



CHAPTER 6

Cutting the Cake of Science and Policy

The first two parts of this book followed British debates over badgers and bTB as the two previously separate issues collided in the early 1970s, tracing the formation and development of three epistemic communities engaging with badger/bTB—animal health, disease ecology and animal protection.¹ It explored the historical backstories of each of these and documented how they engaged with the news of tuberculous badgers; created and contested new knowledge; and shaped new policies to deal with the problem. The last part of this book will bring these stories back together to help us understand what has happened since the 1990s to create the situation we see today: to ask once again, ‘How did we get into this mess?’² From here on in, we will address the overall knowledge controversy around badger/bTB, to help us understand how and why this relatively obscure science-policy problem has transformed into the extensively reported, highly polarised and political public controversy we see today.³ To this end I will adopt a metaphor of events in the ‘backstage’ and the ‘frontstage’ of the controversy as an aid to analysing this situation. Policy is usually constituted by interactions between: informal and internal communications; formal policy documents and technical information (open to public scrutiny, but engaged with by specialists); and material circulating around the wider public sphere, including mass media coverage, campaigning materials and political statements, aimed at and involving public audiences.⁴ These sit on a spectrum of ‘publicness’, which is getting messier as new communications technologies make it possible for relatively

closed communications (such as private emails and policy documents) to be brought into the wider public sphere.⁵ While it is only possible to gain access to informal/internal interactions via first-hand observation (e.g. ethnography) or in hindsight using archives (as in the first two parts of this book), the increased accessibility of specialist policy documents makes today's 'backstage' much more visible than in the past.

Badger/bTB debates have always had an aspect of publicness which emerged from time to time—as seen in animal protection activist Ruth Murray's attempts to prosecute the Farming Minister (Chap. 2), or the controversy following the 1980 Zuckerman review. However, these were specific incidents, with most of the dialogue still taking place between people already deeply involved with the issue. Towards the end of the last decade this started to change, and since 2010 the controversy has become more consistently public, attracting widespread mainstream media coverage, involving larger and more diverse media audiences, and stepping firmly onto the 'frontstage' of British political life. In order to understand this shift into the broader public sphere, we must first gain a deeper understanding of the 'backstage' of badger/bTB by asking a number of questions: how have scientists, veterinarians, farmers, journalists, campaigners, policymakers and politicians negotiated what we know about badger/bTB; what that knowledge means and what to do about it? Who has been considered to be an 'expert', by whom, and how has this expertise been established? What have scientists and policymakers expected from each other, have these expectations been fulfilled, and what have been the consequences? How, when and why has policy learned from past mistakes, and if not, why not? This chapter will analyse the 'backstage' of bTB policy since the mid-1990s, demonstrating how past events and expectations of the future have contributed to decision-making in the present, creating a repeating cycle of science–policy interaction.⁶ In the long term, this has created mutual disillusionment and mistrust on all sides: however, I will argue that it may also have enabled some success in advancing 'backstage' policy agendas both within and beyond badger/bTB.

6.1 EXPERTS, EVIDENCE AND POLICY

By the end of 2018, the problem of badgers and bTB in Britain will have been the responsibility of nine prime ministers, and twenty-one cabinet ministers—initially of the Ministry for Agriculture, Fisheries and Food (MAFF) and since 2001, the Department for Environment, Food and

Rural Affairs (Defra). Between them, these ministers have weathered eleven general elections, bringing them into and out of power. Over this time, badger/bTB has also provided scientists and veterinarians (as researchers in government and academia) with intellectual, funding and career opportunities, as well as applied roles in government, NGOs and private companies. Badger/bTB has also become a battleground for the increasingly tense relationships between science, policy and politics in the UK. Between 1980 and 2018, there have been nine expert-led reviews of the evidence and/or policy surrounding the issue, starting with the Zuckerman report discussed in Chap. 3. The most recent of these was chaired by population biologist and bTB policy veteran Professor Sir Charles Godfray and was published in October 2018.⁷ Given the long-standing nature of the problem, on one level it is entirely unremarkable and indeed sensible that there have been so many of these reviews, especially given the centrality for policy of rapidly changing scientific knowledge about badger/bTB. These reviews take place in the context of wider traditions across British policymaking, whereby publics sceptical of government and ambitious politicians have required them to support and justify their decisions with expert knowledge. This expertise must in turn be recognised as legitimate—and in the UK this takes the form of a combination of technical qualifications, professional reputation and social standing (hence all the ‘Sirs’ and ‘Lords’ chairing bTB reviews).⁸

As we have explored through the earlier parts of this book, the first twenty years of badger/bTB was shaped and reshaped by a broader ‘sea change’ in interactions between science, policy, publics and wider society. Historian Jon Agar argues that this took the form of experts starting to disagree in public much more often, while publics (particularly via new social movements) have contested Establishment views on many fronts, including environmental and animal politics.⁹ During the 1990s and early 2000s, the UK saw a further wave of changes in relationships between scientists, publics, politicians and policymakers, precipitated by a series of crises centring upon agriculture, food and animal health. These included failings in decision-making under uncertainty in the case of Bovine spongiform encephalopathy (BSE); mismatches between expert, policy and public understandings of ‘risk’ in the case of genetically modified foods; and disciplinary rivalries, policy–community disconnects and the traumatic loss of thousands of animals following an outbreak of foot and mouth disease (FMD).¹⁰ As well as impacting on wider debates about science and society,¹¹ these crises exposed governance flaws which eventually led to the reorganisation of MAFF into Defra

in 2001.¹² This period saw the widespread embedding of environmental concerns into UK national, European and international policy. This created new policy mechanisms to curb pollution and CO₂ emissions, protect biodiversity and encourage sustainable farming; while environmental NGOs further professionalised and embedded themselves in policy. The UK also saw a ‘third wave’ of renewed activism on environmental issues, this time driven by a plethora of ad hoc ‘grassroots’ campaigns, more willing than ever to take direct action on a wide range of issues.¹³ Since 2010, long-standing government agendas for implementing policy via markets have combined with internal tensions in political parties to create further shifts in the politics of expertise, environment and agriculture.¹⁴ In recent years we have seen the public dismissal of ‘experts’ by some politicians and campaigners, and widespread concerns that many countries, including the UK, are entering a ‘post-truth era’, in which science itself is becoming politically polarised.¹⁵ Most famously, this has been in relation to the US Trump administration’s hostility to science and environmental interests: of more relevance to badger/bTB would be the pro-Brexit politician (and current Secretary of State for Defra) Michael Gove’s 2016 comment that ‘people in this country have had enough of experts’.¹⁶

Given these changes—including several transitions back and forth between Conservative and Labour governments—the persistence of the ‘authoritative expert’ bTB review in the face of ongoing controversy requires explanation. Why have successive generations of politicians, policymakers and scientists continued to commission, conduct and cooperate with these reviews? Recalling the timeline presented in Chap. 1 (Fig. 1.1), it is noticeable that such reviews have often been commissioned at politically significant moments, such as transitions between government administrations (e.g. Major–Blair, or Blair–Brown). Whether and how they end up effecting policy change is—as we saw with the Zuckerman report—another matter. Policy scholars have not been optimistic about the bTB case: it has been characterised as following in the footsteps of BSE and FMD—yet another classic example of ‘policy failure’, one which may even be ‘intractable’.¹⁷ Since the 1990s badger/bTB has been further complicated by the devolution of agricultural policy powers to Scotland, Northern Ireland and Wales: resulting in an increasingly diverse patchwork of regional policies, sometimes at direct odds to those of national government in Westminster. As political administrations have changed, so bTB policies have swung back and forth, often justified by multiple interpretations of the same substantive evidence base.¹⁸ This situation has led some

to characterise bTB as a ‘pathology of policy learning’—a situation ‘where learning processes degenerated as the result of various weaknesses in government’s management of its relationship with an epistemic community established to advise it.’¹⁹

This chapter will build on this research, explaining how today’s situation has come about by tracing the development of the badger/bTB controversy since the mid-1990s, through the course of two Labour governments (Blair and Brown), the Coalition government of 2010–2015 and into Theresa May’s Conservative administration. Over the longer history of badger/bTB, I see a pattern of repeatedly building and breaking the mutual *expectations* that have been built between science, policy and wider society. As in other cases where promises made in the present about what science and technology will do in the future (e.g. *there will be a cure for cancer in five years*) then go unfulfilled, I argue that this has created disillusionment and alienation between scientific, policy, political and campaign actors, and contributed to a long-term politicisation of the debate.²⁰ Expanding on the situation outlined in Chap. 1, I will also explore the complexities of ‘the science’ of bTB, drawing out the knowledge practices of the epistemic communities involved in badger/bTB, and demonstrating their strategic deployment to support multiple positions in the debate.

Before exploring the post-1990s history of badger/bTB in depth, a brief reminder about epistemic communities: these are groups of people who work together to produce reliable knowledge about a particular policy area. In the above quotation, the ‘epistemic community’ referred to was a group of scientists known as the Independent Scientific Group (ISG), appointed by government in 1998 to conduct a specific piece of research about badger/bTB. We will learn more about the ISG later in this chapter, but for now it is important to note that, as we have traced through this book, the ISG has not been the only epistemic community involved with badger/bTB. While much of the literature on epistemic communities regards them as conventional ‘experts’ by default, here I have drawn upon an expanded definition which includes the contributions of other actors with specialist knowledge, including farmers, naturalists and animal advocates.²¹ I have applied this to the worlds and work of three overlapping but identifiable cultures of care arising from the epistemic communities around badger/bTB. We started with *animal health* (veterinary scientists and clinicians, farmers and agricultural policymakers) and the long-established policy of ‘stamping out’—controlling contagion with animal slaughter and movement restriction. We then traced the development of a

parallel epistemic community also concerned with animals and infectious disease: that of government pest control scientists and their colleagues in *disease ecology*, natural history and conservation. They were primarily concerned with understanding ‘organisms in their environment’, gaining support by applying their research to boosting agricultural productivity. MAFF scientists become involved in disease ecology when dealing with myxomatosis in rabbits during the 1950s and were drawn into the bTB issue because of their expertise in working with wildlife. Our third epistemic community is the most fuzzy—and has experienced rapid change—the complex alliances involved in campaigning for *badger protection*. While the British ‘badger debate’ has been ongoing for hundreds of years, it was reignited in the mid-1960s by canny and charismatic animal advocates. When tuberculous badgers were found in the early 1970s, campaigns for badger protection were already in full swing.

While initially the three cultures worked closely together to investigate the previously unknown connections between *M. bovis*, cattle and badgers, tensions rapidly manifested—initially between MAFF and animal advocates, then with conservationists and ecologists. The epistemic communities around animal health and pest control moved apart as their theories and methodologies diverged, creating new internal and external pressures on traditionally veterinary-dominated animal health policy. This came to a head during the early 1990s, when a new ‘live’ test for bTB in badgers turned out to be ineffective. When the expectations of politicians and policymakers (that new technologies would solve the bTB problem) were broken, disease ecology advocates renewed lobbying for a new approach to scientific investigation of the problem.²² In the meantime bTB faded into the background, as the emergence of BSE fully occupied the attention of MAFF scientists, policymakers, ministers and wider publics. The policy and political failures associated with animal health, particularly the attempts of ministers to reassure the public that British beef was ‘perfectly safe’ during the BSE crisis, contributed to a disintegration of voters’ trust in the Conservative party and their defeat in the 1997 General Election.²³

6.2 ‘A PROPER EXPERIMENTAL ASSESSMENT’

On 23 July 1996, the last Conservative Agriculture Minister of John Major’s government had announced the third independent scientific review into policy on ‘TB in cattle and badgers’ since 1980: the report was

delivered to Labour's new Minister, Dr Jack Cunningham, a year later.²⁴ The enquiry was chaired by a senior ecologist, Professor John Krebs, and included a highly distinguished team including three Fellows of the Royal Society, several ecologists, an epidemiologist, a microbiologist, immunologists and a statistician.²⁵ Krebs et al. concluded that while MAFF's existing research findings supported the idea that bTB in badgers was being passed to cattle, the evidence was 'indirect'.²⁶ The various culling policies that had been implemented involved different scales, geographical features, quantities, frequencies and timings of culls, making it impossible to coherently understand their effects. To counter this problem, the Krebs group recommended conducting a major field experiment testing the effects of badger culling on bTB in cattle—a study directly comparing several culling strategies with a 'control' (with no culling), where the application of each condition was randomly applied.²⁷ The scientists envisaged that such a study would take about five years, could provide better evidence about whether culling worked, and therefore would be able to directly shape policy:

A proper experimental assessment is the only way to test rigorously the effectiveness (and cost-effectiveness) of different strategies and to provide a sound basis for future policy. Although this would have significant resource implications for Government, these must be considered in the context of the actual and potential costs of TB. An analogy might be the evidence required to recommend the widespread use of a new therapeutic drug.²⁸

By drawing this analogy with biomedicine, Krebs et al. presented their proposed experiment as a randomised controlled trial (RCT), considered to be the 'gold standard' for research in evidence-based medicine, as well as in agricultural and ecological research.²⁹ They appealed to a core idea of the new Labour government—evidence-based policy—suggesting that the best way of resolving the bTB controversy would be to put politics to one side and let policy be determined by the evidence that their proposal would deliver.³⁰ Cunningham was convinced, and appointed a new Independent Scientific Group (ISG). The group was chaired by Prof. John Bourne (former director of the government Institute for Animal Health), and included former members of the Krebs group, plus the economist member of the 1986 Dunnet group and two further statisticians.³¹ The new ISG was charged with designing and implementing the proposed experiment, which they named the Randomised Badger Culling Trial (or

RBCT, sometimes known as the ‘Krebs trial’). The RBCT is probably the largest field trial yet conducted in the UK: it was carried out across over 3000 km² of the South West of England, took over nine years, culled approximately 10,000 badgers and cost just over £49 million.³² By the end of the trial, the ISG had met 103 times, published six formal reports and at least twenty-eight peer reviewed journal articles.³³ Since then their findings have been cited, presented, interpreted, contested, analysed, *reanalysed* and *reinterpreted* by multiple actors in the bTB debate, who sometimes refer to it as ‘the science’ or the ‘sound science’ of badger culling. While much more research has been conducted since (including analyses of the long-term effects of culling after the RBCT, studies of badger–cattle interactions, sophisticated epidemiological models and comparisons with other countries), RBCT data still provide the core of most contemporary research about bTB in the UK.³⁴

The ISG was charged with the design, implementation and monitoring of the RBCT experiment, but from the start the group claimed a wider remit: ‘to recommend a combination of measures which, taken together, will provide information essential for the establishment of future policy.’³⁵ The ISG drew up a list of research questions, on topics including cross-species disease transmission, wildlife ecology, the genetics of bTB and alternative ‘control strategies’ beyond culling. The experiment was designed to compare three experimental conditions: culling badgers *reactively* on an ad hoc basis in response to bTB outbreaks in cattle herds; culling *proactively* across an entire area; and a *control* condition where information was gathered but nothing else was done. The ISG decided that these conditions would be implemented across ten ‘triplet’ areas in parts of the country where bTB was prevalent—adjacent circles of land, each with an approximate area of 100 km². In the process of implementing the design, some modifications were made. Rather than starting the experiment across all ten ‘triplets’ at the same time, it was implemented as and when land became available in different places. Krebs had emphasised the need to remove *all* badgers in areas assigned to the culling conditions, including repeating culls to prevent ‘recolonisation’.³⁶ However, the ISG culls were undertaken on a more restricted basis than had been employed in MAFF’s earlier culling trials such as at Thornbury. The ISG was at pains to ensure that its work was as ‘humane’ as possible, employing cage-trapping with care, closely monitoring trapped animals and only culling outside of the badger breeding season of 1 February to 30 April. This

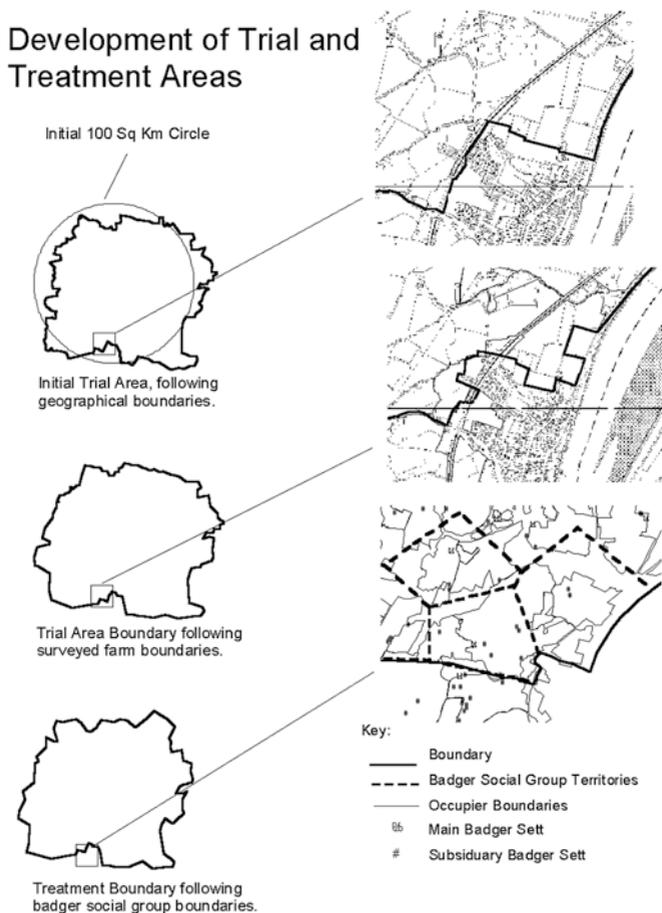


Fig. 6.1 Translating experimental design into lived landscape. Source: Bourne et al., 'Bovine TB: Second Report of the Independent Scientific Group on Cattle TB' (27).³⁸ © Crown copyright, 1999

continued the practices of conservation and animal welfare care which had been developed at the Pest Infestation Control Laboratories (PICL); responded to concerns of external animal advocates; and ensured that the trial complied with the UK's international legal commitments.³⁷

The next job was to translate the planned ‘triplet’ design into the landscapes of the South West of England, resulting in a shift from idealised interlocking circles to messily bordered specific places, taking account of human and badger social boundaries (Fig. 6.1). A year in, the ISG reported a series of complications and delays—relating to surveying potential trial areas, gaining consent from landowners, recruiting staff to do the culling and other fieldwork, and localised ‘interference’ with staff and equipment.³⁹ ‘Interference’ was MAFF and the ISG’s term for the actions of badger protection activists who opposed culling for various reasons. While some advocacy groups campaigned in more conventional ways, others acted directly against the RBCT. As had happened intermittently in the past, these activists destroyed cage-traps, released trapped badgers and damaged equipment: threats were also made against ISG members, MAFF officers and government ministers.⁴⁰ It was three years before the ISG had surveyed all ten of the proposed triplet areas, although it had started culling in seven of these. The experiment had only just gotten into full swing when the situation was further complicated by a major outbreak of FMD in February 2001. The outbreak brought much of the British countryside to a standstill and the RBCT experiment with it. The severity of FMD was such that all meat exports were stopped, as were animal and human movements in affected areas. Most of MAFF’s animal health officers and scientists were seconded into the FMD control effort, suspending not only the RBCT experiment, but routine bTB controls.⁴¹ By the end of the outbreak approximately 10 million animals had been slaughtered, with economic and social impacts on farming communities for years to come.⁴² When bTB testing resumed in January 2002, it soon became clear that bTB incidence had risen sharply (see Chap. 1, Fig. 1.2), creating renewed pressure from farming and veterinary groups for policy action, rather than more research.⁴³ This had a further knock-on effect for the RBCT trial, which was dependent on routine cattle testing to proceed: there was now a year’s backlog to catch up with.⁴⁴

Once the experimental fieldwork finally resumed and the ISG was able to start analysing the preliminary data, an unexpected finding emerged, which the scientists advised ministers of immediately:

... the incidence of herd breakdowns in reactively culled areas has been consistently greater than expected. This increase was estimated to be 27%, though it could be as small as 4.3% or as large as 53%. This increase was consistent in all nine triplets that had received reactive culls by the time of

analysis (triplet J has not yet been reactively culled). While the larger adverse effects may be implausible on general grounds, even a 10% deterioration, if it persisted, would clearly be of major concern. (ISG advice to DEFRA, 29 October 2003)⁴⁵

Not only was culling not reducing bTB in cattle, it looked like the ‘reactive’ condition was actually making things worse. The ISG recommended completing data collection for that season, then stopping the reactive condition as it was ‘not a viable base for a future policy option’.⁴⁶ However, Labour ministers instead decided that the implications for farming were so severe that they stopped reactive culling immediately, leaving the dataset incomplete. As the decision was announced, the ISG published its preliminary analysis in the scientific journal *Nature*.⁴⁷ While these events received relatively little attention, the 2005 publication of the 5th ISG report, combined with a public consultation, did stoke controversy. Ex-MAFF veterinarian and bTB pioneer John Gallagher resigned from Defra’s science advisory group, mustering 420 veterinary colleagues to sign a letter of no confidence in the Ministry; opposition MP Owen Paterson asked over 600 questions in Parliament about bTB; while National Farmers Union (NFU) spokesmen called for an immediate ‘blitz cull’ in the press.⁴⁸ In the meantime, Defra’s public consultation had come back with responses that were overwhelmingly (over 90%) against badger culling: backstage, political pressures on the ministry were building.⁴⁹

Perturbing Findings, Policy Recommendations

For the next few years, the ISG concentrated on publishing findings from the ‘proactive’ culling condition. These seemed contradictory: while bTB incidence had dropped by 19% inside areas where badgers had been culled, it went up by 29% in areas surrounding these cull zones.⁵⁰ It was not until the ISG published its Final Report on 18 June 2007 that the findings were seriously discussed in wider public contexts. This 289-page document, (published ten years after Krebs) laid out the ISG’s data, analyses, findings, key conclusions and policy recommendations. From inception to final report, the ISG’s research had taken over nine years to complete, over which time MAFF/Defra’s policy on badger culling could best be summarised as ‘wait for the science’. The report revealed that there had been further adjustments to the original research design: as well as cutting short

reactive culling, it transpired that several of the ‘triplets’ (meant to provide comparable conditions) had migrated significant distances apart, in one case to the very different landscapes of North and South Devon.⁵¹ We can surmise that this was due to the complications of conducting a controlled experiment across a living countryside instead of a laboratory: one populated by reluctant landowners, disillusioned farmers and angry animal rights protestors, all intervening in unanticipated and unwelcome ways.

The ISG summarised its overall findings: that *reactive* culling appeared to increase bTB in cattle, while *proactive* culling decreased it where badgers were culled, but seemed to make things worse in surrounding areas. The report also provided a coherent explanation for these apparently contradictory findings—the perturbation effect:

The disruption of the social organisation or structure of badger populations, such as that which is caused where trapping/culling has taken place.⁵²

Badgers in Britain tend to live in unusually large family groups defending well-defined territories over long periods of time. The ISG argued that badger culling, particularly when undertaken on an ad hoc, localised basis (as in the ‘reactive’ intervention), disrupts this social organisation. As Infestation Control Division (ICD) staff had known since at least the 1960s, an emptied territory was likely to be ‘recolonised’ by badgers from adjacent areas; just as Eunice Overend had predicted, this resulted in *M. bovis* spreading further. While the scientific term ‘perturbation’ is used throughout the sciences to indicate any kind of unusual interaction, ecologists use it to characterise and explain the consequences of human disturbance of ecosystems on populations and their movements.⁵³ By the mid-1990s, mammal and disease ecologists had already linked perturbation to the spread of rabies in foxes and were already speculating about its effects on the disease ecology of bTB.⁵⁴ While the ISG had anticipated that perturbation might play a role, devoting an entire subprogramme of the project to badger ecology, it had not anticipated the strength of the effect on the spread of bTB. It was not until 2007 that the ISG foregrounded the idea and term ‘perturbation’,⁵⁵ arguing that perturbation explained both the acute increases in cattle bTB following ‘reactive’ culling and the increases in neighbouring areas around ‘proactive’ culling.

Drawing on perturbation theory alongside their own economic analyses, the ISG made a series of policy recommendations. These not only pushed back against years of denial (from badger protection campaigners)

that the animals harboured *M. bovis*, but also against agricultural interests' lobbying for a cull:

First, while badgers are clearly a source of cattle TB, careful evaluation of our own and others' data indicates that badger culling can make no meaningful contribution to cattle TB control in Britain. Indeed, some policies under consideration are likely to make matters worse rather than better. Second, weaknesses in cattle testing regimes mean that cattle themselves contribute significantly to the persistence and spread of disease in all areas where TB occurs, and in some parts of Britain are likely to be the main source of infection.⁵⁶

The ISG argued that badger culling was simply too expensive and risky to be economically or practically viable, and that tightening the existing regulatory framework of bTB testing and movement control was the most viable way forwards for policy. On the day the Final Report was published, four members of the ISG gave evidence to a parliamentary enquiry on bTB, while John Bourne gave a series of media interviews.⁵⁷ Unlike their earlier 'backstage' approach to working with policymakers, (private briefings and publicly available but technical reports), the scientists had decided to take the conversation about badger culling onto the 'frontstage': it was now critical that their ideas reached wider public audiences.

6.3 'CUTTING THE CAKE' OF SCIENCE AND POLICY: THE AFTERMATH OF THE RBCT

As soon as the report was published, the ISG came under fire from representatives of the NFU, Conservative politicians and media, who renewed their calls for culling. Government responses to the report were lukewarm, stating only that ministers would 'consider carefully' the findings.⁵⁸ All went quiet until four months later, when the government's Chief Scientific Adviser, Sir David King, published a second report on 'Bovine Tuberculosis in Cattle and Badgers'.⁵⁹ King, a chemist known for his climate change advocacy, had convened an alternative expert panel (comprising a mammal ecologist, an immunologist and three veterinary scientists): their report was endorsed by the Chief Veterinary Officer (CVO). Directly rebutting the ISG, but drawing on RBCT data, King et al. concluded that culling in high-incidence areas was the 'best option available at the moment to

reduce the reservoir of infection in wildlife'. How was this possible? From the start, the ISG had adopted a deliberately broad remit, integrating scientific questions with policy considerations, while King's group had framed the problem narrowly, only considering the effects of 'badger removal' on bTB without weighing it against other policy options. The report justified this move as addressing the 'scientific basis', enabling them to also disregard considerations of animal welfare, practicality and the economic implications, including the crucial cost–benefit analysis conducted by the ISG.⁶⁰ King's group only considered the RBCT data on proactive culling, including their estimates of how many animals needed to be killed and how large an area was necessary to make the strategy viable. They combined these figures with their own modelling, looking only at the impacts inside culling areas, projecting forwards over longer periods of time and exploring the possibility of using 'hard' geographical boundaries (such as rivers or major roads) to prevent perturbation. While the King group drew upon the same data as the ISG, the different boundaries drawn around 'science' and 'policy' enabled them to reach the opposite conclusion.⁶¹

The ISG immediately defended its claims, arguing that King's conclusions were unrealistic for policy practice. The ISG, King, politicians and others campaigning for and against badger culling then engaged in a heated debate, fought out in mass media as well as an enquiry conducted by the House of Commons Environment and Rural Affairs Committee:

The scientists—Professor John Bourne, Christl Donnelly, Rosie Woodroffe and Sir David King—gave evidence before us. The atmosphere between them was interesting; it was probably more of an atmosphere than we sometimes have in here for Prime Minister's Question Time, such was their commitment to the work they had done.⁶²

Further critiques of the ISG emerged, this time from ex-MAFF veterinary officers and scientists, focusing on the detailed design and implementation of the RBCT. These included the adjustments that the ISG had made to adapt to policy, welfare and practical requirements, the curtailment of the 'reactive' condition and the disruptive effects of badger protection activism. The vets argued that this meant *not enough* badgers had been culled in the trial areas, *increasing* the likelihood of disruption to their social groups. This resulted in a flawed experiment which could not support the ISG's claims; some argued that the RBCT was actually designed to induce

perturbation and was not comparable to the culling regimes used in past trials such as Thornbury, which they believed had removed more badgers more effectively.⁶³

As the still-ongoing Parliamentary enquiry continued, it unravelled the ‘backstage’ sequence of events contributing to the appearance of badger/bTB onto the ‘frontstage’ of rural politics.⁶⁴ As its work approached completion, the ISG sent Defra ministers a near-final draft of the report on 23 May, but received little or no feedback—while they had attempted to communicate directly with ministers when possible, as the ISG’s findings about perturbation had emerged, the relationship between Defra and the ISG had deteriorated.⁶⁵ Until a few weeks prior to the publication of the ISG’s final report, Defra was briefing that culling was about to be reintroduced, and correspondence published in 2015 confirms that Prime Minister Tony Blair had supported this position.⁶⁶ Once again, political expectations of scientists had not been met, as was forcefully explained by the Defra minister who had overseen much of the ISG, Jeff Rooker:

I have gone back and looked at what we were told the trials would deliver 10 years ago—that we would find out the extent of TB in the badger population, how badgers transmit TB to cattle, that we might have a vaccine, and that we would have all the answers. Well, frankly we haven’t, have we? The fact that they can’t tell us how TB is spread from badgers to cattle, other than it’s respiratory, is not a lot of bloody help to us.⁶⁷

Shortly after reading the ISG’s final report, the Secretary of State for Defra, David Milliband, contacted Sir David King and asked him to ‘undertake a short objective assessment of the key scientific issues’, which ‘did not extend to economic or other practical issues’.⁶⁸ The King report was written and delivered to Defra within six weeks: however, it was not made public until October 2007, after which ministers finally met with the ISG to discuss its findings.

This was due to a critical political transition: on 27 June, only ten days after the ISG publication, Gordon Brown took over from Tony Blair as Prime Minister, and as part of this shift within Labour, a new Defra minister, Hilary Benn, was appointed. It was therefore Benn who took delivery of the King report, releasing it to the public in October and then meeting the ISG scientists. In July 2008, Benn announced that ‘after a great deal of consideration’, he had decided not to resume culling, pri-

marily on the advice of the ISG scientists.⁶⁹ Instead, there would be major investment in vaccination as a long-term solution to bTB, including further clinical research and a new field trial testing badger vaccination. While the announcement was welcomed by badger advocates, it produced correspondingly negative responses from culling advocates, some of whom had nicknamed the Minister ‘Veggie Benn’, who interpreted this rapid policy reversal as politically motivated. While Krebs and the ISG’s original intention that scientific research would directly inform bTB policymaking had been met, it was at a deep cost. The disease ecology epistemic community—of which the ISG was a part—were now regarded as allies by badger advocates, environmentalists and political interests on the left; and as opponents by farming advocates and right-wing political interests.⁷⁰ While these actors had not changed their positions on badger culling, some curious reversals had taken place in their rhetoric about science and evidence. In 1998, the Badger Trust had campaigned vociferously against the trial, critiquing the validity of the science and appealing to EU law to try and stop the research. However, by the time that the ISG delivered its final report they were effusive in their praise for the ‘sound science’ that demonstrated culling did not work.⁷¹ Correspondingly, NFU representatives had initially welcomed the RBCT, anticipating that it would provide evidence to support culling. When the ISG instead reached the unexpected and unwelcome conclusion that culling could make things worse, the NFU also reversed their position, criticising the ISG and selectively citing David King’s report to argue for immediate ‘action’.⁷² Since then, it has become increasing common for both pro- and anti-culling actors to argue that ‘the science’ of bTB supports their arguments, while selectively drawing on different experts or interpretations of research findings to do so.

*From ‘Evidence-Based Policy’ to ‘Veterinary Advice’: The Post
2010 Return to Badger Culling*

Benn’s decision not to cull badgers had less than two years to embed into policy before being upended by the outcome of the next General Election in May 2010, when the Brown Labour government was ousted in favour of the first Coalition Britain had seen since the Second World War. David Cameron became prime minister of an administration formed between his own Conservative Party and the Liberal Democrats. While much of the rapidly formulated Coalition Agreement involved careful fudging of the

two parties' rather different positions, one easy point of agreement was over badgers and bTB. The Conservatives had made a manifesto pledge to reintroduce badger culling: while the Liberal Democrats held a similar position.⁷³ Within months, the new Farming Minister, Jim Paice, announced their plans: the vaccination trials were cut back and replaced by a new 'science-led' policy, in which licences would be issued 'to enable farmers and landowners to cull badgers at their own expense'.⁷⁴ Departing from Defra's established best practice, this would be undertaken by a new technique referred to as 'free' or 'controlled' shooting. The idea was to adapt existing practices for shooting foxes and deer to 'free ranging' badgers, even though the risks of causing suffering were 'unknown'.⁷⁵ Extrapolating from the rather different practices of deer shooting, policy-makers estimated that free shooting would cost half as much as the long-established procedure of cage-trapping followed by shooting badgers (used in the RBCT).⁷⁶

Two new 'pilot culls' were announced, to be carried out in bTB 'hotspots' in Somerset and Gloucestershire—unlike the RBCT, but like the vaccination trials, these were not experimental tests of the effects on bTB but were instead intended to 'test' out the application of the new policy in the field. Ministers took care to flag their engagement with science, holding an open meeting at the Royal Society and drawing once more on the RBCT data and King et al. to set out the licencing conditions. These stipulated the size, geography and number of badgers that would need to be killed in a given area to achieve a 16% reduction of bTB in cattle.⁷⁷ They also appointed not one but two new expert groups—one to 'provide a succinct summary of the natural science evidence base underlying bovine tuberculosis policy in the UK'⁷⁸, and a new 'Independent Expert Panel' (IEP), asked to 'look at the effectiveness, humaneness and safety of controlled shooting as a culling method'.⁷⁹ While the plans were criticised by badger and animal welfare advocates, as well as Labour politicians in opposition, the idea that the government's strategy was 'science-led' seemed to hold.⁸⁰ However, there was a shift in emphasis—while the new policy was based upon 'the available scientific evidence', it was also critically supported by 'veterinary advice'. While scientists could only provide evidence for later interpretation by policymakers, veterinarians were visible again as publicly trusted experts on animal health, providing advice and directly shaping bTB policy.⁸¹

The Coalition's policy was beset with problems from the start. Following high-profile anti-culling campaigns, the first round of culling

‘trials’ was delayed. Badger/bTB was debated several times in Parliament, and a group of senior scientists (including Krebs, members of the ISG and other epidemiologists and ecologists) publicly criticised the culling policy, predicting it would not work and would be a ‘costly distraction’ from bTB control.⁸² When the pilots finally started in the summer of 2013, they were further disrupted by anti-cull campaigners directly sabotaging attempts to kill badgers (as happened during the RBCT), as well as indirect ‘badger patrols’ who guarded setts or monitored culling operations in the field. Contractors were not killing enough animals to meet government targets, and chronic uncertainties over how big the badger population was in the first place meant that this figure was adjusted several times, changing the success rates of the pilot culls.⁸³ It was this uncertainty which led Defra minister Owen Paterson to famously state that ‘the badgers are moving the goalposts’—a comment we will return to in Chap. 7.⁸⁴ Then in 2014 the IEP investigating badger shooting delivered its final report to the Minister. The IEP’s report, like those of its predecessors, did not fulfil the expectations of policymakers and politicians to calm public controversy or provide legitimacy for bTB policy. Instead, the IEP’s conclusions were deeply critical not only of ‘free shooting’ but of the implementation of the new policy in general. While the IEP had been charged with assessing free shooting only, they found that both pilots had also used cage-trapping, without recording exactly how much, confounding the study. The IEP concluded that while the trials had been *safe* (in terms of risks to the public), they had not been *effective* (had not killed enough badgers) or *humane* (too many animals had been shot that took longer than five minutes to die).⁸⁵

Shortly after the IEP’s report, Defra published their *Strategy for Achieving Officially Bovine Tuberculosis Free Status for England*, which set out their full policy plans, including the overall goal—to bring bTB incidence below a threshold set by EU law, lifting some trade restriction—confusingly, this was referred to as ‘eradication’. The strategy document emphasised the need to use ‘all available tools’ up to and including badger culling: while it discussed the commissioning of the IEP, their disruptive conclusions were not discussed.⁸⁶ Instead, culling (by whatever method) was framed as an established policy approach, used successfully in the past in Britain and in the present in other countries, including Ireland and New Zealand. In an unprecedented shift, the new strategy moved away from a uniform policy to one using different approaches according to the level of bTB in the area—from ‘low risk’ in the North and East to ‘high risk’ in the

South and West, with an ‘edge’ zone between the two.⁸⁷ The bTB control ‘tools’ included tightening of testing and movement regimes for cattle, biosecurity practices, badger culling, but also its publicly abandoned counterpart, badger vaccination. The new strategy also brought in a stronger emphasis on ‘partnership working’ with industry, veterinary practitioners and other ‘stakeholders’. This came hand in hand with an expectation that government would bear less of the costs of bTB control and that ‘risk-based trading’—in which bTB risks factor into market valuations of cattle, meat and milk—would be introduced.⁸⁸ As we will explore in the next chapter, little of this complexity was made visible in the ‘frontstage’ of the bTB debate. Shortly after publishing their strategy document, Defra proceeded with a second year of culling, a move which was publicly criticised by IEP and ISG scientists.⁸⁹ This elision and then open conflict with scientific expertise contrast starkly with the early 1980s (see Chap. 3), when scientific recommendations that a culling method was ineffective and inhumane resulted in the swift and public withdrawal of Cymag ‘gassing’ from use.

The 2015 General Election saw the replacement of the Coalition government by a Conservative administration (led initially by David Cameron and then by Theresa May), opening the most recent phase of bTB policy. The intensity of public controversy has subsided somewhat, in part due to its displacement by debates leading up to and following the UK referendum on withdrawal from the EU on 23 June 2016. Meanwhile the ‘backstage’ negotiation of bTB policy has continued, with a curious mix of continuity and change. Further culling licences have been granted, for culls no longer characterised as ‘pilots’, while Defra have progressively adjusted licencing criteria away from the original conditions, which were shaped by the ISG, the King group and the IEP. The next Defra Secretary, Michael Gove, showed a subtler approach to science, environment and agriculture than expected, as he worked to persuade scientists, farmers and conservationists alike into backing his proposals to replace EU agricultural subsidies with ‘public money for public goods’.⁹⁰ In March 2018, Gove commissioned the ninth expert review on badger/bTB to be conducted since 1980, to ‘reflect on progress being made with implementation of the bTB Strategy’. Even though this third Godfray Review had not yet reported, Defra also announced the further rollout of culling across the country, citing drops in bTB incidence in the initial ‘trial’ areas in Gloucestershire and Somerset.⁹¹ As we will explore in the next chapter, while media coverage of badger/

bTB has died down from a media ‘storm’ which peaked in 2013, the ‘frontstage’ of the controversy remains highly polarised. Locally based anti-cull activism continues, in the form of public protests, as well as direct ‘sabbing’ activities, disrupting culls out in the field: the ongoing conflict has become deeply divisive for many communities across the South West.⁹²

Meanwhile, in the backstage of badger/bTB new complexities have emerged, alongside renewed signs of interest from all sides in finding alternative, more productive approaches to research, policy and practice. To start with, long-standing processes of reorganisation and privatisation in government research have continued. The Food and Environment Research Agency (or FERA, of MAFF’s Agricultural Science Service) was privatised in 2014, while the scientists of Woodchester Park were placed alongside Defra’s veterinarians in a newly merged Animal and Plant Health Agency. As we have seen, earlier reorganisations tended to move around the placement of research, policy and implementation functions within government, but maintained broad organisational distinctions between animal health and agricultural science (including ecological) expertise. The impacts of this organisational shift have yet to be documented, but the decision was justified in terms of ‘One Health’—the need to address multisectoral problems like bTB in a more coordinated way. However, as is often the case with One Health, other agendas are at work—in this case the Conservative-led ‘bonfire of the quangoes’, in which many arm’s-length government agencies and regulators have been closed, privatised or scaled back since 2010.⁹³ This broader political agenda has also knocked on to bTB policy via Natural England (NE), a descendent of the Nature Conservancy Committee (NCC), whose scientists had been so critical of animal health approaches to badger/bTB during the 1970s and 1980s. NE remains the regulatory body which monitors and grants licences for interventions in conserved landscapes and legally protected species, and is therefore also responsible for licencing the return to badger culling. Government ‘austerity’ agendas have hit Defra particularly hard, with NE’s budget being cut in half, undermining its core expertise and ability to provide independent advice on conservation, or to fulfil its regulatory functions.⁹⁴ The devolution of agricultural policy to Scotland, Wales and Northern Ireland has also contributed to the ‘backstage’ diversification of complexity in bTB policy, fostering a range of attempts to target and tailor bTB control measures (including culling) geographically.⁹⁵

While Defra's CVO regards the culls to be 'safe, effective and humane', since 2015 the British Veterinary Association (BVA) has opposed free shooting (but not culling with other methods) on animal welfare grounds—breaking a forty-year history of solidly pro-cull support from the veterinary profession.⁹⁶ Scientific research on the topic has expanded and diversified, involving a wider range of methodologies and disciplines than ever before, including an increasing emphasis on social research.⁹⁷ New testing technologies are being developed which may open up new possibilities for bTB policy—by differentiating between vaccinated and infected cattle (which the current regime cannot do); and by directly identifying the presence of mycobacteria in living animals and environments.⁹⁸ While debates continue about the applicability of these tests for regulatory frameworks, they are already being marketed for private use to farmers and veterinarians.⁹⁹ This diversity has been accompanied by a new willingness to engage in dialogue: a good example of this would be a shift in tactics from Brian May's 'Save Me' organisation (see Chap. 7) towards sponsoring scientific conferences, farm trials of new technologies and undertaking more direct policy engagement.¹⁰⁰ Behind the scenes at least, there appears to be more potential for exploring the possible 'diplomatic spaces' of mutual interest and even agreement around badger/bTB than at any time since the early 1970s.¹⁰¹

6.4 EPISTEMIC RIVALRIES IN bTB POLICY

By tracing the developing 'backstage' story of how bTB policy has changed over time, we can gain further insights into the peculiarities of this case, as well as into broader changes and problems in science–policy relations in the UK. A central feature of British policymaking—the expert-led policy review—has been deployed with increasing frequency since the 1990s. However, it seems to have become less and less effective (for all concerned) as tensions between the epistemic communities of badger/bTB, as well as between scientists and politicians in general, have become dramatically visible. The first two parts of this book have charted the origins and development of the *animal health*, *disease ecology* and *badger protection* epistemic communities, their engagement with the new problem of badger/bTB, and the changing 'cultures of care' developed by these communities along the way.¹⁰² Between 1971 and 1996, relations between the three changed from a collaborative effort directed at solving the new and urgent problem of tuberculous badgers, to open conflict between policy

insiders and outsiders, and backstage tensions between government veterinarians and ecologists. The twists and turns of badger/bTB since the 1990s can therefore be understood as the outcome of intensifying epistemic rivalries, entrenched by the reorganisation of government research and policy following Krebs and the RBCT culling trial. The incoming Labour government's decision to accept Krebs's recommendations marked a major shift away from MAFF's traditional approach to bTB, characterised by 'stamping out' in infectious disease control and close working relationships with the animal health epistemic community. The long-standing 'Badgers and Bovine TB' research programme, led by animal health policymakers, and involving Ministry veterinary and ecological scientists, was closed. While MAFF's own bTB research continued, it was under the aegis of the new programme formulated by the ISG—scientists from outside the Ministry. As such, the commissioning of Krebs and then the ISG signified a loss of influence for the animal health epistemic community, which had already been the target of significant criticism for their roles in government mishandling of BSE. Around this time, the inclusive but powerless Badger Consultative Panel was shut down and replaced by the narrower TB Advisory Group (TBAG). While the former was designed to draw all parties into the policy process, including representatives from conservation, animal welfare, veterinary, landowner and farming bodies, the latter was focused on bTB control, and largely comprised veterinary and farming interests.¹⁰³ Research on the insider–outsider distinction suggests that due to their lack of access to policy processes, outsiders tend to focus their activities on the public sphere—in other words the 'frontstage': for this reason we will return to badger protection in the next chapter.¹⁰⁴

As has already been emphasised, epistemic communities are not conventionally disciplinary entities—therefore it should be no surprise that the Krebs, King and ISG committees were all multidisciplinary, nor that the King group included a badger ecologist, while the ISG was chaired by a Professor of Animal Health. These review groups are better understood as entities connected to the various epistemic communities of badger/bTB, which in turn form a wider 'ecology of knowledge' subject to constant renegotiation and change over time.¹⁰⁵ The Krebs and ISG groups were both connected with *disease ecology* (explored in Chap. 4)—most obviously through Krebs himself, whose primary expertise is in behavioural ecology. This field combines the traditions of Elton's ecology with Tinbergen's ethology (animal behaviour): Krebs trained in these groups at Oxford University, and has close links with another influential grouping of

British ecologists engaged in interdisciplinary, policy-oriented research: the ‘Silwood Circle’ of Imperial College London.¹⁰⁶ Prior to chairing his bTB review, Krebs was the head of the UK Natural Environment Research Council and afterwards ran the Food Standards Agency for five years: he continues to command considerable influence through his appointment to the House of Lords.¹⁰⁷ The Silwood group also includes epidemiologist Roy Anderson, a pioneer in the mathematical modelling of disease—work which directly informed Defra’s drastic FMD culling policy and further fuelled tensions with animal health and farming.¹⁰⁸ The Krebs and ISG groups both included other members of the Silwood and Oxford research networks. These connections are also visible in the research design of the RBCT, which drew upon classic ecological research methods, including randomised, controlled experiments, cost–benefit analysis and mathematical modelling—all intended to make field research more like the controlled space of the laboratory and the lab more like the field.¹⁰⁹

The hostile reactions to the ISG’s final report from farming representatives, the more specific criticisms from ex-MAFF veterinarians and the contradictory conclusions of the King report become much easier to understand as part of this process of epistemic rivalry. Contra to recent policy scholarship on bTB, these were not coming from a ‘counter-epistemic community’ formed in reaction to the ISG, but instead from core members of the much older *animal health* community explored in Chap. 3.¹¹⁰ While animal health was still integral to Defra’s policy implementation by 2007, it had been challenged by the BSE and FMD crises as well as by the reorganisation of a ministry devoted solely to agriculture and food (MAFF) to one also charged with protecting the environment (Defra). Veterinarians have a long history of engaging in disciplinary rivalries aimed at expanding or defending their own epistemic authority, and so the conflict with the ISG can be understood as a continuation of these traditions.¹¹¹ Krebs and the ISG had taken full advantage of biomedicine’s ‘rhetoric of control’, gaining policy influence by positioning their approach to bTB as more ‘scientific’ than MAFF’s earlier veterinary-led research.¹¹² In turn, the animal health critics of the ISG pointed out the contrasts between the ideal experiment pitched by Krebs and the multiple compromises that had to be made while implementing the RBCT in the field. The controversy has become subject to what historian Amanda Rees has described as the ‘field experimenter’s regress’—the ease with which scientific findings can be critiqued and unpicked by pointing out the contingencies, compromises and sheer messiness involved in doing field

research.¹¹³ Veterinarians and farmers have highlighted these limitations and the abstracted nature of ecologists' expertise, while effectively contrasting it with their own professional expertise and experiences of dealing with bTB in the 'real world'.¹¹⁴

The responses of Defra and their changing political masters to the ISG can also be better understood as an outcome of these epistemic rivalries. Krebs had persuaded the New Labour government that a new approach was needed, and gained the support of sceptical farmers and landowners with the promise of providing evidence to support policy. However, the envisaged experiment was not designed to test whether culling worked in the first place, but which form of culling worked best, building expectations that the RBCT would provide scientific legitimacy for badger culling. When the unexpected and unwelcome findings—that localised (reactive) culling might make bTB in cattle worse—started to emerge, the research left policymakers with few practical courses of action.¹¹⁵ This explains the subsequent distancing between policymakers and the ISG, the pro-cull briefings coming out of Defra in 2007, and the commissioning of King (with the help of government veterinarians) to reinterpret RBCT data in a more useful direction. This 'cutting of the cake' of what counts as 'science' and what counts as 'policy' can also be interpreted as boundary-work: drawing rhetorical boundaries around the category of 'science' to further a specific aim.¹¹⁶ Hilary Benn's reversal to a 'no-cull' decision (informed by the ISG) reflects political differences between the new Brown and old Blair administrations, but was also an attempt to redirect the institutional inertia of Defra away from the long-standing pro-culling stance of animal health.¹¹⁷ However, there was not enough time for this decision to embed into policy before the next election, while the ISG's findings and post-publication dispute had further politicised the problem. The breaking of high expectations—this time that science could provide 'all the answers' to a notoriously thorny problem—has created widespread disillusionment between scientific, political, policy and campaign actors.

The Coalition and the following Conservative governments' decisions to return to badger culling can also be interpreted in this light. These politicians have returned to a trusted epistemic community who can offer them authoritative expert advice under ongoing uncertainty (the classic working conditions of the veterinarian). Animal health experts can also help the current government to deliver a policy that has been increasingly vocally demanded by key political supporters in right-leaning and rural

constituencies. But how can we explain the ‘backstage’ situation? Recent years have seen a breakdown of the distinctions between animal health and disease ecology research, and a new willingness to engage in direct dialogue. Scientists working with and particularly inside Defra have worked hard to redraw the boundaries of science, policy and politics blurred by the ISG, arguing that they should lay out ‘the science’, but leave decisions to politicians.¹¹⁸ Policy scholar Paul Cairney has written of the British government’s ‘imaginative use’ of evidence to make policy—in a study of family policy, he demonstrates how policymakers work with, around and through developing evidence in order to achieve their own, longer-term policy goals.¹¹⁹ A longer view of badger/bTB reveals another agenda at work beyond ‘the science’ of bTB control, which I argue has directed the overall direction of policymakers’ work on bTB. In contrast to the expansions of the 1970s and 1980s, Defra’s research budget has been cut repeatedly since the 1990s—a consistent trend across Labour and Conservative governments. Indeed the Krebs report notes the need to cut the costs of bTB control, and a wider ‘cost-sharing’ agenda for animal health was fully articulated by Defra under Labour.¹²⁰ However, cost-sharing requires the cooperation of industry, opening up badger culling as a potential quid pro quo and negotiating tool. In October 2007, the chair of Defra’s TBAG wrote to the farming minister as follows:

We were struck by the farming industry’s willingness to consider additional cattle controls, but they made clear that going down this route without addressing the wildlife reservoir could only have a partial impact on levels of TB in cattle and, in their view, would not be acceptable given the need to control the disease. As we move further towards cost and responsibility sharing for animal health and welfare, including bovine TB, we were also encouraged to learn that the farming industries were exploring the costs and benefits of the ISG’s recommendations for increased cattle measures and would welcome the opportunity to discuss these in more detail with Government.¹²¹

In other words, the chair of TBAG was saying that industry was willing to cooperate with government on tightening up cattle controls (as per the ISG’s recommendation) as well as on cost-sharing only if government was willing to give them badger culling. As we have already seen, Hilary Benn’s decision to not cull would have gone directly against this ‘backstage’ negotiation process, perhaps driving some of the intensity of farming reac-

tions and the politicisation of scientific expertise we have seen. While the post-2010 reversal of Benn's decision and return to culling has further driven public polarisation of the debate, it is worth noting that behind the scenes Defra has since been more successful at implementing these cost-sharing and regulatory agendas. At present, bTB policy (including the tightening of cattle controls recommended by the ISG) is (albeit with reluctance) being supported (and paid for) by farmers, who in turn have been permitted to cull badgers for themselves.¹²² In Chap. 8, we will revisit the long-term retreat of the state in animal health and disease control and explore the implications of this for the longer history of bTB beyond the culling controversy in Britain.

NOTES

1. For epistemic communities, see Claire A. Dunlop, 'Knowledge, Epistemic Communities and Agenda-Setting', in *Handbook of Public Policy Agenda-Setting*, ed. N. Zahariadis (Cheltenham: Edward Elgar, 2016), 273–96; Meyer and Molyneux-Hodgson, 'Introduction: The Dynamics of Epistemic Communities'.
2. Reynolds, 'Case Study'.
3. As discussed in Chap. 1, a knowledge controversy is an academic and/or policy and/or public debate centred upon questions of scientific knowledge, expertise and evidence: Pinch and Bijker, 'The Social Construction of Facts and Artefacts'; Barry Barnes, David Bloor and John Henry, *Scientific Knowledge: A Sociological Analysis* (Chicago: University of Chicago Press, 1996); Whatmore, 'Mapping Knowledge Controversies'; Barry, 'Political Situations'.
4. Backstage–frontstage was originally developed by Goffman as an analysis of how people behave and think differently when 'in private' compared to 'in public': Erving Goffman, *The Presentation of Self in Everyday Life* (Garden City, NY: Doubleday, 1959). For this analysis, I draw upon research applying the idea to museums and 'public science': Sharon Macdonald, *Behind the Scenes at the Science Museum* (Oxford: Berg, 2002); Angela Cassidy, Simon J. Lock and Georgina Voss, 'Sexual Nature? (Re)Presenting Sexuality and Science in the Museum', *Science as Culture* 25(2) (2016): 214–38; science–policy relations: Stephen Hilgartner, *Science on Stage: Expert Advice as Public Drama* (Stanford, CA: Stanford University Press, 2000); Göran Sundqvist et al., 'One World or Two? Science–Policy Interactions in the Climate Field', *Critical Policy Studies* 12(4) (2018): 448–68; and policy–political negotiations: Raymond Alan Friedman, *Front Stage, Backstage: The Dramatic Structure of Labor*

- Negotiations* (Cambridge, MA: MIT Press, 1994); Ayres, Sandford and Coombes, 'Policy-Making "Front" and "Back" Stage'.
5. For an accessible discussion of 'publicness', see Nick Mahony, Janet Newman and Clive Barnett, *Rethinking the Public: Innovations in Research, Theory and Politics* (Bristol: Policy Press, 2010); for the complicating effects of social media and online communications, see Nancy K. Baym and danah boyd, 'Socially Mediated Publicness: An Introduction', *Journal of Broadcasting & Electronic Media* 56(3) (1 July 2012): 320–29.
 6. To clarify, I use the term 'science' in the inclusive sense of the German term *Wissenschaft* (any field of systematic research); i.e. this would encompass natural sciences such as ecology and epidemiology; medical fields such as veterinary science; engineering and mathematics; and the social sciences, arts and humanities. See Angela Cassidy, 'Communicating the Social Sciences: A Specific Challenge?' in *Handbook of Public Communication of Science and Technology*, 2nd ed., ed. Massimiano Bucchi and Brian Trench (New York: Routledge, 2014), 186–98.
 7. In date order, the reviews have been: Zuckerman, 'Badgers, Cattle and Tuberculosis'; Dunnet, Jones and McInerney, 'Badgers and Bovine Tuberculosis'; Krebs et al., 'Bovine Tuberculosis in Cattle and Badgers'; Godfray et al., 'Independent Scientific Review of the Randomised Badger Culling Trial and Associated Epidemiological Research'; Bourne et al., 'Bovine TB'; King et al., 'Bovine Tuberculosis in Cattle and Badgers'; Godfray et al., 'A Restatement of the Natural Science Evidence Base Relevant to the Control of Bovine Tuberculosis in Great Britain'; Munro et al., 'Pilot Badger Culls in Somerset and Gloucestershire Report by the Independent Expert Panel'; Godfray et al., 'A Strategy for Achieving Bovine Tuberculosis Free Status for England'.
 8. Regarding social status and badger/bTB, we should note that while several highly eminent women have participated in bTB expert review committees, all have been chaired by senior white men. For a detailed analysis of the contrasting 'civic epistemologies' of science-policy in the USA, Germany and Britain, see Sheila Jasanoff, *Designs on Nature: Science and Democracy in Europe and the United States* (Princeton: Princeton University Press, 2005). For relationships between experts, the state, NGOs and publics in Britain, see Hilton et al., *The Politics of Expertise*.
 9. Agar, 'Transition'.
 10. For BSE see, Miller, 'Risk, Science and Policy'; Patrick Van Zwabenberg and Erik Millstone, 'BSE: A Paradigm of Policy Failure', *The Political Quarterly* 74(1) (January 2003): 27–37. For GM foods, see Brian Wynne, 'Creating Public Alienation: Expert Cultures of Risk and Ethics on GMOs', *Science as Culture* 10(4) (2001): 445–81; Renata Motta, 'Social

- Disputes over GMOs : An Overview', *Sociology Compass* 8(12) (2014): 1360–76. For FMD in 2001, see Bickerstaff and Simmons, 'The Right Tool for the Job?'; B. Nerlich, 'War on Foot and Mouth Disease in the UK, 2001: Towards a Cultural Understanding of Agriculture', *Agriculture and Human Values* 21(1) (2004): 15–25; Convery et al., 'Death in the Wrong Place?'
11. G. Blue, 'Food, Publics, Science', *Public Understanding of Science* 19(2) (April 2009): 147–54; Melanie Smallman, 'Science to the Rescue or Contingent Progress? Comparing 10 Years of Public, Expert and Policy Discourses on New and Emerging Science and Technology in the United Kingdom', *Public Understanding of Science* 27(6) (1 August 2018): 655–73.
 12. Neil Ward, 'Rethinking Rural Policy under New Labour', in *New Labour's Countryside Rural Policy in Britain since 1997*, ed. M. Woods (Bristol: The Policy Press, 2008), 29–43.
 13. Griggs and Howarth, 'Protest Movements, Environmental Activism and Environmentalism in the United Kingdom'; Hilton et al., *The Politics of Expertise*.
 14. Neil Carter and Ben Clements, 'From "Greenest Government Ever" to "Get Rid of All the Green Crap": David Cameron, the Conservatives and the Environment', *British Politics* 10(2) (1 June 2015): 204–25.
 15. Chloe Lucas and Russell Warman, 'Disrupting Polarized Discourses: Can We Get out of the Ruts of Environmental Conflicts?' *Environment and Planning C: Politics and Space* 36(6) (16 May 2018): 987–1005; Matthew Motta, 'The Polarizing Effect of the March for Science on Attitudes toward Scientists', *PS: Political Science & Politics* (July 2018): 1–6.
 16. This is something of a misquote as Gove was cut short, but his comments were widely reported in this form, suggesting deep resonances during the UK's EU membership referendum campaign: Henry Mance, 'Britain Has Had Enough of Experts, Says Gove', *Financial Times*, 3 June 2016.
 17. Grant, 'Intractable Policy Failure'.
 18. Spencer, 'One Body of Evidence, Three Different Policies'; Dunlop, 'Contestation and Contingency in Advisory Governance'.
 19. Claire A. Dunlop, 'Policy Learning and Policy Failure: Definitions, Dimensions and Intersections', *Policy & Politics* 45(1) (17 January 2017): 3–18; Claire A. Dunlop, 'Pathologies of Policy Learning: What Are They and How Do They Contribute to Policy Failure?' *Policy & Politics* 45(1) (17 January 2017): 19–37.
 20. On building and breaking expectations around science and technology, see Nik Brown and Mike Michael, 'A Sociology of Expectations: Retrospecting Prospects and Prospecting Retrospects', *Technology*

- Analysis & Strategic Management* 15(1) (March 2003): 3–18; Nik Brown and Sián M. Beynon-Jones, ‘“Reflex Regulation”: An Anatomy of Promissory Science Governance’, *Health, Risk & Society* 14(3) (2012): 223–40. On science as *political* but *politicisation* as a process that science can still be drawn into, see Brown, ‘Politicizing Science’.
21. Meyer and Molyneux-Hodgson, ‘Introduction’.
 22. Stephen McGinness, ‘Bovine Tuberculosis’, *House of Commons Library Research Paper* 63 (1998): 29.
 23. Miller, ‘Risk, Science and Policy’.
 24. HC Deb 23 July 1996 vol. 282 c262W.
 25. The full Krebs review group were: Prof. John Krebs, Prof. Roy Anderson, Prof. Tim Clutton Brock, Prof. Ivan Morrison, Prof. Douglas Young and Dr Christl Donnelly, assisted by Dr Simon Frost and Dr Rosie Woodroffe. See Krebs et al., ‘Bovine Tuberculosis in Cattle and Badgers’.
 26. Krebs et al., ‘Bovine Tuberculosis in Cattle and Badgers’, 6.
 27. *Ibid.*, 6–7.
 28. *Ibid.*, 128.
 29. For evidence-based medicine in animal health see Jean-Michel Vandeweerd et al., ‘Is Evidence-Based Medicine so Evident in Veterinary Research and Practice? History, Obstacles and Perspectives’, *The Veterinary Journal* 191(1) (January 2012): 28–34. For RCTs in agricultural and ecological research, see Berry, ‘The Resisted Rise of Randomisation in Experimental Design’.
 30. The Agriculture Minister, Jack Cunningham, trained as a scientist and was also a key architect of Labour’s reform and evidence-based policy agendas: Cabinet Office, ‘Modernising Government’ (London: HMSO, 1999). Cunningham received the first report of the ISG and initiated the post-BSE reform of MAFF, which led to the creation of Defra.
 31. John Bourne et al., ‘Bovine TB: Towards a Sustainable Policy to Control TB in Cattle’, Independent Scientific Group on Cattle TB (London: Defra, July 1998).
 32. Bourne et al., ‘Bovine TB: The Scientific Evidence, Final Report of the Independent Scientific Group on Cattle TB’; Defra, ‘A Strategy for Achieving Officially Bovine Tuberculosis Free Status for England’.
 33. The full ISG group were: Prof. John Bourne, Prof. Christl Donnelly, Sir David Cox, Prof. George Gettinby, Prof. John McInerney, Prof. John McInerney, Prof. Ivan Morrison and Prof. Rosie Woodroffe. The full documents of the ISG are held in the UK Government Web Archives at: <http://webarchive.nationalarchives.gov.uk/20081107202002/http://www.defra.gov.uk/animalh/tb/isg/index.htm>.
 34. For recent reviews, see Godfray et al., ‘A Restatement of the Natural Science Evidence Base Relevant to the Control of Bovine Tuberculosis in Great Britain’; McDonald, ‘Animal Health’.

35. Bourne et al., 'Bovine TB: Towards a Sustainable Policy to Control TB in Cattle', 3.
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