Northern Ireland Assembly

Committee for Agriculture and Rural Development

OFFICIAL REPORT (Hansard)

Bovine TB Review: Agri-Food and Biosciences Institute

1 May 2012

NORTHERN IRELAND ASSEMBLY

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Members present for all or part of the proceedings:
Mr Paul Frew (Chairperson)
Ms Michaela Boyle
Mrs Jo-Anne Dobson
Mr William Irwin
Mr Kieran McCarthy
Mr Oliver McMullan
Mr Robin Swann

Witnesses:

Professor Seamus Kennedy	Agri-Food and Biosciences Institute
Dr Stanley McDowell	Agri-Food and Biosciences Institute
Dr Robin Skuce	Agri-Food and Biosciences Institute
Dr Sam Strain	Agri-Food and Biosciences Institute

The Chairperson: We are struggling for time, so we will move on to the briefing from the Agri-Food and Biosciences Institute (AFBI). I welcome Professor Seamus Kennedy, chief executive; Dr Stanley McDowell, senior veterinary officer; Dr Sam Strain, veterinary research officer; and Dr Robin Skuce, veterinary research officer. As we are struggling for time, I ask Committee members to keep it to two direct questions. If you have further questions, get them to the Committee Clerk, and she will pass them on.

Mr Swann: Are you going to stick to two as well?

The Chairperson: I will stick to two.

Gentlemen, you are very welcome to the Committee. I apologise for keeping you so long. You will appreciate that this is a very important issue for the Committee. I am sure that you have a presentation. I ask you to keep it brief, and then we will go straight to questions. Thank you very much.

Professor Seamus Kennedy (Agri-Food and Biosciences Institute): Thank you, Chairman and Committee members, for the invitation to AFBI to provide evidence on the scientific base around tuberculosis (TB). I will very quickly introduce my colleagues: Stanley McDowell is the head of the bacteriology branch in AFBI's veterinary sciences division, where our statutory TB work and R&D work is mainly carried out;

Sam Strain is in charge of that statutory programme of work but also has a particular specialism in the immunology of TB and the gamma-interferon testing; and Robin Skuce is our molecular fingerprint expert, which is a topic that came up earlier.

AFBI's work on bovine tuberculosis (bTB) includes a range of statutory work, basic testing of the lesions that are sent in to the lab from reactor animals and a range of R&D that is funded by the Department of Agriculture and Rural Development (DARD) and various other external funders.

The statutory and analytical work that AFBI carries out is in direct support of the Northern Ireland control programme. It includes microscopic examination of lesions from reactor animals to show whether they are TB lesions; the culture of the organism itself under high biocontainment conditions, because of the health and safety issues that go with TB; and molecular confirmation of the organism and the strain typing. We also carry out work on the performance of blood testing — the gamma-interferon assay— high-resolution strain typing of TB isolates, and laboratory examination of roadkill badgers.

We carry out DNA forensic typing of cattle, which is used by the Department to investigate potential cases of cattle identity fraud. All our statutory testing is accredited to ISO 17025 standard, which is the international quality assurance standard, and all our R&D is accredited to ISO 9001 standard.

We are very active in a range of international collaborations on TB research. That is important to us, because it is essential that we are at the leading edge of research and are working with the leading groups in the world on TB so that AFBI has the most appropriate and up-to-date staff skills and technology.

I will give you an idea of the range of people with whom we collaborate. We collaborate with the European Union Reference Laboratory for TB in Madrid; the Institut Pasteur in France; the Animal Health and Veterinary Laboratories Agency (AHVLA) in the UK; the National Institute for Public Health and the Environment (RIVM) in the Netherlands; the Roslin Institute at the University of Edinburgh; Trinity College Dublin (TCD) and University College Dublin (UCD); the Statens Serum Institut (SSI) in Denmark; the Norwegian Veterinary Institute (NVI); the United States Department of Agriculture's Agricultural Research Service (ARS); and AgResearch in New Zealand. Those contacts allow us to access the most up-to-date technology and to share and exchange ideas on TB research.

AFBI has secured substantial competitive R&D for TB research over the years, and, over the past 15 years, we have won contracts amounting to approximately £3·5 million. That is an important addition to the work that is already funded by the Department. If we take in research on related diseases such as Johne's disease, the total goes up to over £4 million.

The core research that we carry out in AFBI is in the key areas of molecular biology and immunology. It is necessary for us to maintain the capacity and expertise to do the gamma-interferon testing and the other statutory TB work through research. The research is important in order to answer questions that are asked, but it is also important to maintain those skills among our staff. That is the lifeblood of our science organisation.

With that, I will end my introduction and hand over to Dr McDowell. He will concentrate more on the detail of the TB work that AFBI carries out.

Dr Stanley McDowell (Agri-Food and Biosciences Institute): The paper that we submitted contains two main themes. First, it tries to summarise briefly, as far as we can in a short paper, current scientific thinking on bovine TB and bovine TB control, and hopefully it covers in outline the points that were raised in your letter of invitation. Secondly, it provides an overview of the research and development work that AFBI is funded to undertake, as well as a number of pointers towards the key role that science has to play in tackling this most complex and significant disease.

By way of introduction, bovine TB is caused by mycobacterium bovis (M.bovis), and is widely recognised as the most difficult endemic animal disease problem that we currently face. M.bovis is very similar though distinct from the cause of human TB, mycobacterium tuberculosis (M.tuberculosis), and the two share a number of similarities, including some of the difficulties encountered in areas such as disease

diagnosis, vaccination and control. As we heard earlier, bTB is primarily a chronic respiratory disease of cattle, which, in an advanced stage that is fortunately now rare, is associated with a loss of productivity and milk yield. The causal organism presents a potential risk to human health, and prior to the introduction of control programmes, between 2,000 and 2,500 deaths were recorded each year in the UK. Such infections are now rare, principally due to the introduction of milk pasteurisation.

The epidemiology of bovine TB is probably uniquely complex. However, current evidence indicates that cattle and wildlife are sources of infection. A valid and often-asked question is what the relative importance of cattle and wildlife sources are. However, it is not exactly known, and the importance of both sources will vary across regions, depending on factors such as the adequacy of cattle control measures, the infection pressure in wildlife and the degree of interaction between the species.

Primarily, bTB is a respiratory lung disease, and prior to the introduction of tests and slaughter programmes, cattle-to-cattle transmission overwhelmingly predominated in the disease transmission. The predominant mechanism of cattle-to-cattle transmission is via aerosol contact, which means small droplets moving over a space of 2 metres to 3 metres, and it necessarily involves close contact between cattle. Indirect transmission between cattle via contaminated slurry or other contaminated objects is thought to be much less important. Milk-borne infection occasionally happens in young calves but is quite rare. Importantly, there appears to be marked variation in the level of cattle-to-cattle transmission in different settings. It would appear that not all individual cattle are equally infectious. There are parallels with the human TB situation. In many situations in NI, for example, there appear to be relatively low levels of transmission in within-herd spread. Equally, however, there are incidents of large outbreaks of what appear to be significant cattle-to-cattle spread.

It is not uncommon to have natural variation in the genetic susceptibility of individual animals to disease. That also appears to be the case with bTB. Recent evidence, including collaborative work undertaken by AFBI and the Roslin Institute, which, as was said, is part of the University of Edinburgh, indicates that cattle vary in their genetic susceptibility to TB and raises at least the prospect of trying to breed animals with increased resistance. Variability in the susceptibility of individual animals and their infectiousness owing to non-genetic effects, such as intercurrent disease and physiological status, is also likely. The parallel for that is human infection, where interaction between HIV/AIDS and M.tuberculosis infection is well recognised.

I will now move on to wildlife-to-cattle transmission. Wildlife reservoirs of bTB infection are not unique to the UK and Ireland. Indeed, they are recognised in a number of countries. Such reservoirs include possums in New Zealand, white-tailed deer in Michigan and wild boar in Spain and Portugal. A wildlife source was first suspected in GB owing to persistent foci of bTB infection in south-west England and infected badgers were detected subsequently in Gloucestershire in 1971. Reports of infected badgers followed from the Republic of Ireland and from road traffic accident (RTA) surveys in Northern Ireland.

Although bTB has a very wide species range of infection and has been recorded in a range of domestic and wildlife species, only badgers, and possibly deer in some localised areas, are thought to be significant in the epidemiology of the disease in the UK and Ireland. The evidence implicating badgers in the epidemiology of bovine TB includes the recorded occurrence in the species, spatial similarities in the strain type — although that does not indicate the direction of transmission — and the results of things such as badger removal trials, which have either increased or decreased the occurrence of bTB. M.bovis infection in badgers is again primarily respiratory, and badger-to-cattle transmission is thought to occur either directly via aerosol transmission or indirectly via contaminated urine or faeces. Going back 10 or 15 years, much of the focus would have been on the indirect routes of transmission, through things such as urine and faeces, but current evidence and thinking tend to favour direct aerosol transmission. I will come back to that when dealing with some of the issues around biosecurity. As you perhaps heard earlier, there is published evidence from GB indicating cattle-to-badger transmission in certain circumstances. That evidence comes from the randomised badger culling trial (RBCT). When there was a suspension of cattle testing, it was associated with an increased occurrence of M.bovis in badgers.

I will move on to bTB control in cattle testing. The control of bovine tuberculosis was first initiated owing to the human health risk, with voluntary test and slaughter schemes introduced in the UK in the 1930s and later followed by compulsory schemes. It may be worth noting that, prior to the introduction

of such control schemes, infection in cattle was widespread, with some 20% to 40% of cattle estimated to be infected. Therefore, yes, control schemes have made significant progress, despite all their problems.

Following the introduction of test and slaughter control schemes, there was generally rapid progress in reducing the number of reactors. In England and Wales, infection during the 1970s and early 1980s was largely confined to pockets in the west and south-west. However, the past 25 years — from around 1987 — have seen generally sustained increases of occurrence across the west and south-west of England and Wales. The NI situation also showed rapid initial progress, with generally low levels occurring during much of the 1970s and 1980s. There was also a period of sustained increase in NI from the late 1980s to 2002, although that has more recently been reversed. One of the obvious questions is this: why have those increases occurred? The aim of test and slaughter programmes is to detect and remove infected animals and to control cattle-to-cattle spread. However, importantly, their effectiveness relates to the accuracy of the test used. Skin testing is and remains the standard test used in control schemes worldwide, albeit in slightly different formats.

Estimates of sensitivity, which is a measure of how good the skin test is at detecting infected animals, are variable. They range from somewhere in the region of 55% to 90%. Recent estimates of skin test sensitivity tend to be towards the lower end of that range, and the test sensitivity overall could be best described as moderate. The recent estimates may be due to differences in methodology, or they may reflect genuine changes in test sensitivity of the skin test over time. Overall, sensitivity of the skin test at a herd level is higher, and that is as a result of repeated and regular testing.

Efforts to develop alternative tests have been hampered by the complex nature of the disease. The most common alternative in use, including at AFBI, is the gamma-interferon test. It is a test that, as we heard earlier, has a higher sensitivity but, in its current format, is more costly and has lower specificity, which limits its application. However, a number of possibilities exist to improve the performance and reduce the cost of the test, and there are a number of alternatives, such as serological tests, which may have a place in the control.

There is evidence to indicate that bTB sensitivity may be reduced by intercurrent disease, including Johne's disease. Johne's disease causes reactions at the avian site, and changes in the prevalence of Johne's disease over time may have affected the sensitivity of the skin test. Work by AFBI — for example, in collaboration with UCD — has demonstrated experimentally that co-infection with liver fluke also suppresses the immune response to bTB, as measured by the skin and gamma-interferon tests.

I move now to biosecurity and some of the steps that can be taken to limit infection. We heard quite a bit about biosecurity earlier. Fundamentally, bovine TB is an infectious disease, albeit that that appears variable, and biosecurity measures to limit transmission are a necessary part of control. A broad range of measures have been proposed to prevent infection through cattle-to-cattle transmission. They include issues around cattle purchase; pre- and post-movement testing; the prevention of close contact between neighbouring herds; and such measures as boundary fencing and control of cattle slurry.

Measures to prevent wildlife-to-cattle transmission are more uncertain owing to the limited evidence base, but they can be conveniently divided into measures at housing and measures at pasture. Measures at housing include preventing direct badger-to-cattle transmission by preventing badger incursions into farm buildings, and preventing indirect transmission by stopping badgers accessing feed and silage stores. That leads to part of the critical evidence base into knowing whether the primary routes of transfer to cattle occur at housing or at pasture. Measures at pasture are much more difficult, but they are aimed mainly at stopping indirect contact between badgers. They include such measures as raising feed and water troughs, fencing off setts and possibly altering grazing patterns. Practically, that is probably a lot more difficult.

Dealing with TB in wildlife, particularly in badgers, presents fundamental difficulties and, as we heard earlier, can have unintended consequences. Direct intervention options are badger culling or vaccination. I will not repeat a lot of what the Assembly researcher covered earlier, but it is worth pointing out that the randomised badger culling trial, which is probably the most comprehensive evidence base for badger culling, occurred over a period of six or seven years and cost close to £50

million. The results of the RBCT indicated that proactive culling was associated with a modest beneficial effect, by way of a decrease in bovine TB within the cull area, but an initial detrimental effect in the surrounding 2-kilometre area. Preliminary results from reactive culling showed a detrimental effect of an increase in bovine TB in local cattle herds, and that area of the trial was stopped early.

Results from the four-areas trial and other trials in the Republic of Ireland have shown beneficial effects from area-based culling approaches. The potential benefits of culling need to be balanced against ecological impacts and significant economic costs. The Department for Environment, Food and Rural Affairs (DEFRA) has estimated that proactive culling costs around £2,500 per square kilometre. It is also worth noting that culling in small, targeted areas will have very limited impact on the overall regional or national statistics. Some extrapolations from DEFRA figures in their consultation suggest a benefit of 16%. If that is applied to only 10% of the cattle population or TB problem, we would reduce the overall regional prevalence by 1·6% to 2%. We are left to deal with 98% of the problem.

Badger BCG is the only TB vaccine currently licensed for badgers, and it is injectable. It is an old vaccine, which was first developed for human use in the 1920s. Being an injectable vaccine, it requires badgers to be caught, with all the associated costs. Experimental and field data have shown the vaccine to give a reasonable degree of protection. There have not been large trials to demonstrate the impact on cattle bTB levels, but the experimental evidence gives cause for reasonable hope that the levels of TB protection would translate to cattle. Further work on oral delivery vaccines is ongoing in GB and Ireland, and there is ongoing work in the human field on developing more modern and complex TB vaccines.

I will now give an overview of AFBI TB research. Owing to the complex nature of bovine TB, including the organism itself, the response of cattle to infection, the limitations of diagnostic tests and vaccines, and some of the major gaps in our knowledge of interactions between wildlife and cattle, disease eradication can be based only on increased emphasis on research. The TB research undertaken by AFBI falls predominantly into two areas, the first of which is our work on molecular and strain-typing research. AFBI scientists, and in particular by my colleague Robin Skuce, who is sitting to my right, have been to the forefront of developing strain-typing methods for M.bovis, including the identification of genetic markers, which are now used not only for M.bovis but for human M.tuberculosis. Those rapid and high-resolution techniques are applied routinely in NI as an aid to identifying sources of infection and for surveillance purposes.

Importantly, strain typing is important in two aspects: first, at local outbreak level; and secondly, for research. At research level, the integration of strain-typing information with NI cattle movement and test data has started to show significant potential and to answer fundamental questions about bovine TB epidemiology. Such questions include: is there a variation in virulence between different bovine TB strains? Are there strains that evade current skin testing? How do cattle and wildlife strains compare? What is the role of cattle movement? How do NI strains compare with those in GB, Ireland and beyond?

The work on strain typing has also led to further significant areas of investigation, an example of which is the work on genetic susceptibility that I referred to earlier. Other significant work includes recent pilot studies with the University of Glasgow, which is using whole genome sequencing methods — sequencing the entire genome of M.bovis to compare cattle and badger isolates at the highest possible level of detail. Such high-resolution methods establish how similar strains are, not just that they are similar. It also opens up the possibility of indicating directions of transmission and of modelling transmission events.

Understanding the cattle immune response to infection is crucial to understanding bovine tuberculosis and to developing improved diagnostics and vaccines. Bovine TB immunological research at AFBI has included understanding the early immune response; understanding disease transmission between cattle; looking at new diagnostic reagents; trialling novel vaccine candidates; and looking at the effects of co-infection on disease development and diagnosis. Some examples of early work include the characterisation of the early immune response in cattle; work on ESAT-6, which is a highly specific antigen now used in gamma-interferon tests. Central to much of the work has been the development of highly refined bovine models of infection that closely mimic natural infection. The cattle infection model is widely used in international research projects.

Bovine and human TB, as I referred to earlier, have many similarities. The expertise that has been established at AFBI has attracted collaborative research from experts in human TB. One of our important collaborations is with the SSI in Denmark, which is probably the world-leading institute on bovine TB. Recently, AFBI secured EU funding to develop ferret infection models to mimic badger infections. The use of that model has included the evaluation of novel vaccine candidates. Those vaccine candidates offer the potential to go beyond the BCG in conferring protection in animals that are already infected.

I will now talk about epidemiology and ecology. Routine data collation and the majority of epidemiological research on bTB in Northern Ireland has, to date, been undertaken in-house by DARD's Veterinary Service. AFBI has been funded by DARD to undertake three projects, which are a TB biosecurity study, an analysis of gamma-interferon testing, and an ecological project on cattle and wildlife interactions. Those projects are ongoing.

Significant bovine TB R&D has been undertaken in NI and elsewhere, but the challenges of bovine TB control are, quite simply, immense. A multiplicity of factors drive short- and long-term disease trends. Research is therefore needed in a number of areas to address the challenges. Some examples of work that are needed for cattle include a better understanding of cattle-to-cattle transmission and the circumstances in which it most occurs; the impact of genetic and non-genetic effects on susceptibility; the effect of intercurrent disease, such as fluke and paratuberculosis, including their impact on skin and other tests; improved bTB diagnostic tests, including further development of gamma-interferon and other assays; and improved understanding of the general and molecular epidemiology of the disease.

There is a need to better understand badger-to-cattle interactions and how best to minimise contact between the species. Work on vaccine efficacy, improved vaccines and vaccine delivery mechanisms are also long-term requirements. Work is also needed to better understand how best to deliver biosecurity measures to farmers and how best to work with farmers to achieve changes in biosecurity standards.

I appreciate that that was a fairly rushed and rapid run-through of what is a complex scientific area. We are more than happy to take questions and provide further written evidence on some of the issues if you feel that that would be useful.

The Chairperson: OK. Thank you very much for your presentation. I have a couple of questions before I invite questions from members. I remind members to stick to two questions because we are tight for time. If you can get your other questions to the Committee Clerk, she will pass them on.

Northern Ireland has been working on the eradication of the disease for over 60 years. It is not a Northern Ireland-specific disease, but it seems that officials, scientists and others still have so much more to learn about the disease. Why is that, in layman's terms? Explain to me why it is so complicated a disease to get a real handle on.

Professor S Kennedy: It is down to the nature of the TB bacteria. We all know about brucellosis. Although that has not been eradicated, we are on the way to doing that. However, for an organism such as brucellosis, we have the advantage of a very good blood test. It is the same with Aujeszky's disease in pigs. The TB organism hides itself in the body and changes its spots, and so on, so there is a fundamental gap in our knowledge of how it does that — its pathogenesis. As Stanley said, there are also unknown questions, such as whether there are some cattle that are almost like super-shedders that cause a lot of the spread of TB and perhaps other animals that do not spread it at all. There is a huge amount of information that we do not know because of the complex nature of the organism.

The Chairperson: To elaborate on that, are you saying that the disease is evolving quicker than we are researching it? Is that a way to put it?

Professor S Kennedy: The TB experts can comment on —

Dr McDowell: One of the difficulties with M.bovis is a parallel with M.tuberculosis. The latter causes in the region of two million deaths each year in something between a quarter and a third of the world's population. A massive research effort has gone into human TB. That maybe gives you part of the answer as to why we are struggling with bovine TB.

Yes, there may well have been changes in epidemiology over the past 20 or 30 years. It was assumed with the control programmes in the 1960s that we would eradicate TB very quickly. That has proved not to be the case. There may well be changes in the nature of the disease, the organism and the tests over time, and that is why ongoing research is required and will be required for the foreseeable future if we are really to get on top of the disease.

The Chairperson: You are the specialist experts. Do you have it in your heads what research needs to be done, and can you put a price on that? That is not to hold you to account in any shape or form with regard to funding packages, just to give us an idea how much this could actually cost to resource properly.

Dr McDowell: In paragraphs 35, 36 and 37 we have given an idea of some of the research ideas that we have. We have not formally costed those, but, to give some parallels in research funding, the randomised badger control trial cost £50 million as one study. DEFRA has spent close to £90 million on R&D. Its current annual spend on evidence and innovation is £12 million, a lot of which is research. That gives an indication of the global figure in terms of the research spend that is required to deal with the disease.

Professor S Kennedy: It is important that collaboration on research between international groups continues, because the cost would be horrendous if every group replicated what was done elsewhere.

Dr McDowell: We gain huge benefits from the collaborations that we have in trying to gain knowledge from world-leading groups in the UK, Ireland and further afield.

Mr Irwin: Thank you for your presentation. The different strains of TB were mentioned a couple of times, including in the previous presentation. Almost 600 animals on a farm near to me were recently taken inside a 12-month period. I know of another herd where 700 animals went down for TB, two were taken and that was it clear. Presumably, those different strains can be identified by the Department. Should extra restrictions not be put on herds that have a very contagious strain? We talk about biosecurity but neither of those farms did anything different from the other, and one lost 600 animals and the other two.

Dr Robin Skuce (Agri-Food and Biosciences Institute): You make a very interesting point, and the answer may surprise you. We have undertaken very structured surveillance of the strains that occur in animals at herd level and at the animal level. In recent years, we identified in the order of 200 TB strains in Northern Ireland. It continues to generate new strains all the time, and some of those get transmitted and others get removed by testing.

With regard to your point, about 40% of outbreaks have one or two reactors. However, the number of reactors by herd is highly skewed. An easy way to think of it is that 80% of reactors are in 20% of herds; it is clustered. So, you have examples, as you said, with big outbreaks. We looked at whether there is a strain effect that is responsible for that and, surprisingly, there is not. Our interpretation of that situation is that there are risk factors adding to substantial cattle-to-cattle spread in those herds, whether it is concurrent infection or something else — and I am guessing at the moment. However, it is not a strain effect, which is surprising.

Mr Irwin: All I will say is that a local veterinary officer, when questioned on this issue, said that they knew where it came from.

Dr Skuce: Yes, the strains are so geographically clustered that there is an Enniskillen strain, a Dromara strain and a Coleraine strain, and we can spot them very readily when they move around the country. When they move out of their hot-spot and into another herd, the outcome can be very variable. They can sit in that herd and do nothing; they can spread in that herd and not beyond; or they can spread to

other herds. I would be over-reaching the evidence to say that, over time, there is evidence of transmission into wildlife. Those are examples and anecdotes, really, and we hope to get the funding to summarise those.

Mr Irwin: If one was looking from the outside, one would say that there is something wrong here.

Dr Skuce: It is a very important observation.

Dr McDowell: In summary, it appears that the variance does not occur within the strain. It occurs in the factors in the cattle. In those circumstances, issues that affect cattle transmissability are probably reasons why you are dealing with large outbreaks of that nature.

Dr Skuce: We have looked at a couple of other things. We have looked at whether the skin rises in the skin test are a strain effect, and that does not seem to be significant either. We would have thought that the recent application of the TB programme would have imposed a substantial selection on the population, so that maybe we have selected strains that are less detectable. However, that is not supported by our current evidence. That is reassuring because there do not tend to be big differences between the behaviour of human and bovine TB, except at the very big family level. However, that is a different story.

Dr McDowell: The worrying fact has been that skin testing by its very nature has been selecting and removing those strains that are most reactive and leaving those that are least reactive. However, the evidence indicates that that is not the case. It is important to know.

Mr Irwin: Do you have any idea what percentage of reactor animals that are taken from the farm actually show lesions for TB?

Dr McDowell: That is predominantly from DARD data. Our estimate is that it is approximately 40%. That does not mean that the other 60% are not infected.

Mr Irwin: I am a farmer myself. Do you understand that some farmers feel that animals are being taken unduly?

Dr McDowell: Absolutely.

Mrs Dobson: Thank you for your presentation. Has the Minister ever asked you for statistical research into a possible date when Northern Ireland could be TB-free?

Dr McDowell: No. That has never been raised with us.

Mrs Dobson: It has never been requested. Did she ask for AFBI's input into the determination of the PFG target for a brucellosis end date?

Dr McDowell: I am not aware of any approach.

Professor S Kennedy: Not aware; any request from the Minister normally comes through her officials.

Mrs Dobson: So, as far as you are aware, those were never asked for. You said that you have obtained substantial external funding for your TB research. How much funding have you secured, and how does that compare to DARD's contribution to your TB research?

Professor S Kennedy: Over the past 15 years or so, we have secured about £3·5 million external funding. Over the same period, the figure for the DARD work is about £7 million.

Mrs Dobson: That is substantial. How do you ensure that your research does not overlap with that of other institutions across the UK and Europe? You outlined the places that you combine research with. How do you ensure that that does not happen?

Professor S Kennedy: It is mainly through collaboration. The research team has constant communication with all those teams, and, when we go forward for external funding, for example, that is put through a peer review process. Therefore, if the funders — the EU or DEFRA, or whoever it happens to be — thought that there was duplication of work elsewhere, that would come out. However, it is done mainly through collaboration.

Dr McDowell: Research falls into two categories. There is the fundamental basic science research; collaborations are very important in that, and it is important not to duplicate. In terms of understanding the local epidemiology, it is important to have local research that understands the local problem.

The Chairperson: OK. I am going to move on. If there are any other questions, give them to Stella, and we will get a written response to them so that they can form part of the inquiry. It is very important that we ask all the questions that we can. The only unfortunate problem we have today is that we are stuck for time.

Mrs Dobson: That is OK. No problem.

Mr McMullan: The more I listen to scientific presentations, the more the badger argument goes out the window. Is that a fair comment in the future of eradicating this disease?

Dr McDowell: It is recognised that the badger plays a significant role in the disease, but we have tried to indicate in the paper and some of the discussions just how complex the issue is. It is not simply a wildlife source. There are a lot of complexities in respect of the cattle programme and cattle testing.

Mr McMullan: Yes; there is a myth that this or that Minister has not done enough, but this is a more complex disease than I think any of us realised until quite recently when we listened to gentlemen like you. We need to change our thoughts on the disease. It is not a back-door disease. It is a very complex disease, and the fact that bovine TB is so close to the human strain really surprised me. If nothing else, we need to go out of this whole thing about tuberculosis on a different way of thinking.

Professor S Kennedy: It is complex, and there is no one answer to it.

Mr McMullan: Thank you for your presentation. It was very interesting.

Mr Swann: Gentlemen, I am sorry that I missed part of your presentation. I have a quick question. Do you have any solutions? What would be your steps? As you were sitting working through all the statistics, you are bound to have thought about that.

Professor S Kennedy: That is a difficult question. We have skimmed over a lot of the unknowns. We definitely need more research; that is a given. However, I am mindful of the Chair's earlier comments that there is no point doing research if there is no benefit. It is a long-term process.

Dr McDowell: There is a range of possibilities. Things like cattle vaccines would be an ideal solution, but they are not an easy answer. They have cost implications, they react with the skin test and the BCG, for example, is not universally effective. I would be cautious in saying that the vaccination of cattle is a long-term and viable solution. If we could orally vaccinate badgers with an easy uptake, that would be a major step forward. I mentioned that we also have to look at the improved cattle tests that are more sensitive and specific and that can remove the disease more easily. We also have to look at and understand the large outbreaks, why they happen and whether other factors such as paraTB are having an impact. We know that bovine viral diarrhoea causes immunosuppression and we need to understand whether that is also an issue in some of the large outbreaks. As we go down the road towards eradication, there are a combination of factors.

Professor S Kennedy: One of the other points that we have not touched on is Robin Skuce's work with colleagues in Scotland, which indicates that there is a surprisingly high heritability of cattle resistance

to TB. That raises the whole issue of whether, over a period of years, we could breed cattle that are progressively more resistant to the disease.

Dr McDowell: That research falls into two parts. The first is the quantitative part, which analyses retrospective data, and our collaborators in the Roslin Institute are engaging with the dairy industry to see whether that data could be used to promote the selection of sires with increased resistance. The longer-term aim is to look at whether we can genomically determine which animals are more resistant and say that those animals are the ones that should be bred from. However, that is a much longer-term objective.

Mr Swann: Has that research started yet? That is being done in Scotland?

Dr McDowell: We have undertaken the genomic selection part as a case control study, and the Roslin Institute is analysing that. Those are the first steps down what may be a long road.

The Chairperson: OK. Members, all of the questions have been asked. If you have any further questions for AFBI, please get them to Stella and we will ensure that they form part of the inquiry. Gentlemen, thank you very much for your attendance, your presentation and your answers.