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Science

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INTRODUCTION

Science and central, national political structures are the two greatest modern institutional forms of authority. They can sometimes align and sometimes clash. Science and technology policy has, in the UK, been seen since the twentieth century as an important lever to encourage innovation and ultimately economic growth. Some of the most challenging issues facing politicians depend, partly, on scientific understanding and advice. This chapter reviews and assesses the experience of policy-for-science and science-for-policy under the Coalition and Conservative administrations. It is a pattern of modified continuity and the articulation of the possibility of radical change. While there were instances of effective political leadership, especially in the more settled early 2010s, ultimately both, in ways that will be described, were undermined by the tumultuous events of Brexit and Covid.

WHAT WAS UK SCIENCE BEFORE 2010?

During the Cold War the UK had spent about half of its R&D budget on defence. This proportion had declined since 1990 and just before the 2010 election expenditure on research and development stood at over a £25 billion, less than 2 per cent of GDP, with defence research forming only

Background interviews with George Freeman, Greg Clark, David Willetts and Mark Walport assisted the author in writing this chapter.

a tenth of the effort.[1] The spending on science had gently increased under New Labour, although not at the same pace as the rest of the economy. In relative terms the UK spent much less on research than the United States, Japan and Israel, and just shy of the Organisation for Economic Co-operation and Development (OECD) average. In proportional terms other industrialised nations, therefore, spent more of their GDP on science, but not by much, and some – such as Italy and Canada – spent less. The UK science budget was weak but unexceptional for an economy of its type.

The other major shift from the late twentieth century was the proportion carried out by private rather than public funds. Two-thirds of research in Britain by the first decade of the twenty-first century was funded and performed by business enterprises.[2] Only three UK companies spent over a billion pounds on research – GlaxoSmithKline, AstraZeneca and BT – and only the first two would be found on a global list of the top twenty-five business enterprises by research spending, reflecting the distinctive prominence of the pharmaceutical sector.[3] There was a very long tail of smaller companies. Of the remainder of UK research, only a quarter was performed in universities. Again there was an uneven concentration, with high investment in the so-called 'golden triangle' of Cambridge, Oxford and London. In general then, when we think of 'typical' scientific research in early twenty-first-century Britain we should think of private-funded research

[1] Gross domestic expenditure on R&D (2008). Office of National Statistics, SET statistics (accessed at www.statistics.gov.uk/pdfdir/gerd0310.pdf, 10 October 2023).

[2] Gross domestic expenditure on R&D (Total GERD) 2008, according to the sector carrying out the work, Office of National Statistics, SET statistics (accessed at www.statistics.gov.uk/pdfdir/gerd0310.pdf, 10 October 2023).

[3] Department for Business, Innovation & Skills (BIS), *2009 R&D Scoreboard* (London: Department of Business, Innovation and Skills, 2009), 'Top 25 UK companies by R&D expenditure' and 'Top 25 global companies by R&D expenditure'. GlaxoSmithKline and AstraZeneca were ranked twenty-first and twenty-fourth respectively.

performed in a medium or even small enterprise.[4] In contrast, what we tend to think of when picturing UK science, misleadingly, are the prestigious research universities and the biggest research-intensive corporations.

Furthermore, the linkage between private and public science had been decisively reshaped, almost severed, late in the Thatcher administration. Whereas previously an informal industrial strategy pumped money into promising areas of research, from around 1986 a crucial shift disfavoured such 'near market' research.[5] The argument, which stemmed from the Number 10 Policy Unit, was a Thatcherite one: public money disincentivised private companies from making their own, market-led investments in science. There should be no more picking winners. Only by government stepping aside would the private innovators and entrepreneurs step up. The ending of near-market research was accompanied, deliberately, by a celebration of pure science, now branded as 'curiosity-driven' research.[6] The Royal Society and research-intensive universities had applauded. The end of the Cold War, which had justified pump-priming science through funding military R&D, pushed in the same direction. The result was an impoverished role for the state as a supporter of innovation. It would be two decades before talk of a science-based 'industrial strategy' returned, as we shall see.

But 'science' is more than 'research'. Around 2010 the total science workforce was calculated to be over 6 million employees, around a fifth of the UK total.[7] As broadly defined, this workforce included roles such as health professionals, science teachers, environmental health officers, civil and mechanical

[4] Twenty-seven per cent of the scientific workforce worked in firms of 500 or more; the majority therefore worked in smaller firms. Royal Society, *A Picture of the UK Scientific Workforce. Diversity Data Analysis for the Royal Society. Summary Report* (London: Royal Society, 2014), p. 21.

[5] Jon Agar, *Science Policy under Thatcher* (London: UCL Press, 2019), pp. 88-99.

[6] Jon Agar, '2016 Wilkins-Bernal-Medawar lecture: The curious history of curiosity-driven research', *Notes and Records of the Royal Society*, 71:4 (2017), 409–29.

[7] Royal Society, *A Picture of the UK Scientific Workforce*, p. 19.

engineers or in nature conservation. A core of just over one million people worked in occupations defined as 'primary science workers', in which the consistent application of scientific knowledge and skills was central.[8] Members of this core group were relatively more likely to be male than female, and possess higher levels of formal qualifications as well as socioeconomic status than the non-science workforce.[9] Despite its size and distinct character, the 'science workforce' has not been regarded or targeted as a significant political demographic. Politicians have not made it a priority to secure the science 'vote'.

The politics of science, therefore, was not so much a matter of public debate and elections as of decision-making and governance internal to the state. Within Whitehall, departmentally, science has moved back and forth between being placed with education or with industry. Ministers responsible for science have mostly, in our period, but not always, had Cabinet rank. A useful distinction can be made between 'science-for-policy', the many ways that scientific understanding and advice underpins policy on a wide range of areas and issues, and 'policy-for science', the decisions and choices made by government that guide science funding and shape the science sector. The Coalition and Conservative governments from 2010, like their predecessors, faced many science-for-policy issues. The scientific advice for the policies during the Covid pandemic was perhaps the outstanding example, in which despite the claims to be 'following the science', scientific advice was one input among many that had to be considered as choices were made.[10] In terms of policy-for-science, the

[8] Ibid., p. 12. [9] Ibid., pp. 22, 24.

[10] The sheer scale of the Covid challenge nearly overwhelmed the science-for-policy processes, as discussed below. This situation was despite the fact that the systems for provision of scientific advice around emergent diseases had been significantly strengthened prior to 2020, and tested against the threats of ebola, influenza and MERS, especially in the 2010s under the GCSA Mark Walport. Walport told the Covid inquiry it was his 'opinion that in the area of natural hazards, health was amongst the best prepared areas in relation to access to strong scientific evidence and an exceptional array of scientific advisory groups' ('UK Covid-19 Inquiry. Witness statement of Sir

Conservative administrations after 2010 inherited and largely continued the approach that had been decisively shaped under Thatcher and had continued under Major, Blair and Brown.[11]

The relationships between policy advisers and politicians were nevertheless important. Internal advice was channelled through the system of scientific advisers, headed by a government chief scientific adviser (GCSA). In our period there were four GCSAs: the population biologist John Beddington (2008–13), the medical scientist Mark Walport (2013–17), both academics who had come from Imperial College, the previous head of research at GSK Patrick Vallance (2018–23), and the Oxford mathematical biologist Angela McLean (2023 onwards).[12] The GCSA worked from a unit – the Government Office of Science, or GO-Science – supported by staff. External advice came from many sources, including academics, think tanks, business, campaigning organisations and learned societies. One major, traditional conduit was the Royal Society, led by its president, always an accomplished scientist. In our period the three presidents of the Royal Society were Paul Nurse, who was also head of the new, flagship London biomedical Crick Institute (2010–15), the Cambridge molecular biologist Venki Ramakrishnan (2015–20), and the statistician and head of another new London science flagship, the Alan Turing Institute, Adrian Smith (2020–5).

SCIENCE UNDER CAMERON (AND CLEGG)

Even before the 2010 general election, the financial crisis of 2008 left many countries, including the UK, with a hole in public

Mark Walport FRS', 8 April 2023, p. 25). In 'smaller' emergencies, such as the response to the disruption caused by the Eyjafjallajökull volcano in Iceland to UK air travel in 2010 and the UK decision-making following the Fukushima nuclear accident in Japan in 2011, scientific advice and the response of politicians seems to have been fast and effective.

[11] Kieron Flanagan, David Edgerton, Claire Craig, Sabine Clarke and Jon Agar, *Lessons from the History of UK Science Policy* (London: British Academy, 2019).

[12] Chris Whitty served as interim GSCA between 2017 and 2018.

finances. In 2009 Brown's government had signalled the likelihood of cuts in public expenditure, including research and £950 million from university budgets.[13] With the economy failing to improve, the next decade and a half would witness cycles of threatened cuts, the mobilisation of opposition, limited reprieves and a resumption of the cycle. In the election campaign of 2010, Labour made a few minimal offerings to scientists (postponing, perhaps, the onerous evaluation of academic research), while the Liberal Democrats possessed more appeal, not least via their Oxford West and Abingdon MP Evan Harris, regarded by the scientific community as one of its own.[14] The Conservatives offered no reassurances. In 2010 the new coalition government under Cameron and Clegg, perhaps partly because Harris lost his seat, indicated, like Brown's Labour, that cuts would have to be found.

The ministry responsible for science, the Department of Innovation, Business and Skills, asked research councils to model three scenarios, in which science funding was either kept flat (still, with albeit minimal inflation, a real-terms reduction), or cut by 10 or 20 per cent. Word soon leaked out.[15] The Royal Society and the Campaign for Science and Engineering (CaSE), a lobbying group that had been born out of the fierce opposition to Thatcher's public sector cuts of the mid 1980s, led the fight. The Royal Society's argument, evidenced in its earlier report *The Scientific Century*, for example, was that UK science was not only international, but internationally outstanding, with the UK producing proportionately more, higher-cited research papers than its peers, while such excellence in pure science was the eventual, if unpredictable, spring of innovation.[16] According

[13] Geoff Brumfiel, 'Debt crisis threatens UK science', *Nature*, 463 (28 January 2010), pp. 410–11.

[14] Geoff Brumfiel, 'High stakes for science in UK election', *Nature*, 464 (29 April 2010), pp. 1254–5.

[15] Richard Van Noorden, 'UK government warned over "catastrophic" cuts', *Nature*, 466 (22 July 2010), pp. 420–1.

[16] Royal Society, *The Scientific Century: Securing our Future Prosperity* (London: Royal Society, March 2010).

to the Royal Society, a special case for protection, therefore, existed for (pure) science. At a press conference hastily convened alongside university heads and other science organisations, Martin Rees, the astronomer and outgoing president of the Royal Society, summarised a submission to the Treasury and spoke in apocalyptic terms:

> 'Constant cash' – a reduction in real terms – 'could be accommodated', a ten per cent cut termed 'slash and burn' would have 'serious consequences', and a 20 per cent cut which they say would mean 'game over' for British science.[17]

As was the case during the cuts under Thatcher, a grassroots campaign emerged to oppose reductions in the science budget. Founded by cell biologist Jennifer Rohn, the Science is Vital campaign organised a petition that gathered 20,000 signatures and held a rally outside the Treasury in October 2010. Protestors, many in white coats, heard speeches from Dr Evan Harris, author Simon Singh and activist-medic Ben Goldacre, among others, and waved placards with slogans such as 'Science – it beats living in a cave' and 'No more Dr Nice Guy'.[18]

In George Osborne's austerity budget of October 2010, scientists were relieved to hear that science funding would be 'ring-fenced'. It seemed to be a victory for UK scientists and their supporters. David Willetts, science minister, was even presented with a bouquet of white roses, sent by William Cullerne Bown, the founding editor of *Research Fortnight*, the leading science policy newsletter.[19] John Beddington, the GCSA, said that the

[17] Anon, 'Game over for British science?', *Nature* blogpost, 24 September 2010 (accessed at blogs.nature.com/page/888/?action=report&comment=687, 12 October 2023). See also Van Noorden, 'UK government warned over "catastrophic" cuts'.

[18] https://scienceisvital.org.uk/2010/10/19/rally-report/ (accessed 15 October 2023) has links to news coverage (BBC, CBC), as well as blog reports from scientists attending the rally.

[19] Geoff Brumfiel, 'UK science saved from deepest cuts', *Nature* (20 October 2010).

chancellor of the exchequer had been 'won over by arguments from high-profile scientists and industrialists that cuts could hinder the long-term growth of the British economy'.[20] Funds were also finally released for building the massive Crick institute in London. Enthusiasm was tempered when it was realised that, while grants for researchers and universities were to be protected, the small print in the budget cut capital expenditure on the facilities of big science by 44 per cent.

The episode can therefore be seen as part of a larger pattern of failure to invest, through capital spending, in the long term into the facilities and infrastructure of Britain. Canny observers also noted that the underpinning argument, that funding UK basic research was the direct route to improved UK economic performance, was persuasive, again, this time to Osborne, despite plenty of evidence that this 'linear model' was flawed.[21]

If the government remained reluctant to fund near-market research, the presumption was still that the central problem of innovation in the UK was failure to move ideas from universities to industry where they would create wealth. When the Cambridge computing entrepreneur Hermann Hauser had been asked by Peter Mandelson, in the last days of New Labour, to report on the matter he stated what was a commonplace: 'The UK has a science capability second only to the US: an undoubted source of competitive advantage. However, it falls short on translating scientific leads into leading positions in new industries.'[22] Hauser called for

[20] Geoff Brumfiel, 'UK scientists celebrate budget reprieve', *Nature*, 467 (27 October 2010), p. 1017.

[21] Kieron Flanagan, 'Science is vital, just not in the way you think', *The Conversation*, 24 May 2013 (accessed at theconversation.com/science-is-vital-just-not-in-the-way-you-think-14461, 15 October 2023). See David Edgerton, '"The linear model" did not exist: reflections on the history and historiography of science and research in industry in the twentieth century', in Karl Grandin and Nina Wormbs (eds.), *The Science–Industry Nexus: History, Policy, Implications* (New York: Watson, 2004), pp. 37-51, for a typically sceptical view.

[22] Hermann Hauser, *The Current and Future Role of Technology and Innovation Centres in the UK* (London: Department of Business, Innovation and Skills, March 2010), p. 1. The Conservatives had commissioned a parallel report,

a much strengthened 'translational infrastructure', a national mode of coordination that would 'close the gap between universities and industry'. He proposed calling them Clerk Maxwell Centres, commemorating the great Scottish mathematical physicist. Hauser's report lay in the Cameron government's inbox.

When implemented, Hauser's recommendation became the Catapult network – note the directionality of the metaphor. The Catapults – the first was in 2011 and the ninth opened in 2019 – are private bodies that identified the areas where, in early twenty-first-century Britain, it was hoped that research, business and investment interests most strongly overlapped: biomedical and pharmaceutical science (Cell and Gene Therapy, Medicines Discovery); electronics and digital technology (Compound Semiconductor Applications, Connected Places, Digital, Satellite Applications); decarbonisation (Offshore Renewable Systems, Energy Systems); and manufacturing (High Value Manufacturing). The language was of 'catalysing', 'accelerating' and 'leveraging' (and rarely, simply, 'funding'). The initial reaction from scientists and science policy commentators was lukewarm, regarding the measures as inadequate recompense for cuts or as old measures recycled, for example, when the cell therapy Catapult was unveiled by Cameron and Willetts in 2011 as part of a billed new 'Strategy for UK Life Sciences'.[23] Meanwhile, overall business investment in research and development continued to decline.

Nevertheless, the Catapult initiative was one case, amongst others, of a reawakening of a willingness in government to talk 'strategy'. Here we can see the Coalition effect. For example, it

from the inventor-entrepreneur James Dyson, that made remarkably similar suggestions. James Dyson, *Ingenious Britain: Making the UK the Leading High Tech Exporter in Europe*, March 2010 (accessed at media.dyson.com/images_resize_sites/inside_dyson/assets/UK/downloads/IngeniousBritain.PDF, 30 November 2023).

[23] Ewen Callaway, 'Lukewarm reception for UK life-sciences investment', *Nature*, 12 December 2011. Cameron, for tragic family reasons, had a strong interest in genomic science.

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was Vince Cable, the Liberal Democrat who sat in the Cabinet as business secretary, who, in a speech at Imperial College on 11 September 2012, resurrected the term 'industrial strategy' while speaking of long-term support for business and science.[24] No doubt this framing was deliberate, and awkwardly counterbalanced the deregulation announced at the same time and favoured by the Conservative right. There was a strong sense of policy being pulled in two contradictory directions. (Another tension relevant to science concerned immigration: Cable favoured easing restrictions on movement of students and skilled workers, for example from China, to the UK, while Theresa May, then home secretary, wanted controls tightened.[25])

The tension was not simply a matter of different parties in the Coalition. The Conservative science minister David Willetts, closely aligned to Cable, led the way. On 24 January 2013, in a speech given at the Policy Exchange think tank, Willetts not only set out what he called 'Industrial Strategy 101' but also identified eight technological areas that would be targeted with support.[26] The speech is perhaps the most significant one concerning science policy during our period and merits detailed attention. Starting by crediting Cable, Willetts noted the distinctively broad and deep science base of the UK while acknowledging the retreat from strategy and economic interventionism since the 1980s. The result, in combination, had been 'classic British policy on science and technology'. But what was missing, argued Willetts, was the 'crucial stuff in the middle – real decisions on backing key technologies on their journey from the lab to the marketplace … We are living now with the long-term consequences of the failure to have a policy backing these key

[24] Ananyo Bhattacharya, 'UK technology-boost plan disappoints', *Nature*, 489 (19 September 2012), p. 347.

[25] Patrick Wintour, 'Vince Cable rebuffs Conservative right on deregulation', *Guardian*, 9 September 2012.

[26] David Willetts, 'Eight great technologies', speech delivered at Policy Exchange, 24 January 2013 (accessed at www.gov.uk/government/speeches/eight-great-technologies, 20 October 2023).

technologies.' He held up US practice as better, and after considering and dismantling objections, set out his Industrial Strategy 101 – a rather top-down process of gatherings of ministers, researchers, regulators and business interests that set out road maps prior to public funding – and announced (without acknowledging the rather jarring contradiction with the aim to consult first) £600 million of funding, additional to that already 'ring-fenced', to support big data, space, robotics, synthetic biology, regenerative medicine, agricultural science, advanced materials and energy technologies.

Overall, then, science fared relatively well under the early years of austerity: ring-fenced funding for research (if not facilities), and vocal, informed support from a talented minister. When Willetts resigned, as Cameron prepared a major reshuffle in July 2014, the tributes were unusually positive, even glowing. Paul Nurse, president of the Royal Society, called him 'an outstanding science minister'; Sarah Main, of CaSE, said he was 'liked and respected throughout the [science] sector for "getting it"'; Jeremy Farrar, of the Wellcome, called his efforts 'tireless'; the leading neuroscientist Colin Blakemore said science owed Willetts a 'huge debt' and observed that his 'personal affection and enthusiasm for science have been crucially important in sustaining the government's commitment to science in challenging times'.[27] Willetts was replaced by Greg Clark, the MP for Tunbridge Wells who, critics soon noted, had previously spoken in favour of homeopathy. (Clark, nevertheless, was a supporter of the 'strategy' approach; he was well regarded by senior science advisers in government and would later prove to be an effective chair of the science select committee.)

Having fared well, scientists in the UK have been asked to demonstrate the effectiveness and accessibility of their research. Two trends were clearly established in the 2010s. First, while universities were already measured and partly paid by performance via a mechanism called the Research Assessment Exercise

[27] 'David Willetts quits as universities minister', *Times Higher Education*, 14 July 2014.

(RAE, the first of which took place in 1986), in the 2014 iteration, rebranded as the Research Excellence Framework (REF), university researchers had to report on the measurable 'impact' of their work. Public money had to be shown to have public – economic, social, cultural – benefits.[28] For critics the REF was a restriction on freedom to choose research directions, a disincentive to the conduct of 'blue sky' research, or an onerous bureaucratic burden. Second, the movement for 'open access' publication gathered momentum. The scientific publication system, as it had massively expanded from the 1960s onwards, was largely in the ownership of a handful of companies and was extremely profitable, charging considerable sums to university libraries for licences and hiding research papers from non-academic users behind lofty paywalls. The public, critics said, paid twice, once for the research and again to see the results. In 2014, the Wellcome, a private philanthropic foundation that had become a top-rank funder of biomedical research, having encouraged open access publication by its grant-holders from 2006, began to sanction them if they didn't comply.[29] European funders, and eventually, in the early 2020s, UK research councils, followed suit.[30]

BREXIT/COVID/BREXIT

In the general election of May 2015, the Conservatives were returned with a majority and the Liberal Democrat vote collapsed, ending the Coalition government. Scientists again lost a visible friend of science, the Liberal Democrat MP for Cambridge and former biochemist, Julian Huppert. Greg Clark ended his short stint as science minister and was replaced by Jo Johnson, brother of Boris. Johnson, unlike Clark and Willetts

[28] Natasha Gilbert, 'UK science will be judged on impact', *Nature*, 468 (17 November 2010), p. 357.

[29] Richard Van Noorden, 'UK funder explains clamp-down on open access', *Nature*, 9 April 2014.

[30] Richard Van Noorden, 'Major UK science funder unveils strict open-access policy', *Nature*, 6 August 2021.

before him, did not sit in the Cabinet, suggesting science was not to be a political priority. While another initial concern for scientists was funding – neither the Conservatives nor Labour had promised to protect the science budget – the new worry was Europe. UK scientists had always been well supported under European research funding schemes, notably Horizon, receiving back more money than was put in and benefiting immensely from the scale and ease of European networks. But Cameron had promised a vote on Britain leaving the EU. In retrospect, it was apparent that informed commentators on science policy, as was the case more broadly, underestimated the danger, anticipating either a win for Remain, or a continuation of access to European science funding in the unlikely event of Brexit.[31]

In the year before the 2016 Brexit vote, science policy continued in normal mode, although three significant longer-term trends saw significant movement. First, the organisations that lobbied government for the support of science – the Campaign for Science and Engineering and the Royal Society – increasingly focused on a simple percentage target – 2.4 per cent, or 3 per cent of GDP for the ambitious – of research and development intensity as a proportion of the economy. The pressure was relayed via the select committees which listened sympathetically to the call.[32] As a rallying cry, the percentage target had the advantage of clarity. As science policy it was simplistic, a crude measure of input, that hid the important questions of what, where, how and why the science might be done. Jo Johnson, the science minister, was notably unimpressed, telling the Science and Technology select committee that spending 3 per cent of GDP was 'a nice round number, more than anything else', and counselled against 'focusing on such targets,

[31] Elizabeth Gibney, 'What the UK election results mean for science', *Nature*, 521 (8 May 2015), p. 134.

[32] Business, Innovation and Skills Committee, *Seventh Report of Session 2014–15, Business-University Collaboration*, HC 249, recommended 3 per cent. The House of Commons Science and Technology Committee, in *The Science Budget, First Report of Session 2015–16*, HC 340 (London: The Stationery Office, 9 November 2015), p. 3, called for the government to produce a 'road map' to 3 per cent.

arguing that research outputs were a more reasonable consideration than spending "inputs"'.[33] Nevertheless, 2.4 per cent (or 3 per cent) became embedded and increasingly equated with the UK's ambition to be a 'science superpower'.[34] This curious phrase had begun to be used in the 2000s almost exclusively in policy framings of the rise of China;[35] in the 2010s it became the framing for the UK, in a manner that would only be made stronger as the UK struggled with the fallout of Brexit. (George Freeman, who, until late 2023, had been an ever-present politician within Conservative science policymaking, claims credit for using the label.) The quotidian reality of austerity contrasted sharply. In the November 2015 budget, science spending was allowed to increase with inflation, while other public funding was slashed; the mood among scientists was that it could have 'been much worse'.[36]

Second, the research council system was consolidated into a single structure. The research councils were already loosely coordinated when Paul Nurse, president of the Royal Society, began his inquiry. While some feared that a full-blown merger would result, the Nurse Review stopped short in its recommendations.[37] However, Jo Johnson did accept the advice to set up what would become, by 2018, UK Research and Innovation (UKRI), with an individual at its head, in principle a new powerful role in UK science. The first chief executive was the outgoing GCSA, Mark Walport. A central argument made by Nurse was that a centralised UKRI would be a stronger voice for

[33] Johnson, quoted in House of Commons Science and Technology Committee, *The Science Budget, First Report of Session 2015–16*, p. 17.

[34] The first line of the 2015 select committee report, cited above, was: 'The United Kingdom is a science superpower'.

[35] James Wilsdon and James Keeley, *China: the Next Science Superpower* (London: Demos, 2007).

[36] Jennifer Rohn, of the campaigning group Science is Vital, quoted alongside other similar voices, in Elizabeth Gibney, 'UK scientists celebrate slight rise in research budget', *Nature*, 528 (3 December 2015), p. 20.

[37] Paul Nurse, *Ensuring a Successful UK Research Endeavour: a Review of the UK Research Councils* (London: Department of Business, Innovation and Skills, November 2015).

science in the face of arguments with government: 'The present system has not been strong enough,' Nurse had said. 'Properly set up, UKRI can deliver that.'[38]

The third trend was towards the setting of 'grand challenges'. The term 'grand challenge' does a lot of interesting rhetorical work. A challenge is a mission, ambitious and noble. But a challenge does not direct how it should be met. A grand challenge therefore has the advantage of signalling lofty public benefit without the worrying, socialistic implications associated with planning. The new wave of grand challenge discourse began in the United States (home of the Manhattan Project and the Apollo programme) in the late 1980s and 1990s, around high-performance computing (a response to Japanese innovation) and in such initiatives as the Bill and Melinda Gates Grand Challenges on Global Health announced at Davos in 2003. In the 2010s the language of grand challenges was embraced by the European Union and by universities (such as University College London). In November 2015, George Osborne, in the same UK budget that barely maintained science funding, rebranded a portion of it as a new Global Challenges research fund, £1.5 billion over five years. Greg Clark deserves credit for arguing the case for uplift here.

Challenges could sometimes seem superficial, even gimmicky. In 2013 David Cameron announced a Longitude Prize, commemorating and loosely inspired by the eighteenth-century encouragement to search for an accurate means of determining the position of ships at sea.[39] In Dava Sobel's bestselling version of the story the plucky independent clockmaker John Harrison had overcome bureaucratic hostility to win the original prize.[40] In 2014 the audience of BBC's *Horizon* TV programme was asked to vote on six challenges, shortlisted by a committee. The

[38] Daniel Cressey, 'Leading scientists clash over sweeping UK research reforms', *Nature*, 13 October 2016.

[39] Katia Moskvitch, 'UK prize lets public decide on world's biggest science problem', *Nature*, 19 May 2014.

[40] Dava Sobel, *Longitude: the True Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Time* (London: Fourth Estate, 1995).

winner, a challenge to make a new means of testing for infection as part of a fight against antimicrobial resistance, would receive the lion's share of a £10 million pot. It was nostalgic, gave the public what it wanted by a simple vote, discounted the complexities of the real world, looked backwards to the supposed glory days of the nation's history, and, while acknowledging a problem, was woefully short of matching adequate means to ends.

In June 2016 the UK voted, by a very narrow margin, for Brexit. It was not the result scientists wanted: a poll of researchers held in March had suggested more than 4 out of 5 scientists preferred Remain.[41] Some fears concerned funding. A sixth of UK university research funding came from the European Union, much of which came through its Horizon programme. Other anxieties concerned freedom of movement to travel. Scientists are often internationalists, and UK laboratories are cosmopolitan places. Would the 'hostile environment' extend to science?

While it may well be said that the voters were not told what Brexit they had voted for, it is also apparent that there were different views about policy-for-science in a post-Brexit Britain. One approach was to double down on industrial strategy. Theresa May, now prime minister, in a speech to the Confederation of British Industry (CBI) in November 2016, spoke of how the opportunity presented by Brexit to 'do things differently' meant that the 'forces of capitalism' could be harnessed to benefit the 'let down, left behind and marginalised'.[42] The harness was a 'modern Industrial Strategy . . . that will back Britain's strategic strengths and tackle our underlying weaknesses'. She placed science at the centre of these strengths. 'We're ambitious for Britain to become the global go-to place for scientists, innovators and tech investors', she said, promising

[41] Daniel Cressey, 'Scientists say "no" to UK exit from Europe in Nature poll', *Nature*, 531 (2016), p. 559.

[42] Theresa May, CBI annual conference 2016: prime minister's speech, 21 November 2016 (www.gov.uk/government/speeches/cbi-annual-conference-2016-prime-ministers-speech).

action on freer movement for 'the brightest and the best', although adding the significant qualification that the UK could 'only do so by bringing immigration down to sustainable levels overall so we maintain public faith in the system'. She promised government investment in R&D, 'an extra £2 billion a year by the end of this parliament to help put post-Brexit Britain at the cutting edge of science and tech'. (Again science was doing relatively well in terms of funding.) She kept the challenge frame, announcing a new Industrial Strategy Challenge Fund (ISCF) that would 'direct some of that investment to scientific research and the development of a number of priority technologies in particular, helping to address Britain's historic weakness on commercialisation and turning our world-leading research into long-term success'. She claimed it amounted to 'a new way of thinking', and a break from 'business-as-usual', neither of which was correct.

Yet in the reporting[43] that the ISCF might model itself after the US Advanced Projects Agency (ARPA, subsequently DARPA) we can spy another vision of science and government. ARPA was the organisation that had been created in 1958 after the shock of Sputnik and that had backed, with light bureaucratic oversight, risky and innovative ideas with generous funds in return for technologies that might leapfrog those of Cold War enemies. ARPA had claimed the ARPANET (the origins of the internet) as one of its successes. ARPA was a lodestar for Dominic Cummings.

Assessing Cummings' influence is difficult, not least because he was the figure, and already often falsely mythologised figure, at the centre of the Brexit and Covid stories. He also offered a distinct vision for science and government. An Oxford history graduate, he spent time in Russia in the mid 1990s 'starting businesses . . . experience [that he later reflected] was very useful

[43] 'Some of the money will go directly to applied R&D through a new Industrial Strategy Challenge Fund, modelled on the US Defense Advanced Research Projects Agency (DARPA), the Pentagon's high-risk research arm', see Elizabeth Gibney, 'UK scientists excited by surprise £2-billion government windfall', *Nature*, 540 (23 November 2016), pp. 16-17.

in politics as I had an understanding of how large complex organisations work, both badly and well'.[44] He also read narrowly and deeply into a few subjects, notably Bismarck's disruptive diplomacy, predictive data science, US Cold War technological successes, and the computer libertarianism of Silicon Valley. After cutting his political teeth in campaigns (for example, against the Euro) and a brief, awkward stint advising Iain Duncan Smith, by the time of the Coalition government Cummings was, more compatibly, a special adviser to the Education secretary Michael Gove. He commissioned Ben Goldacre to write a report that recommended the application of randomised-controlled trials to policymaking, and made the department take out subscriptions to *Nature* and *Science*. The message was that politics could learn from science. Specifically, he had an analysis and a prescription. The analysis was that Whitehall was too slow, a bureaucracy ingrained against challenge and change; its politicians, educated at Oxford in PPE (Politics, Philosophy and Economics), trained in 'superficial bluffing, misplaced confidence … [with] little or no idea about fundamental issues concerning mathematical models of the economy … [untrained to] make decisions in complex organisations'.[45] The prescription was to 'move from Whitehall control to distributed systems',[46] to strip out the bureaucracy

[44] Dominic Cummings, 'A few responses to comments, misconceptions etc. about my Times interview', 20 June 2014 (accessed at dominiccummings.com/2014/06/20/a-few-responses-to-comments-misconceptions-etc-about-my-times-interview/, 30 October 2023).

[45] Dominic Cummings, 'My essay on an "Odyssean" education', March 2014 referring to an earlier version from 2013 (accessed at dominiccummings.com/the-odyssean-project-2/, 25 October 2023).

[46] Dominic Cummings, '"Standin' by the window, where the light is strong": de-extinction, machine intelligence, the search for extra-solar life, autonomous drone swarms bombing Parliament, genetics & IQ, science & politics, and much more @ SciFoo 2014', 19 August 2014 (accessed at dominiccummings.com/2014/08/19/standin-by-the-window-where-the-light-is-strong-de-extinction-machine-intelligence-the-search-for-extra-solar-life-neural-networks-autonomous-drone-swarms-bombing-parliament-genetics-amp/, 30 October 2023).

and replace it, at the centre of government, with 'high-performance teams', educated in maths and physics, housed in modern 'seeing rooms', who would integrate data science into decision-making.[47] In turn this would allow the creation of a UK 'civilian version of DARPA aimed at high-risk/high-impact breakthroughs … For it to work, it would have to operate outside all existing Whitehall HR rules, EU procurement rules and so on – otherwise it would be as dysfunctional as the rest of the system.'[48] It has to be stressed that this whole was a package for Cummings – destruction of traditional Whitehall, replacement by cybernetic (i.e. feedback-driven) data science, a new political class educated in science, encouragement of inward migration of scientists, and leaving the EU. The ultimate outcome would be an answer to Dean Acheson's quip that Britain had lost an empire but not yet found a role: this role, repeated Cummings, often, should be 'making ourselves the leading country for education and science'.[49] 'We could make Britain the best place in the world', stated Cummings, referencing one of his favourite Silicon Valley heroes, 'for those who can invent the future'.[50]

[47] For 'high-performance teams' see dominiccummings.com/2018/09/11/29-on-the-referendum-4c-on-expertise-on-the-arpa-parc-dream-machine-science-funding-high-performance-and-uk-national-strategy/; for 'integrate physicist-dominated data science in decision-making', see dominiccummings.com/2016/10/29/on-the-referendum-20-the-campaign-physics-and-data-science-vote-leaves-voter-intention-collection-system-vics-now-available-for-all/; for 'seeing rooms', see dominiccummings.com/2019/06/26/on-the-referendum-33-high-performance-government-cognitive-technologies-michael-nielsen-bret-victor-seeing-rooms/ (all accessed 30 October 2023).

[48] Dominic Cummings, *Times* op-ed: 'What is to be done? An answer to Dean Acheson's famous quip', 4 December 2014 (accessed at dominiccummings.com/2014/12/04/times-op-ed-what-is-to-be-done-an-answer-to-dean-achesons-famous-quip/, 30 October 2023).

[49] Cummings, 'My essay on an "Odyssean" education'.

[50] The reference is to Alan Kay, computer scientist at Xerox PARC, where much of the interface of modern consumer information technology was first imagined, who may have said 'The best way to predict the future is to invent it.' Dominic Cummings, 'On the referendum #23, a year after

Cummings, tragically, was successful in implementing some, but not all, of this package. He directed the Vote Leave campaign, guided by an impressive data science. Brexit happened. Back at Number 10, as the political adviser to prime minister Boris Johnson he attempted to recruit a new political class – advertising on his blog in January 2020 for an 'unusual set of people', 'Data scientists and software developers, Economists, Policy experts, Project managers, Communication experts … [and] Weirdos and misfits with odd skills'.[51] (Some of these misfits turned out to be too weird and soon had to leave.[52]) A new civilian British science funding body, modelled on DARPA, the Advanced Research and Invention Agency (ARIA) was formally announced in 2021 and launched in 2023. But if Cummings' revolution failed then overly ambitious aims were only part of the explanation.

In December 2019 news arrived from Wuhan, China, of cases of human infection by a novel coronavirus. The first UK cases were confirmed in January 2020. The Covid pandemic would prove to be the most extraordinary test of the UK science-government system; a test, it seems, it largely failed. In March 2020, with the first UK deaths, and with modelling predicting many more, the risk to the UK was officially categorised as 'high'. On the 12th the prime minister, Boris Johnson, addressed the nation via television from 10 Downing Street. He was flanked, to his right by Chris Whitty, the chief medical

victory: "a change of perspective is worth 80 IQ points" & "how to capture the heavens"', 23 June 2017 (accessed at dominiccummings.com/2017/06/23/on-the-referendum-23-a-year-after-victory-a-change-of-perspective-is-worth-80-iq-points-how-to-capture-the-heavens/, 30 October 2023).

51 Dominic Cummings, '"Two hands are a lot" – we're hiring data scientists, project managers, policy experts, assorted weirdos…', 2 January 2020 (accessed at dominiccummings.com/2020/01/02/two-hands-are-a-lot-were-hiring-data-scientists-project-managers-policy-experts-assorted-weirdos/, 30 October 2023).

52 'Andrew Sabisky: No. 10 adviser resigns over alleged race comments', BBC News, 18 February 2020 (accessed at www.bbc.co.uk/news/uk-politics-51538493, 30 October 2023).

officer, to his left by Patrick Vallance, the government chief scientific adviser. Johnson called the pandemic 'the worst public health crisis for a generation' and warned that 'many more families are going to lose loved ones before their time'. 'At all stages,' Johnson said, 'we have been guided by the science, and we will do the right thing at the right time.'[53] 'Guided by science', sometimes 'led by science',[54] became a mantra; and the repeated spectacle of politicians flanked by scientific and medical advisers at the peak-time televised briefings was the visual reinforcement of this framing.

But the frame was misleading. Vallance and Whitty were the individual pinnacles of advice in the system, but behind them was a complex, and initially to the public eye obscure, structure of committees. The principal set was the Scientific Advisory Group for Emergencies (SAGE), which in turn was informed by the work of specialist bodies, notably the New and Emerging Respiratory Virus Threats Advisory Group (NERVTAG), the Scientific Pandemic Insights Group on Behaviours (SPI-B), a similar one on Modelling (SPI-M), amongst others I will not name in full (JCVI, COG-UK, and so on). During the Brexit debate, Michael Gove, in an interview with Faisal Islam on *Sky News*, had flippantly observed that the British public had 'had enough of experts [shocked laughter from audience] ... from acronyms'. Four years later, under Covid, acronymic bodies staffed by experts were indispensable. The serious point is that a populist and unserious Conservative government had serial dysfunctions working with organised expertise.

The full extent of the dysfunction will only be clear after the completion of the Covid Inquiry, underway in 2023. But we can

[53] Boris Johnson, 'Prime Minister's statement on coronavirus (COVID-19)', 12 March 2020 (www.gov.uk/government/speeches/pm-statement-on-coronavirus-12-march-2020).

[54] Even 'We are just being entirely science-led' (Grant Shapps, on *Sky News*, March 2020), quoted in Peter Walker, 'UK government response to coronavirus "led by science" – Grant Shapps', *Guardian*, 16 March 2023 (www.theguardian.com/world/2020/mar/16/government-response-to-coronavirus-led-by-science-grant-shapps).

say the following. First, in the early months, in addition to multiple distractions to the prime minister's attention, there were also deficiencies: in the collection and timeliness of data, and in that the response was being patterned after preparations for influenza. Big sporting events went ahead partly because the chief medical officer was working from data that was already out of date. The Coronavirus Action Plan – 'Contain, Delay, Mitigate, Research' – was based on an existing strategy for an influenza pandemic.[55] Borders were kept open, even as other countries chose different, robuster responses, such as vigorous testing and quarantine (South Korea) or closing borders (New Zealand).

Second, in the tumultuous, fearful month of March 2020, the realisation that the NHS would be overwhelmed under the existing strategy and the shift to major restrictions happened because politicians were being confronted with the stark results of scientific modelling. SPI-M-O reported on 2 March that modelling showed that it was 'highly likely' that there was sustained transmission of Covid in the United Kingdom; on the 9th, Professor Steven Riley, epidemiologist at Imperial College, informed via SPI-M that care services would be 'overrun'; on the 10th, Professor Neil Ferguson emailed a Number 10 adviser, pleading that the prime minister be given sight of a graph showing the overrun of NHS bed capacity and a likelihood of peak daily death rates of between 4,000 and 6,000 per day.[56] Even then there was confused talk of 'herd immunity', of 'taking it on the chin' (Johnson) and 'allowing the disease, as it were, to move through the population' (Johnson); while Vallance stated at the press conference of 12 March that 'It's not possible to stop everyone getting it and it's also not desirable because you want some immunity in the population. We need to have immunity to protect ourselves.'[57] The new advice, 'Stay home, Protect the NHS, Save Lives', was accompanied by much talk of following

[55] Hugo Keith, recorded in 'Transcript of Module 2 Public Hearing on 3 October 2023', 3 October 2023 (covid19.public-inquiry.uk/documents/transcript-of-module-2-public-hearing-on-3-october-2023/).

[56] Ibid. [57] Ibid.

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the science. Or was it hiding behind the science? 'The diaries of Sir Professor Vallance', summarised the lead counsel to the Covid inquiry, who had access to the documents, 'speak of SAGE and the CMO [chief medical officer] and the CSA [chief scientific adviser] being positioned as human shields.'[58]

Third, Covid hit the centre of government directly: Johnson tested positive on 27 March, the same day as health secretary Matt Hancock. Johnson was in intensive care by April. Whitty and Cummings also succumbed. Cummings, with Covid but feeling unsafe in London, drove his family to Durham; on 12 April he drove them to Barnard Castle, a breach of lockdown that became a scandal in May 2020 and hung over him until leaving Number 10 in November. The epidemiologist Neil Ferguson resigned from SAGE, also in May 2020, after his lockdown breach was revealed. By then SAGE was fraying. In the words of the Inquiry lead counsel: 'SAGE was never designed to be run at such speed, with such heat or for so long. It sat for over 100 meetings. In past crises it's met generally on no more than five occasions. Its members worked around the clock unceasingly in the public interest and pro bono. ... they were placed under sustained and also unfair media scrutiny and, increasingly, attacked.'[59] But SAGE also had weaknesses in its design: it drew on an overly narrow range of scientific expertise (only behavioural scientists rather than a broader but relevant set of social scientists, for example), and, until May 2020, refused to publish its minutes, an unnecessary level of secrecy that limited accountability and encouraged conspiracy theories. (A confusingly named 'Independent SAGE', under David King, a chief scientific adviser during New Labour, was launched in May 2020 precisely because SAGE was too secretive.)

Fourth, politics could cherry-pick, or even ignore the science. By May 2020, even with a vastly expensive Test and Trace system launched and the cumulative number of deaths from Covid in the UK passing Italy's to become the highest in Europe, the first wave was easing. 'Stay at home' became 'Stay alert'. In August, Rishi

[58] Ibid. [59] Ibid.

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Sunak announced 'Eat out to help out'. Vallance and Whitty, in their evidence to the Inquiry, have stated that '*had they* been consulted they would have advised it was highly likely to increase transmission'.[60] Likewise, when guidance was changed on allowing 1- or 2-metre distancing, the chief scientific adviser recorded in his diary it was 'abundantly clear that no one in [Number 10] or [the Cabinet Office] had really read or taken time to understand the science advice on [2 metres]. Quite extraordinary'; while on the same issue, commenting on how SAGE advice had been integrated: 'Some person has completely rewritten the science advice as though it is the definitive version. They have just cherry picked.'[61] Other examples of Covid science being 'led by politics' have been identified.[62] Yet at the same time the scientific advisers were being asked to go beyond advice and therefore beyond their role: Vallance noted in May 2020 'Ministers try to make the science give the answers rather than them making decisions.'[63] SAGE is meant to be advisory only; decisions have to be taken by the executive, by elected, responsible and accountable politicians.

Finally, the products of science, or rather the science-based biomedical industries, would change the narrative. The second wave of Covid hit the UK in autumn 2020, and a second national lockdown began in November. But on 2 December 2020 the Medicines and Healthcare products Regulatory Agency (MHRA) approved the Pfizer-BioNTech vaccine after innovative trials. It was relatively expensive, required refrigeration, but came out of genuinely novel discoveries in mRNA techniques (ones that have immense promise for other infectious diseases). It was the first Covid vaccine approval in the world. Immunisation began six days later. By the end of the month the Oxford AstraZeneca vaccine, which was cheap, developed

[60] Ibid. Emphasis added. [61] Ibid.

[62] Susan Michie, Philip Ball, James Wilsdon and Robert West, 'Lessons from the UK's handling of Covid-19 for the future of scientific advice to government: a contribution to the UK Covid-19 Public Inquiry', *Contemporary Social Science*, 17:5 (2022), 418–33, p. 422.

[63] Keith, recorded in 'Transcript of Module 2 Public Hearing on 3 October 2023'.

with largely traditional methods, had no need for refrigeration, but also benefited from accelerated trials, was also approved. Mass vaccination, dependent on an army of volunteers (and indeed at times, the Army) began in earnest. 'A successful Covid-19 vaccine rollout in 2021', note the authors of a paper on lessons to be learned, retrospectively 'created a generalised positive impression or "halo effect" ... about the way the pandemic had been handled'.[64]

Politicians were not shy of taking credit for the success of the vaccine programme. A similar simplification had been found in the campaign messaging ('Get Brexit done') that led to Boris Johnson's election victory of December 2019. But political fortunes would unravel thereafter. The halo around science and government would also fade. Re-entry into the EU's Horizon funding scheme, a symbol or renormalisation of UK–Europe relations, stalled for many months, much to scientists' concern, while the Covid inquiry began to document in detail the dysfunction in the operation of science advice.

CONCLUSION

No doubt the historians' interpretation of science and government between 2010 and 2024 will change as the full range of primary source evidence becomes available. The thirteen years of Conservative science policy from 1951 to 1964 had been judged as 'thirteen wasted years' in 1969, but have since been revised (along with the Wilson years) as a period of significant national investment and effort.[65] The thirteen years of New Labour science policy have been described as largely a continuation of that of Thatcher and Major, but a reassessment, enabled by access to

[64] Michie et al., 'Lessons from the UK's handling of Covid-19'.

[65] For 'thirteen wasted years' see, for example, Hilary Rose and Steven Rose, *Science and Society* (Harmondsworth: Penguin, 1969), p. 78. For 'technonationalism' in the period, see amongst his other output, David Edgerton in Kieron Flanagan, David Edgerton, Claire Craig, Sabine Clarke and Jon Agar, *Lessons from the History of UK Science Policy* (London: British Academy, 2019), p. 55.

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sources, is only just beginning.[66] We may have been misled by hot takes and obscured views.

Under the Coalition and Conservative governments there was also continuity and change in science policy. More precisely there was modified continuity and the articulation of the possibility of radical change. Modified continuity is best represented by the figure of David Willetts. As science minister he promoted a re-emergence of science-based industrial strategy, gradually reshaping a reluctance to intervene in 'near market' research that had its roots in the late years of the Thatcher administration and had continued under Major, Blair and Brown. The possibility of radical change, on the other hand, is best represented by the provocations of Dominic Cummings, who had in mind a revolution in ways of governing that would serve the purpose of giving the UK, finally, a post-Imperial role as the best place in the world for science and education. Willetts' vision faltered and Cummings' vision failed because of events, internally and externally generated.

When Willetts set out his 'Industrial Strategy 101' in 2013, he ended his speech with six possible versions of where the UK would be in 2023 if his advice was followed. Pessimistically, the brand-new wealth-creating science-based industries would wither or move abroad. Optimistically, the UK would now have its home-grown and home-owned equivalents of the giant innovative companies such as Google, and the UK would be 'purveyors of R&D to the world':

> Britain is increasingly recognised as the world's best R&D lab. We have achieved our ambition of being the best place in the world to do science. Multinationals base their R&D facilities here. Smart people from around the world want to come and research here. We have also earned a reputation as the best managers of big international scientific projects.[67]

[66] See Jon Agar, *Science Policy from Major to Blair* (London: UCL Press, forthcoming).

[67] Willetts, 'Eight great technologies'.

In reality, by 2022, the potential great companies had been bought (AI science pioneers Deepmind was snapped up by Google in 2014) and R&D levels remained in effect static.[68] What happened was political turmoil and especially Brexit.

The rapid turnover of administrations meant that while Willetts had been science minister for four years, enough to build strong relationships and build policy, in the years since 2014 there have been eight science ministers (one serving twice). The churn above also affected policy: Sajid Javid, as a free market chancellor, disliked and discontinued the strategic approach, until he too soon left and policies flipped back again. Cummings was both an agent and victim of this turmoil. He was an agent of Brexit. But he wanted Brexit as part of an overall vision of revolution in government in the name of science. When granted power, as Johnson's adviser, implementing that vision was impossible, first because of the political instability of Brexit (and therefore partly his own doing) and factional infighting within the court of Johnson, and second because of the extraordinary pressure of Covid.

What is remarkable is that science continued to do well. It had been relatively protected in austerity budgets, and science-based industry delivered vaccines when challenged. The significant failings on issues where science-for-policy was critical – climate change is the outstanding long-term example, while AI represents a more sudden emergence – are due to the complexities of committing to necessary action globally rather than nationally

[68] Ironically, one of the measures of being a 'science superpower', R&D spending at a level between 2.4% and 3% of GDP, was achieved overnight in 2022 when the Office of National Statistics changed its methods of calculating GERD (Gross Expenditure on R&D). GERD in 2020 was now said to have been 2.9%. At a stroke a central message of the science lobby's campaigning strategy was nullified – a lesson in the dangers of oversimplifying science policy. For the reasons of the recalculation, see Abbas Panjani, *Research and Development Spending* (London: House of Commons Library, 2023), pp. 8-9.

(although there was always more that could and should have been done within the UK). Public trust in scientific expertise, as polling shows[69] and in stark contradiction to the populist line that the British people had had enough of experts, remained high, and considerably higher than trust in Britain's politicians.

[69] Wellcome/Gallup polling for Wellcome Global Monitor 2020, cited in Michie et al., 'Lessons from the UK's handling of Covid-19', p. 427. Contrary evidence can be found in cases where UK citizens have resisted involvement in scientists' projects, in other words where trust is a direct and immediate issue rather than a general polling question. An example might be found in Helen Pearson, 'Massive UK baby study cancelled', *Nature*, 526 (27 October 2015), pp. 620–1.

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