

Science supplies the state with:

- a flow of knowledge that can enable the delivery of economic and social benefits to its citizens
- expertise and authority to legitimise the operation of state's policy advisory system

State supplies science with:

- resources to pursue its research interests
- right to its own system of self-regulation
- access to policy making

Arrangement and power relationship varies by country and therefore so does the ability to handle the political problem

Science and the emerging economies

- Between 2001 and 2011 emerging economies' share of global R and D rose from 25% to 34%
- China's R and D as proportion of GDP in 1991 was 0.73% rising to 0.91 in 2001. Annual growth since then of 18%.
- US equivalent for both years was 2.7%
- Rapid expansion from very low base

Political consequence: limited or no concordat

- Scientific elites in China and India lack the historic identify, presence and power that they have in the UK and the US
- Limited or no ability to influence the national science agenda
- Dominance of state in science policy formation
- Marginal position in the transnational markets of science (knowledge, labour, capital)

China and India: top-down innovation in bioinformatics

- Dominant role of departments of state in the formation and execution of policy on bioinformatics
- DBT launched Biotechnology Information System in 1986 'to create an infrastructure that enables it [India] to harness biotechnology through the application of bioinformatics'.
- China established a centre for bioinformatics at Beijing University and its first project on bioinformatics funded by the 863 Programme in 1996
- Thereafter both countries funded projects apparently designed to enhance their bioinformatics capacity

Bioinformatics funding in decade up to 2014

- China - £303 million
- India - £19 million
- UK - £164 million

Table 4(a)

China: MOST funding of bioinformatics (2005-14)

Year	Scheme	Category	Funding (£ million)
2005	The National Program for Sci-Tech Basic Conditions Platform Construction during the Year of 2004-2010		0.3
2006	863 Programme	Bioinformation and Computational Biological Technology	8.0
2007	863 Programme	Bioinformation and Computational Biological Technology	6.5
2008	863 Programme	Bioinformation and Computational Biological Technology	2.0
	863 Programme	Biological and Medical Technology- Genome-wide Association Study and Pharmacogenomics Study on Common Severe Diseases	20.0
	11th five-year National Key Technology R&D Plan	Key Technology Development and Demonstration of Public Information Share and Exchange for Biotechnology Industry	3.0
	Second call for 11th five-year plan National Science and Technology Major Project	New Drug Creation and Development (2009-2010)	216.0
2010	2011 National Science and Technology Major Project	New Drug Creation and Development	10.0
2011	2012 National Science and Technology Major Project	New Drug Creation and Development	N/A
2013	863 Programme (2014)		20.0
2014	863 Programme (2015)	Biological and Medical Technology - Key Technology of Biological BIG DATA Development and Application	N/A
Total			**285.8**

Source: the Ministry of Science and Technology of the People's Republic of China (http://www.most.gov.cn

Table 4(b)
China: NSFC funding of bioinformatics (2005-13)

Year	Funding (£million)
2005	0.9
2006	1.0
2007	0.9
2008	0.8
2009	1.2
2010	0.7
2011	2.4
2012	3.3
2013	3.6
Total	**14.8**

Source: National Natural Science Foundation of China (isisn.nsfc.gov.cn

Table 5
India: Department of Biotechnology funding of bioinformatics (2005-14)

Year	Funding (£million)
2005-2006	1.7
2006-2007	2.3
2007-2008	2.1
2008-2009	2.1
2009-2010	1.2
2010-2011	2.2
2011-2012	1.9
2012-2013	2.0
2013-2014	2.5
Total	**18.0**

Source: Datta. 2014: Annex 1

Table 6(a)
UK: BBSRC funding of bioinformatics (2005-2014)

Year	Category/Theme	Funding (£million)
2005	Bioinformatics	0.0
2006	Bioinformatics and Biological Resources Fund Pilot	6.4
2008	Bioinformatics and Biological Resources	5.5
2009	Bioinformatics and Biological Resources	6.7
2010	Bioinformatics and Biological Resources	7.1
2011	Bioinformatics and Biological Resources	5.5
2012	2011-2013 Tools and Resources Development Fund Call 2	1.9
2012	Bioinformatics and Biological Resources	6.6
2012	Tools and Resources Development Fund Call 2 (bioinformatics tools and computational approaches to the biosciences)	1.5
2013	Bioinformatics and Biological Resources	6.0
2014	Bioinformatics and Biological Resources	6.5
Total		**53.7**

Source: * data from '*BBSRC 20 Years of Pioneering*': http://www.bbsrc.ac.uk/web/FILES/Publications/anniversary-brochure.pdf Biotechnology and Biological Sciences Research Council (BBSRC): http://www.bbsrc.ac.uk

Table 6(b)
UK: MRC funding of bioinformatics (2012-15)

Year	Category/Theme	Funding (£million)
2012	MRC/BBSRC Systems Immunology of the Human Life Course	3.0
2012	Initiatives in Informatics Research	19.0
2013	Initiatives in Informatics Research	20.0
2014	Initiative in Medical Bioinformatics	39.1
2015	Initiative in Medical Bioinformatics	10.9
Total		**92.0**

Source: Medical Research Council (MRC): http://www.mrc.ac.uk

Table 6(c)
UK: EPSRC funding of bioinformatics (2013)

Year	Category/Theme	Funding (£million)
To present	Biological Informatics	14.2

Source: Engineering and Physical Sciences Research Council (EPSRC): http://www.epsrc.ac.uk/research/ourportfolio/researchareas/bioinformatics/

Table 6(d)
UK: NERC funding of bioinformatics (2012-19)

Year	Category/Theme	Funding (£million)
2012-2019	Mathematics & Informatics for Environmental Omic Data Synthesis	4.0

Source: Natural Environment Research Council (NERC): http://www.nerc.ac.uk

China and India: top-down innovation in bioinformatics

- State driven and little formal policy discussion of epistemic issues involved in constructing a new discipline
- Lack of epistemic expertise of state
- Failure by state to identify this as a policy problem and recruit science to solve it
- Failure, or lack of power of science, to develop and promote its own agenda on bioinformatics

Absence of national centre - China

Chinese officials don't know the importance of a national centre for scientific research in China. They think that a new national centre is a kind of waste because international databases are open access to Chinese scientists. Another reason is about leadership. More and more Chinese universities and institutes are conducting bioinformatics research and establishing their own bioinformatics centre. Which university or institute, or who, can be the leader of this large project? China won't take any action until we find a proper answer to this question.[Interview 25, China]

Absence of science led approach to bioinformatics

‘Many people recognize the significance of bioinformatics for studying bioscience as an instrumental discipline, but fail to see or value its existence and development as a discipline itself’ [Interview 38, China]

Absence of national leadership – India fragmentation of state bureaucracy

'The Ministry of Health has a different approach [to bioinformatics and biomedical innovation]. Within the Ministry of Science and Technology, CSIR, which is a department in itself, has a different approach. DBT has a different approach, and DSD has a different approach. And then you have the Ministry of Commerce which has a different approach.' [Interview 27, India]

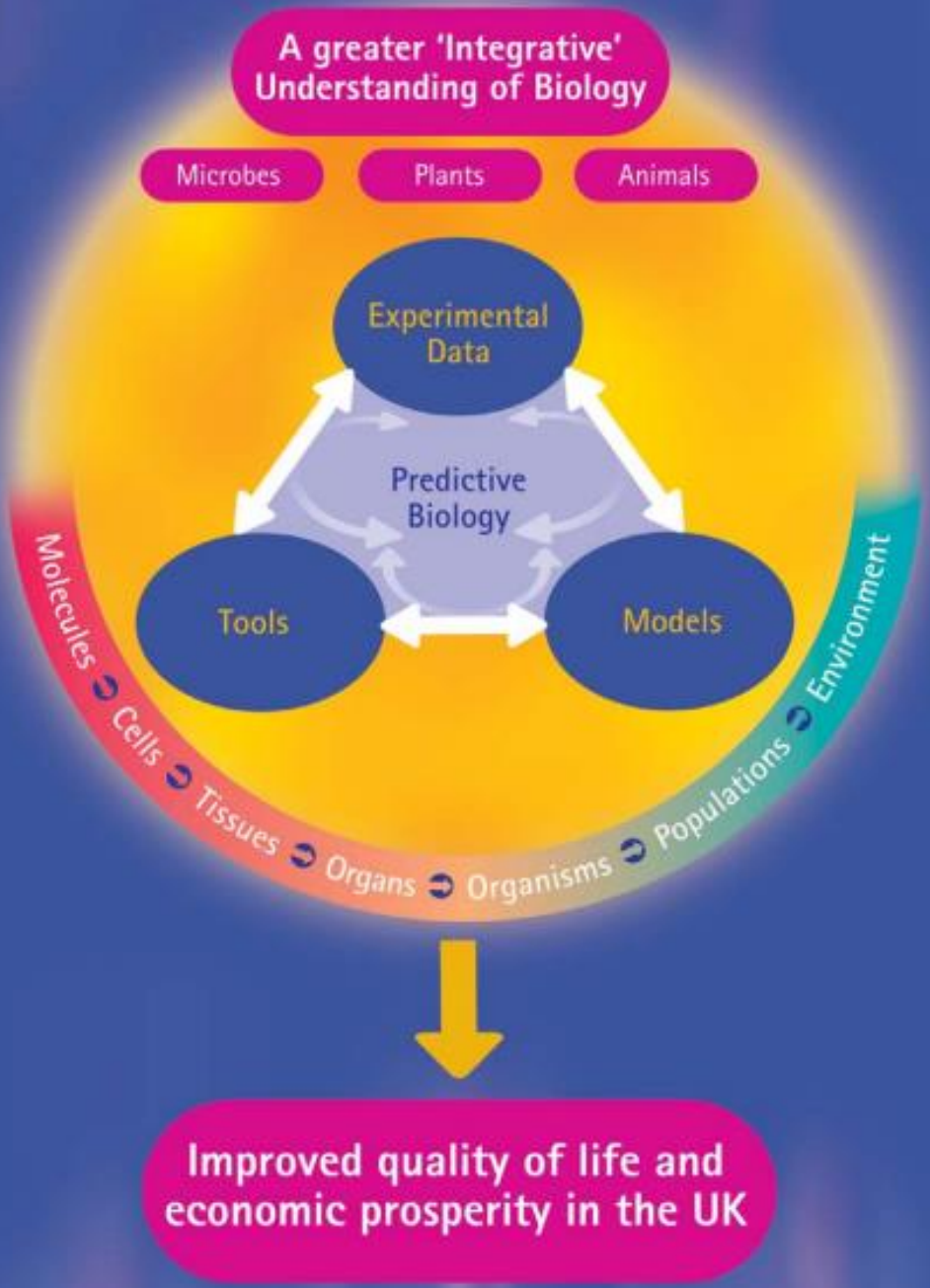
Absence of national leadership - India

The one big grudge that I have is that they're [bioinformatics courses] doing the same thing over and over again, and not enhancing the skills of either programming, or the ability to develop algorithms; those require different kinds of skill sets. They require fundamentals of mathematics, fundamentals of statistics and computer science. [Interview 14, India]

Science leads - UK

- European Bioinformatics Institute (established 1994): It exists 'because science has brought these things together' and 'scientists have had to organise themselves in terms of how they co-ordinate together' [Interview 22]
- European research 'works through a bottom-up approach' [Interview 22]
- Science as entrepreneur: EBI funded by Wellcome Trust, BBSRC, MRC, EU, EU Member States, NIH, EMBO and pharmaceutical industry
- Underlying scientific paradigm guiding and legitimising bioinformatics development – product of continuing epistemic negotiation within UK science

Figure 1.



Bioscience for Society:

A Ten-Year Vision

"Towards predictive biology"

Science leads, state facilitates - UK

- State facilitates at national and international levels through financial support and political support for particular initiatives (eg EBI)
- Western global dominance: propelled by HGP and HapMap projects, creation of global institutions supporting databases (NCBI, EBI, DDBJ)

Maintaining bioinformatics hegemony through transnational governance

- Began with Bermuda rules 1996: set out the new rules for the deposition of genomic data as a precondition for international collaboration between contributing laboratories to the HGP.

- Attended by the Wellcome Trust, the NIH National Centre for Genome Research, the US Department for Energy, the German Human Genome Project, the UK MRC, and the European Commission.

Maintaining bioinformatics hegemony through transnational governance

- Continuing evolution of fresh forms of governance regarding quality, standards and norms
- Proliferating range of bioinformatics tools developing standards for harmonising the ontologies of data in diverse databases
- Working through organisations such as Microarray Gene Expression Data Society, the Macromolecular Structure Database as part of the worldwide Protein DataBank and the Gene Ontology Consortium Project.

Effects on China and India

- Much lower chance of incorporation of data from less prestigious, non-English speaking laboratories into international databases (Leonelli, 2014)

- Absence of national bioinformatics centre means reduced international leverage and ability to influence scientific agenda in bioinformatics

Effects on China and India

- Chinese and Indian bioinformaticians and scientists recognise they are '4-5 years behind the West' [Interview 44, China] and 'we're always laggards' in this field [Interview 14, India]

- 'Bioinformatics in China is still at a relatively early stage, with few internationally influential articles, databases, algorithms, and software. The collaboration between bioinformatics research and experimental biology is not adequate.' [Interview 37, Director of genomics research centre]

From UK perspective

- Frequent collaborations on bioinformatics projects with scientists in Europe, US and Japan
- Collaborations with China and India tend to be:
  - Outsourcing of 'service' bioinformatics activities such as sequencing
  - Advice and expertise for initiation of bioinformatics activities already established in West

UK advantage in balance of power

- Mature scientific community capable of negotiating internal process of epistemic change and creation of new discipline
- Political harnessing of bioinformatics to the agenda of the UK's competitive advantage in life sciences innovation – particularly by genomics
- Cadre of scientists in government (eg House of Lords) and the civil service acting as lobby for the science agenda
- Exploitation by science of the established UK infrastructure in the networks of the transnational life sciences

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Thank you