# Review of the Institute for Animal Health - Pirbright Laboratory

A report for BBSRC Council July 2002

'What, when, where and why exotic disease outbreaks happen is unpredictable, but it is certain that they will occur and so continual preparedness is important'.

P. K. Murray. 1998. 1

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<sup>&</sup>lt;sup>1</sup> P. K. Murray. 1998. An overview of the roles and structure of international high-security laboratories for infectious animal diseases. Rev. Sci. Tech. Off. Int. Epiz. 1998. **17**, 426-443.

# **Forward**

The Pirbright Review Committee was established under the Chairmanship of Professor Keith Gull in November 2001. Our remit was to advise Council on the future role, structure and funding of the IAH-Pirbright Laboratory. See **annex 1** for the Committee's formal terms of reference and membership.

Animal health is a vital, long-term strategic issue for the UK with international dimensions. The threat to the UK from exotic infectious diseases of animals is ever present and could be said to be increasing, particularly with increased international travel, removal of borders to trade, climate change and threats of bio-terrorism. BBSRC's review of Pirbright is therefore highly relevant and timely.

The review Committee met for the first time on 18 January 2002 and again on five subsequent occasions. This included a site visit to Pirbright where we were able to speak directly to the senior staff. We would like to thank Professor Chris Bostock and Dr Alex Donaldson, and their staff, for their time and assistance.

We are cognizant of the fact that individual issues concerning Animal Health, training and capability in the UK has been touched on by a number of previous reviews<sup>2</sup>. Each interrogation has the very natural constraint of examining a historically determined "status quo". We too have felt this pressure. We see many things that appear incoherent and whose rationale for existence is only "understood" when one views them in their historical context. An analysis and understanding of the present institutional and funding situation should be read, in part, as an archaeological record!

In conducting this review we were fortunate that the BBSRC had recently competed its four-yearly Institute Assessment Exercise (IAE), which included a detailed analysis of the research programmes and quality of the science at IAH. We were keen not to repeat the Pirbright element of the IAE and we could therefore focus on understanding the multifaceted activities of Pirbright, how they are funded and managed and how they are best taken forward.

# Consultation

We conducted a consultation of researchers, government officials and senior industry representatives in the UK and overseas. This helped the Committee assess the impact of Pirbright, both nationally and internationally, on current and future understanding

Pickering Report. AFRC. Veterinary Research and Research Training. 1993.

Lucke Report. Royal Veterinary College. Veterinary Undergraduate Education. 1991.

Riley Report. Veterinary Education. UGC. 1989.

Wildy Report on Research and Development in Diseases of Agricultural Animals. AFRC. 1987.

<sup>&</sup>lt;sup>2</sup> Selborne Enquiry. Report of the Committee of Enquiry into Veterinary Research. Royal College of Veterinary Surgeons. 1997.

and management of exotic diseases of farm animals. A copy of the consultation letter and a list of those who kindly responded are at **annex 2**.

We had an excellent response to the consultation, which turned out to be a valuable and informative exercise. Pirbright and its scientists received much praise from around the world, where their impact has been, and remains, considerable.

# Structure of the Report

We begin in Chapter 1 from an empirical base with an overview of what the UK needs in terms of a national capacity for research, regulation and surveillance of exotic infectious diseases of animals. We then expand this overview as a template and vision for this national capacity imagining that we could start *de novo*.

In Chapter 2 we discuss in more detail the current role and management of our national centre - Pirbright. We consider to what extent the empirical template and vision has been achieved and how far there is still to go. We examine and assess many issues that affect the current and future performance of Pirbright.

In Chapter 3 we present our conclusions and recommendations concerning the future role, management and funding of Pirbright within the context of a wider national needs for research and surveillance on highly infectious diseases of animals.

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# **Executive summary**

There is a continuing danger to the UK of known and novel exotic diseases of large farm animals. Increasing international travel, population (and livestock) movements, removal of international borders to trade, climate change and threats of agricultural bio-terrorism lead to an absolute requirement for publicly funded research into exotic diseases of animals in the UK. Pirbright's role in this is, and will continue to be, highly relevant.

We could only support the relocation of Pirbright's research activities elsewhere if that plan were part of a single, major new infectious disease facility built as an innovative response to recent events. The costs involved would be substantial and there are both social and political considerations, in addition to the scientific.

Recommendation 1: In the event of no new large scale, national plan for infectious disease research facilities then investment in the Pirbright site appears to be the most cost-effective way of helping to achieve the required research and national surveillance capability on infectious diseases of animals.

Pirbright has specialised infrastructure needs (with emphasis on the Category 4 containment facility) that are different from those of other BBSRC Institutes. Parts of the estate and equipment infrastructure are below the expected standard for a site of such importance. Given its remit and location there is also a need for investment in housing for staff and visiting workers.

Recommendation 2: The condition of much of the Pirbright Laboratory, site infrastructure and associated housing is unsatisfactory and there is a clear need for urgent investment over the next five years in new laboratories and facilities. This should be part of a phased medium-term (10-year) rolling plan for the Pirbright Estate to be developed by the new Director with BBSRC and in consultation with DEFRA. We further recommend that IAH, in concert with BBSRC, develop a realistic and achievable plan for renovating its housing stock. We view these as urgent issues.

Recommendation 3: We recommend that the new Director should develop a medium to long term plan for platform technologies commensurate with the nature of a modern bio-medical research facility, and that immediate investment is then made in the light of this plan. A series of effective strategic alliances (within and outwith IAH) should be developed in order to provide access to platform technologies that are not to be developed in Pirbright.

There is a degree of excellence within Pirbright's research output and the standing of its scientists within their immediate field, but the research portfolio is unbalanced.

Recommendation 4: Our judgement is that in certain areas of science the Pirbright portfolio has become unbalanced and we recommend that this should be remedied by taking opportunities to refocus and by the addition of key areas

of research which may require some additional resource. Given the complexity and importance of its remit we consider that there is a need for more scientific leadership at the Pirbright site.

Given that Pirbright currently has only nine principal investigators we believe that it is operating below critical mass for it to become an independent bioscience research laboratory.

Recommendation 5: We recommend that Pirbright should remain part of IAH but maintain and enhance its scientific identity. The Director and senior staff need to be able to devote more time to 'leadership' rather than day-to-day management. To aid this, key managerial positions within Pirbright and IAH should be filled as a matter of urgency. This echoes the views of the Visiting Group and Governing Body.

There is an urgent need to identify replacements for key staff due to retire in the next 3-year period. Independent Research Fellows offer an excellent opportunity to develop long-term succession in research.

Recommendation 6: We recommend that the new Director of IAH develops an integrated plan with some urgency for scientific expertise and critical mass required at Pirbright. As part of this, the Director and individual PIs should develop a strategy for attracting and supporting Research Fellows.

We add our voice to the many others that have identified the ongoing weakness of the UK system to attract vets into research as an important issue.

Recommendation 7: We recommend that Pirbright reinvigorates its interaction with the Vet Schools over the specific issue of research training in exotic infectious disease. Innovation from all parties is required. In addition to further attempts being made to open effective dialogues with the Vet Schools, links to other infectious disease centres in Universities should also be explicitly strengthened.

It is our strong belief that an Institute such as Pirbright needs more stable core funding to conduct effective longer-term multidisciplinary research. An integrated, long-term portfolio of research agreed by the major funding agencies is a key to success in future exotic animal disease research.

Recommendation 8: We recommend specifically that a longer-term pattern of funding for key areas of Pirbright's work be developed by DEFRA to complement BBSRC's quadrennial post-IAE awards.

Recommendation 9: We recommend that DEFRA join the BBSRC in a quadrennial assessment of the work of Pirbright which assesses basic/strategic/applied science in an integrated manner.

There are great strengths in Pirbright's staff and professionalism in terms of its role as a National or International Reference Laboratory for various diseases. It also hosts the

International Vaccine Bank. But there is a need for more, funding and 'ownership' of these activities across government departments where they are of benefit to the UK.

Recommendation 10: We recommend that BBSRC, DEFRA and other interested parties, e.g. DfID, should specifically examine Pirbright's International and EU commitments as part of their policy and joint funding portfolio. The IAH Director should also set a specific strategy and targets for EU funding in concert with BBSRC and DEFRA.

Recommendation 11: We recommend that a real-cost/real-value (in both financial and strategic terms) assessment be conducted of the International Vaccine Bank by the incoming IAH Director with DEFRA.

Pirbright's relative independence of management by government departments should be maintained as a central buttress of its important policy advice role.

Recommendation 12: We recommend that Pirbright/IAH reviews, and where necessary improves, its capability to influence and inform policy.

There needs to be more effective co-ordination of actions, policies and practices within a national long-term vision of animal disease research and surveillance in the UK. Key to this will be more co-ordination between leading animal disease laboratories such as Pirbright and the Veterinary Laboratories Agency at Weybridge.

Recommendation 13: We recommend that models for the status and *modus* operandi of a higher-level UK organisation for the control of exotic diseases of animals need to be investigated and assessed.

Our discussions over specific items of policy and practice at Pirbright suggest to us that the present sectored governance and responsibility arrangements (Governing Body, BBSRC CE and staff, BBSRC Council) appear to be particularly problematic for an organisation with a statutory function. There is a danger that key responsibilities fall between two stools.

Recommendation 14: We recommend that governance responsibilities of IAH (Pirbright) be examined by the new Director, IAH Governing Body, BBSRC and DEFRA, and where necessary improved.

# **CHAPTER 1**

# An Empirical View of a UK Research Centre for Exotic Infectious Diseases of Livestock: the need, remit and operation.

1.1 We began the review of Pirbright by asking whether the UK has a need for publicly funded research into exotic diseases of livestock and, if so, what would be the nature and characteristics of an effective organisation to deliver it if we were able to start *de novo*.

# The Facility and its Characteristics

- 1.2 We conclude that there are clear present and future needs for the UK to be actively engaged in research into exotic diseases of animals. This capability will involve a network of players supported by a facility to conduct high containment research. These needs predicate a facility with the following characteristics and remit:
  - a scientifically ambitious research capability in the basic, strategic and applied biology of the infectious agents and their vectors.
  - the science remit will be a portfolio of work that addresses basic through to applied issues of early, accurate detection of disease, transmission, pathogenesis, epidemiology, the identification and threat of new, emerging and re-emerging disease, diagnostics and vaccine development.
  - a capacity to work *in vitro* and *in vivo* with live, virulent infectious agents in target species.
  - research which underpins an expertise capable of providing scientific advisory/regulatory/diagnostic advice to the UK Government, regulators, policy-makers, veterinary and agricultural industry and the public.
  - active and passive surveillance
  - a capacity to react quickly and effectively to an exotic disease outbreak, including scale-up of diagnostic tests within wider Government contingency planning.
  - a capacity to provide effective and proactive knowledge transfer and training to individuals and organisations.

- effective international outreach and maintenance of a scientific resource that provides the UK with individuals capable of formulating regulatory advice and providing training to World and European agencies.
- a capacity to act effectively as a designated National Laboratory under European Community law or as a World/EU Reference Laboratory for specific OIE list A diseases.
- acting as a EU/World reference laboratory to gather intelligence on the prevalence and spread of exotic infectious agents throughout the world.
- 1.3 This investment should result in important innovations of intrinsic scientific importance and of direct benefit to the livestock industry. It should also maintain a cohort of excellent personnel whose expertise is at the forefront of current knowledge, expertise and capability.

# The Template and Implications

# **Organisation**

- 1.4 This portfolio, let alone the containment issues concomitant with exotic agents, suggests to us that this remit is best met by a Research Institute structure and philosophy rather than through the UK University funded research infrastructure. Moreover, we envisage the ideal solution being a single facility of this type in the UK, which would interact with other Institutes and academia through collaboration.
- 1.5 By necessity this Institute will prosecute a World remit with an international dimension of benefit for the UK with work in countries within which the diseases under scrutiny are endemic. We recognise that this will often provide direct benefits to developing countries. The Institute will manage effectively the balance between the International and National aspects of its portfolio.
- 1.6 Whilst recognising this wide context, the Institute will exhibit an extensive set of facilities and a cohort of group leaders commensurate with critical mass.

#### Management and manpower

- 1.7 The nature of the research, bio-security issues, regulatory advice and training predicates the highest level of leadership and management of the facility. In addition the strategic, long-term nature of the research portfolio necessitates a high level of integration and connectivity with the ambitions and needs of users.
- 1.8 The need to maintain a cohort of trained manpower and the continuing need to develop this interdisciplinary area means that succession planning for this intellectual resource will be a priority.
- 1.9 Acceptance of the isolated working environment of the scientists produces a discrete challenge in terms of integration to avoid intellectual isolation.

Confidence in safety and security are paramount but must not be achieved at the cost of intellectual isolation or complacency. In our vision for the ideal UK facility this issue will have been tackled explicitly and effectively regardless of whether the Institute is geographically isolated or is embedded within a wider bio-medical/veterinary research location.

- 1.10 The facility will work to high operational standards and appropriate Quality Assurance throughout the system and will maintain and develop this expertise.
- 1.11 There are significant differences between this Exotic Disease Institute remit and the remits of many other types of Research Institute in the UK. On the one hand the Institute has statutory/regulatory duties as a National/EU/World reference laboratory, and on the other hand there is a need to do high quality basic research. This is likely to create tensions for staff pulled between different objectives. The funding agencies will recognise these differences.

### **Bio-security**

- 1.12 The very nature of work with exotic microbial agents demands that there will be a high level of confidence in bio-security measures, both in terms of physical barriers and the management of the facility and the individual professional expertise of the personnel.
- 1.13 Given the specialised nature of the containment for bio-security the science will be done within a modern laboratory infrastructure, with access to the usual range of high quality analytical and preparative facilities.
- 1.14 The importance of an excellent infrastructure for handling, diagnosis and containment of these exotic diseases (in and out of the laboratory) is emphasised even more given the newly recognised appreciation of the threats of agricultural bio-terrorism.

#### **Facilities and estate**

1.15 There will be recognition that high security facilities are expensive, are in continuous operation and require substantial, on-going investment. The specialised bio-containment facilities come at additional costs to those of even advanced bioscience laboratories. This recognition will extend from construction costs through to maintenance and equipment and include staff costs associated with mandatory practices and procedures. Rolling long term plans (5-10 years) will be available for all aspects of laboratory infrastructure – from equipment to buildings and security.

# **Funding**

1.16 We envisage that a single funding stream will best support the above remit. In the event of multiple majorfunding streams then the following principles are key:

- that the funding portfolio does not become incoherent by division, drift and sectorization.
- that the major funding streams are integrated, mutually coherent and adopt a long-term policy of responsibility and decision-making.
- that all parties have responsibility for succession planning and physical infrastructure costs.

These long-term issues require agreement, interaction and coordination between Government, the main funding agencies and those managing the Institute.

- 1.17 A long term funding portfolio is critical for success. However, stability of funding should not be equated with a wish for complacency. In contrast the funding agencies should have mechanisms whereby broad portfolios of funding are matched to their particular needs and ambitions. In return those managing and working in the Institute will produce a portfolio of research activity that matches the user's and funder's needs and is dynamic in its ability to accommodate change and termination of individual projects.
- 1.18 A feature of the Institute will be that both it and the funders/users will have identified mechanisms whereby scale-up and contingency plans can be activated to ensure scale-up, delivery of expertise, training and advice in the event of a UK epidemic of an exotic disease. Funding agencies will have mechanisms outwith of the norm for financing these activities. Contingency planning predicates close links of research to diagnostics and therapeutics
- 1.19 The long-term nature of the research, and changes in emphasis and pattern likely to occur during specific time periods necessitates an integrated plan by funding agencies. This will include a transparent set of requirements from the different funding agencies and interested users. However, whilst each may have different ambitions and needs these need to be part of an integrated and agreed portfolio of research, policy development and advice undertaken by the Institute.
- 1.20 Just as the Institute must manage its portfolio of research in a coherent, integrated manner, it is incumbent upon the funding agencies to provide an integrated assessment of the Institute's performance. There will not be a series of separate overlapping or non-overlapping assessments nor separate assessment criteria.
- 1.21 Judgements and metrics applied to the Institute will be clear to both assessors and scientists within the institute. This suggests that funders will understand and work with each other, each needing to accept responsibility for producing a clear set of requirements and ambitions and moreover, to integrate these into the overall research portfolio of the Institute.
- 1.22 Funding agencies will understand the likely consequences of the reaction of scientists within the Institute (and hence the long-term scientific expertise

- base) to the differing metrics and assessments applied. Incoherence in the application of sectorized metrics will have consequences on the form and structure of the science base of the Institute.
- 1.23 All major funding agencies will understand, appreciate and accept a level of responsibility for the reaction to their individual actions within the total research portfolio.
- 1.24 Contracts placed with the Institute and the matching research plans, their assessment upon completion or renewal will be subject to a high quality of peer review. Therefore, government departments and major funders will have adequate mechanisms for peer review of their contracts before being placed at the Institute.

# Policy and communication

- 1.25 The long time lines involved in this area of activity will necessitate that the Institute has a coherent "forward look" vision. The Institute must not be merely responsive. If it is to serve its users and its scientists then it must be known as a world-class centre providing early warning and effective strategy advice buttressed by excellent underpinning science. It would thus play a key role in Government horizon scanning activities.
- 1.26 The Institute will be at the heart of a policy system that is able to integrate and deliver high-level advice in a coherent strategy. It will operate as a critical node for developing the scientific evidence base for policy in this area.
- 1.27 The Institute will have excellent outside links to universities, Institutes and government agencies world-wide. In particular, it will have developed important collaborations with other exotic disease laboratories in Europe/World.
- 1.28 There will be a coherent and effective policy for communication to funders and users. Communication mechanisms, IT, data recording and compatibility, physical transport of samples and information will all be maintained at a cutting edge status and be able to function and interact with others during an emergency.
- 1.29 Government will recognise the need for quality scientific/veterinary expertise within their departmental civil service in order to receive and understand scientific advice from the Institute experts and scientific out-turns.

#### International role

1.30 Given that the Institute is a World and/or European reference lab for OIE list A diseases and the likely international consequences of its work the UK Government will recognise the value of this development work, and take 'ownership' of the issues requiring international agreements over funding for these roles.

# **Training**

1.31 The Institute will have a central role in training and dissemination of its knowledge and expertise. This will involve the Public, Government scientists, Vets, Farmers, Agricultural industry, overseas countries and international agencies.

# **CHAPTER 2**

# The IAH-Pirbright Laboratory: a review of the current position

2.1 We now turn from an empirical vision to a review of the UK's current capacity – the Pirbright Laboratory. However, before describing the results of our review of the Pirbright Laboratory it is perhaps important to state what we have not reviewed. We have not conducted a detailed review of the current science portfolio nor the recent scientific achievements and outputs of Pirbright. BBSRC has recently conducted a review of all aspects of the work of the Institute of Animal Health as part of its 2001 Institute Assessment Exercise. Whilst we have views (see later) on the context and metrics of this exercise we found the report informative and the results useful. However, where our analysis indicates an imbalance in the research portfolio or research strategy we have made comments and recommendations.

# Overview

2.2 Pirbright was originally a Government TB quarantine station established to ensure that pedigree cattle being exported to southern Africa were free from TB. Work on FMD began there in 1924. Pirbright now operates as one of three geographically separated sites within the Institute for Animal Health (IAH). IAH's own description provides the following view of its remit and key strengths:

"IAH is a world centre for research and training in fundamental, strategic and applied research on infectious diseases of farm animals. It advances knowledge on the etiology, pathogenesis, epidemiology and control of existing and new diseases and develops control measures that enhance farm animal welfare, increase the efficiency of agriculture and protect the environment.

# Key strengths:

- World reference laboratory for foot and mouth disease and regional reference laboratory for a number of other exotic viral diseases
- Provides long-term stable diagnostic and surveillance capabilities for UK and other countries
- High category containment facilities."

It is important to note that the Pirbright Laboratory has maintained a distinct identity within the IAH organisation.

# The Role of Pirbright

- 2.3 Pirbright operates as the only site within the IAH (and the UK) with facilities to conduct research on the following highly infectious exotic diseases of large animals - FMD, Swine Vesicular Disease, and other vesicular diseases, Rinderpest, Bluetongue, African Horse Sickness and African Swine Fever. Initially we addressed the question of whether these functions will still be required by the UK in the next 20 years. Our answer is an emphatic yes! The threat to the UK from exotic infectious diseases of animals is certainly not declining, and given all the evidence we have assessed we believe the threat to be increasing. The UK has recently experienced an outbreak of FMD and classical swine fever (CSF) immediately before that. Other EU Member States have also faced FMD and CSF, and Bluetongue is already present around the Mediterranean basin. Against this background and coupled with increased international travel, livestock movements, removal of international borders to trade, climate change and threats of agricultural bio-terrorism then our view is that the UK has an absolute requirement for an Institute that fulfils the roles set out in Chapter 1 of this report.
- 2.4 Both BBSRC and DEFRA value Pirbright and recognise the national and international expertise and facilities that the Laboratory provides.

In essence, the role of Pirbright from BBSRC's perspective is:

- to conduct high quality basic science of strategic relevance
- to contribute to BBSRC's mission in respect of Knowledge Transfer
- to contribute to BBSRC's mission in respect of training

The role of Pirbright from DEFRA's perspective is:

- Applied research
- Expert consultancy services in case of disease outbreak
- Surveillance national and international
- Independent advice
- National reference laboratory (part of statutory requirement) for FMD and other statutory diseases
- Training (State Veterinary Service)
- Contingency planning for disease outbreaks in UK

# **Basic, Strategic and Applied Research**

- 2.5 Given the recent (2001) BBSRC Institute Assessment Exercise (IAE) we did not perform a *de novo* assessment of the research output of Pirbright. We did assess international perceptions of this research during our consultation and we did utilise bibliometric analyses of particular issues.
- 2.6 The BBSRC IAE did not specifically differentiate between the component sites within IAH, however we were able to discern specific aspects of the

assessment of Pirbright's science, strategy and staff in the Visiting Group's report:

"the Exotic Disease Group plays a key role in providing an interface between advances in research and government agencies responsible for the prevention and control of important animal virus disease. Maintaining the interface between research and surveillance was considered a major strength. The Visiting Group was impressed by the work of this very well respected team, which was performing an excellent and highly valued service to the world community"

- 2.7 Overall our analyses endorse the BBSRC IAE Visiting Group's assessment of a level of excellence within Pirbright's research. We recognise that some of the best scientists in the world in exotic virus research are currently working at Pirbright.
- 2.8 The animal disease research community is small relative to the human infectious disease community however, in the specific area of Pirbright's remit there are exciting topics for basic science study. Given that the Laboratory operates with some scientific and managerial élan then there should be ample opportunity to attract excellent young scientists.
- 2.9 At the other end of the research spectrum we were told on a number of occasions that vaccine development for exotic animal diseases is an unattractive proposition for the commercial agricultural research industry. There are, therefore, ample opportunities in this area. This breadth of scientific opportunity confirmed our view that it is critically important to maintain a mix of basic and applied research on the same site, to maintain connectivity across the full spectrum from virus phenotype to diagnostics and vaccine development.
- 2.10 In terms of research on a number of infectious disease agents, we concurred with views that a greater focus could be placed on disease control, vaccination, the carrier state, viral persistence mechanisms, epidemiology and modelling. We formed a view that in respect of these areas of science the Pirbright portfolio has become unbalanced. It appears to us that the Laboratory could be more ambitious in these areas but we concur with the view that this will require additional resource.
- 2.11 However, we also recognise that the funding agencies need to provide clearer integration and expression of their own ambitions, objectives and policies for the Laboratory to place such long-term projects firmly within its portfolio. Some of our concern here relates to the funding practices, metrics of success and strategic ambitions set by the funding agencies and then perceived by individual scientists and the corporate scientific leadership within IAH.

# **International Status and Activities**

2.12 Pirbright is a centre of national and international importance for basic and applied research on exotic viral diseases of animals. The four diseases actively worked on are Foot and Mouth Disease, African Swine Fever, Bluetongue and Rinderpest (though work on the latter is declining as eradication progresses). All of these diseases are of strategic importance to the UK. The Laboratory is a major supplier of statutory diagnostic, surveillance and testing services to DEFRA, the European Commission, Office International des Epizooties (OIE) and the Food and Agriculture Organisation (FAO). The Statutory and International Group is on call 24 hours a day, year round. A vaccine bank is maintained on behalf of Australia, Eire, Finland, Malta, New Zealand, Norway, Sweden and the UK. (200,000 doses of fully formulated vaccine can be supplied within 2-3 days).

## **OIE** experts

2.13 Several members of staff are recognised by the OIE as experts for particular diseases and provide advice in the member states. The subject areas are: African Swine Fever, Bluetongue, Sheep and Goat Pox, Foot and Mouth Disease, Peste des petits ruminants, Rinderpest, Swine Vesicular Disease and Vesicular Stomatitis.

# Reference laboratory status

2.14 Pirbright is a reference laboratory for the following diseases:

•	Foot and mouth disease	(OIE, FAO, EU)
•	Vesicular Stomatitis	(FAO)
•	Swine vesicular disease	(OIE, EU)
•	Rinderpest	(FAO)
•	Peste des petits ruminants	(FAO)
•	Lumpy skin disease	(OIE)
•	Bluetongue	(OIE, FAO, EU)
•	Sheep and goat pox	(OIE)
•	African swine fever	(OIE)
•	African Horse Sickness	(OIE, FAO)

2.15 Pirbright is a World Reference Laboratory (and acts as the EU's Reference Laboratory) for FMD and is one of 14 National labs in the EU legally allowed to handle the live virus. Reference laboratory function is clearly beneficial to the quality of science conducted at Pirbright and attracts international interest and collaboration. It also brings benefits to the UK Government. For example, in the recent outbreak of FMD the fact that Pirbright is the World Reference lab meant that DEFRA had immediacy in isolating, diagnosing and typing the virus strain. Also validated reagents/tests and national and international experts were readily available as well as facilities to conduct experiments on the pathogenesis of the virus in target species.

- 2.16 Reference Laboratory status also confers on Pirbright, and its scientific staff, an international profile whereby they are seen from abroad as a valuable source of advice. A 'UK spin' on that advice helps to maintain standards and ensure UK security. It is apparent that a large amount of "Knowledge Transfer" occurs via these routes. Moreover, the status of Pirbright allows the UK a strong and influential voice in the drafting of international regulatory documents. Our consultations with leading figures from around the world endorsed this view with many adding that Pirbright's research was internationally competitive.
- 2.17 We are, however, concerned that this aspect of Pirbright's work may not be adequately valued in the metrics used by the two major funding agencies (BBSRC and DEFRA). Moreover, we have some concerns that trans-national activities are not adequately resourced within the Laboratory. There are indications that this form of aid to overseas agriculture, in particular in developing countries, is inadequately "valued" and resourced by government departments such as DfID. We also have concerns that this area seems often to fall between stools. There appears to be an inadequate forum for discussion between government departments as to who takes responsibility for funding activities in the area of overseas aid and for maintaining long-term expertise. There also appears to be some internal government cross-departmental inconsistencies over who takes responsibility for Pirbright's work in representing the UK internationally. It is possible that Pirbright cannot operate (or is not) efficient mechanisms for linking its management of these commitments to overall Government department research/aid planning and procurement.

#### International vaccine bank for FMD

- 2.18 Pirbright houses the seven nations International Vaccine Bank (IVB) for FMDV. Antigens sufficient for 500,000 doses from seven FMDV strains are held in liquid nitrogen. Pirbright has the facilities and expertise to test antigen/vaccine potency and formulate and bottle vaccine on site. In our view the IVB is probably not funded at full economic costs but an argument was made that Pirbright science benefits from having it on site.
- 2.19 A question exists as to whether this is an appropriate, cost-effective strategy or whether other commercial/semi-commercial arrangements should put in place for the long-term.

# **Facilities and Infrastructure**

#### Laboratories and estate

2.20 The Pirbright site is a mixture of modern buildings and areas that are clearly pre-1940. There is a new (1999) main office block and shower facilities as a gateway 'inside' to the category 4 containment area. Worl is also underway on a new high security containment facility for large animal exotic virus

- infectious disease work to replace the "Isolation Unit 7". This is absolutely essential for both the scientific and statutory work.
- 2.21 We believe that Pirbright's specialised infrastructure needs are different from those of other BBSRC Institutes. We question whether these additional oncosts have been well represented to, or appreciated by, all funding parties. A new IAH Director should ensure that these costs and responsibilities are clearly identified and communicated
- 2.22 Some of the laboratories and other areas of the estate are not of the standard that would be expected in a modern bio-medical research facility. We considered that the organisation (office accommodation/lab usage) does not reflect the standards likely to be met in the best BBSRC Institutes or University Departments. Research facilities for the scientists did not appear to be commensurate with the standard of accommodation that might be expected for work in this area of infectious disease nor for attracting the world's best young scientists. We had concerns that some areas of a site of such importance should be so shabby. There had clearly been an on-going investment in existing facilities yet one suspects that new build rather than renovation is the only serious policy for the future.
- 2.23 Replacement of the existing research laboratories should be a high priority. Staff often reported that the facilities were just adequate ("you don't notice it after a couple of weeks"). The research environment is not conducive to a site of international standing. We detected a sense that staff had a poor expectation of change and improvement.
- 2.24 Bio-security of the site is taken extremely seriously. There is a strong need to ensure that a level of security and bio-security commensurate with the work conducted and the associated risk is maintained.
- 2.25 Many countries such as Australia, Canada, Switzerland and Spain, have recognised the need for high security facilities for exotic diseases research and have commissioned new facilities in recent years. In the UK the major burden for infrastructure investment in Pirbright is borne by BBSRC. Despite capital expenditure of around £34M at IAH over the last 10 years, with about £15M allocated to development at Pirbright, there remains much still to do. We believe that there are special infrastructure costs at Pirbright related to regulatory and bio-security responsibilities. We consider that these have not been adequately recognised by IAH and BBSRC as being of a different nature to infrastructure costs at other Institutes. A medium-term (10 year) plan for the Pirbright Estate does not appear to exist. Whilst acknowledging that forward planning of some facilities exists in the IAH Business Plan, there is a need for a more serious global review of laboratory facilities and urgent investment over the next five years in priorities for infrastructure development.

### **Equipment infrastructure**

- 2.26 Provision of equipment within a closed, containment facility offers unusual planning and procurement issues. This is compounded by the need for modern molecular and cellular biology and access to a range of platform technologies.
- 2.27 We found that there was evidence of some recent investment in state of the art imaging equipment such as electron and confocal microscopy. Apart from this, the standard of laboratory equipment was mixed, with a significant amount looking rather dated. Whilst some groups have good external connections and the planning of platform technologies was at the level of IAH itself we consider that there is a lack of forward planning in this important area. A worry is that in this and other areas of research capability there has been a 'degradation of expectation' on the part of some staff in terms of what constitutes a well-found laboratory infrastructure.
- 2.28 The BBSRC grant to IAH has an admirable aspect of a separate by-line for equipment. In respect of other funders it appears that equipment costs are a matter for individual projects, a situation, which if not reversed, will require excellent overall control by Pirbright management in order for the costings for individual bids to accumulate to a holistic equipment capability.
- 2.29 Whilst these equipment issues are at too fine a level for this committee to assess accurately the IAH budget suggests that the targeted sums may be too low in terms of maintaining this equipment infrastructure in relation to Staff and Consumable costs.

# Scientific Staff Issues

#### Recruitment, retention and succession planning

- 2.30 The location of Pirbright, in an area geographically removed from experimental and commercial farm animal facilities is a useful aspect of biosecurity. However, such benefit comes at some cost. Surrey and Berkshire are expensive areas of the country for housing. Staff salaries have not kept in touch with those in the commercial or industrial sector and housing difficulties associated with relocation of staff to this area is seen as a major difficulty.
- 2.31 Recruitment and retention difficulties involving staff at all levels were reported to us:

'as a major and growing problem. Application rates for postdoctoral positions are low and, in general, quality of applications is low also. Salaries are not competitive and so it is difficult to recruit to senior scientific positions. The problems extend to key support staff. The Institute needs high quality dedicated animal technicians but a combination of uncompetitive salaries, jobs held in low esteem by the public and threats to personal safety mean these posts are difficult to fill and there is a high turn over with newly trained staff leaving to better paid jobs in neighbouring organisations. Similarly given the

Institute's position in Surrey it is difficult to recruit well trained computing staff at the salaries we are able to offer. Once trained, staff become highly marketable and are able to leave Pirbright/Compton for improved career prospects and salaries'.

It is, however, important to dissect the Pirbright-specific problems out from those currently afflicting all public sector science laboratories in the UK.

- 2.32 Pirbright has some serious succession issues looming. Several key senior staff retire in the next 6-36 months and key skills will be lost i.e. insect vector/virus transmission and about half the number of vets. This is a serious matter for Pirbright and a serious matter to IAH as a whole.
- 2.33 It is unclear to us how vigorously IAH can/has pursued a policy of adequate remuneration packages for key staff under present funding/governance arrangements. Whilst salaries and housing are important they are just one factor in recruitment. The market place for good scientists is international and recruitment, succession and retention issues are a major managerial priority for Pirbright.
- 2.34 We see an improvement in recruitment and succession planning coming only from improvements in multiple issues including a higher profile for Pirbright, improvement and better use of housing accommodation, use of the flexibility already inherent in BBSRC pay policy, and improving the laboratory facilities to make Pirbright more attractive to excellent PIs.
- 2.35 It is disappointing that Pirbright (and IAH in the wider context) has failed to recruit independently funded research fellows (BBSRC, Royal Society, etc) to set up their groups at Pirbright. This is a very effective way to develop young scientists, to import new technologies and expertise and to support succession planning.

#### Staff and student housing

2.36 A major ambition of a research Laboratory must be the development of a widespread research community and culture involving post-docs, students, and research fellows and visiting fellows. Given the current small size of Pirbright (and the comments above about location) it was disappointing to us that the housing available to accommodate/attract and support this community was in such a bad state of repair and that a PFI initiative to build a hostel had been abandoned by the institute. Whilst the Governing Body had reviewed the matter over many years there has been no adequate resolution of the issue between IAH and funders. Our view is that this is but one of the unresolved issues to which there did not appear to be a long-term plan and which would benefit from more direct management ambition.

#### **Veterinarians in Research**

2.37 We consistently heard the view that Pirbright needs more vets in research positions. This echoes an almost eternal problem of attracting vets to a

research career. This difficulty has been the context of many other reports over recent years but no effective plan or solution has been defined. The view was offered that trained veterinarians bring a holistic 'whole animal' view to research on infectious diseases. Whilst likely to be true, in essence this debate also encompasses the recognised lack of "Integrative Biologists" in the UK. Pirbright has been proactive in attempting to bring veterinary students into research placements, but with only small success and a little direct support from the Vet Schools.

- 2.38 The Pickering report in 1993 to AFRC (now BBSRC) recommended, amongst other things:
  - The secondment of veterinary school staff to research institutes and vice versa.
  - That AFRC should hold summer schools for veterinary undergraduates at institutes with large animal facilities.
  - Electives and vacation studentships

We believe that all of these points are just as relevant a decade later.

# **Training**

- 2.39 Pirbright has an important role in training. At national level there are courses for the UK Government's Veterinary Service and at international level there is training of visiting workers from developing countries. The latter has two benefits. First it improves animal health in poor countries and thus contributes to an improved quality of life. Second it provides a network of overseas contacts for improved surveillance and disease intelligence. It is however unclear as to whom in the UK takes responsibility for these international activities and yet our international consultations suggest that they have a high impact.
- 2.40 Our impression was that the full prospectus of training offered by Pirbright was declining; if so this trend should be reversed.

# **Funding and Funders**

#### **BBSRC and DEFRA**

- 2.41 Pirbright is funded from a variety of sources, but the major funders are BBSRC and DEFRA.
- 2.42 BBSRC funds Pirbright with a Core Strategic Grant and the Laboratory can bid for peer reviewed BBSRC Competitive grants (in competition with Universities and Institutes) up to a nominated capped sum.

- 2.43 Examination of the 2001/2 budget for Pirbright (annex 3) reveals that BBSRC funds around 30 % of the total and DEFRA around 43%. There are important differences between these two funders:
  - BBSRC's funding is, in essence, a block strategic grant for a portfolio of projects. It is awarded for 4 years after each quadrennial round of the Institute Assessment Exercise. The grant is awarded along with a 'ringfenced' component for equipment.
  - DEFRA's funding is a sum composed of funds awarded for individually costed and awarded projects (currently number = 17) (see **annex 4**) Some of the DEFRA funding is awarded on an annual basis.
  - The remaining 30% of total funds is distributed amongst a number of agencies. The sums are relatively small. It is noticeable that the funding from the EU amounts to only around £300,000 per year and that from Government Departments other than DEFRA must also be very small.

#### EU and international work

- 2.44 We question whether the work done by Pirbright on behalf of the UK, in the EU and in developing countries is adequately valued and funded by the respective Government departments and the EU. In particular we recognise that the Reference Laboratory and Regulatory functions of Pirbright gained general acclamation during our consultation yet ownership of the full costs of these appears often to fall between FAO OIE, EU and certain UK government departments such as DfID and DEFRA. There appears to be some difficulty for the Institute to obtain reasonable cost recovery for its work on behalf of the international community in these arenas. International agencies see this as a UK cost and the respective UK government departments espouse a position that given the UK's freedom from exotic diseases this is not within their immediate sphere of interest. Thought they acknowledge the benefits in terms of global surveillance and expertise that come from having Pirbright as the world reference laboratory. This appears to be yet another Cost/Value exercise that remains hanging. The full economic cost of the reference lab and vaccine bank (if it is to continue) functions needs to be resolved. Current problems with remuneration from interested parties appear to be indicative of a lack of connectivity between UK government policy and payment of costs. Greater clarity and a unified view of fiscal responsibility across government departments would assist Pirbright's activities.
- 2.45 Apart from the costs of the EU regulatory function there is a specific issue of EU grant funds within the forthcoming Framework 6 Programme. Given the emphasis on linking "Centres of Excellence' in EU Framework 6, the existence of exotic disease laboratories in Europe and the events of 2001 then one would expect Pirbright to be an active player in this area.

# The nature of DEFRA's funding

2.46 DEFRA funding has remained 'relatively constant' at around £2M, (annex 5). Research projects tend to be based on three year contracts awarded from

DEFRA Animal Health and Welfare Group budget. A further £500K of DEFRA funding is a contribution to bio-security measures, testing and reference lab functions. This money is awarded annually from a different budget.

- 2.47 There appeared to be little within DEFRA's structure influencing how the UK might maintain and manage the long-term intellectual resource of this type of Institute. Mechanisms for mapping the pattern of funding of individual grants to how the resource might be maintained seems not to have been well rehearsed.
- 2.48 Does this pattern of funding matter? We believe it does and that it should be changed. It was noted that there is an on going difficulty each year in balancing the books at Pirbright. We question whether such an important infectious disease facility should be run on this financial base. Also, we formed a strong view that individual scientists at Pirbright found difficulty integrating these two strands of funding into a continuous spectrum of research outcomes. Often, highly specific project targets and metrics were utilised. Moreover, this individual small contract funding mitigates against long-term strategic thinking and objectives.
- 2.49 It is our strong belief that an Institute such as Pirbright needs more stable core funding to conduct effective longer-term multidisciplinary research, especially on the development of diagnostic methods and vaccine research. This long term funding is currently only provided by BBSRC, though DEFRA invest considerable short-term funding into Pirbright. Whilst it appears to be recognised that longer-term funding is desirable in some cases, DEFRA budget holders believe that they need to maintain flexibility to shift funds at short notice to respond to changes in UK policy needs.
- 2.50 However, examination of the total funding going to Pirbright year on year has been relatively predictable (annex 5). Given this, a very significant benefit could be achieved by DEFRA's establishment of a long-term pattern of funding to complement BBSRC's quadrennial post-IAE awards. It is our view that an integrated, long-term portfolio of research agreed by the major funding agencies is key to success in the future of exotic animal disease research in the UK and must be developed. There appear to be opportunities to develop a 'Portfolio' of research within which themes may be modified over time. We recognise and welcome the corollary that this would necessitate effective project management and policy review mechanisms both within Pirbright and DEFRA.

#### The DEFRA and BBSRC partnership

2.51 There is scope for partnership between BBSRC and DEFRA to provide joint core funding to Pirbright in a more coordinated manner. This is likely to be focused on research in mutually agreed priority areas of national importance. Such an ambition requires effective management decision-making and assessment. An integrated 'Portfolio' should be developed with good project

- management, well-defined medium to long term targets and appropriate assessment metrics.
- 2.52 Who in Pirbright (and how) decides on the funding areas for DEFRA/BBSRC and other agencies? We have asked whether the present funding arrangements are fit for the purpose? In particular are the decision timing, decision processes, grant size/type/length in relation to topic, fit for the intended project aims? We recognise and welcome some changes in DEFRA's (in contrast to MAFF's) mechanisms for awarding contracts which have too often in the past been the result of debates between small cohorts/individuals within the department and Laboratory (we have referred to this as a 'caustic cycle'). We look forward to seeing more transparency in these arrangements for policy development, project placement and management. These issues are critical for Pirbright since it is, in effect, in a monopoly position because of its remit and containment capabilities. However, the potential for policy driven movements in its area of activity is large.
- 2.53 We have stated that the BBSRC pattern of research project funding offers a useful model at present. However, there are still gains to be made in how BBSRC and its Institutes work together to identify and fund long term infrastructure needs and site development. In addition, other major funders should understand the responsibility of full economic costs for maintaining expertise, technologies, laboratory infrastructure and containment/bio-security measures.
- 2.54 We believe that aspects of Pirbright's remit and mode of operation place it in a unique category amongst Agricultural Institutes in the UK. Here we refer to the statutory, regulatory and bio-security aspects of work with exotic diseases. BBSRC's Council needs to maintain an awareness of these specific differences which should be made more manifest within IAH and BBSRC's planning. In addition it is our view that DEFRA should consider a longer-term window for awarding funding to Pirbright for bio-security.

# Assessment of the science portfolio

2.55 We have been struck by the reaction of individual scientists to the assessment procedures of the two main funders. In essence they make a clear distinction between BBSRC and DEFRA and operate a clear differentiation between the metrics used by both funders. We view this as unhealthy within such an Institution. DEFRA is improving its assessment procedures but we believe that it is imperative that it joins BBSRC in the quadrennial assessment exercise. The Institute and its scientists should receive an integrated assessment of their work as an encouragement to interdisciplinarity and connectivity of the science (basic/strategic/applied) within such a Laboratory.

#### **Original intent and future partnerships**

2.56 During this review we have, at times, looked back at the actual intent of those who defined the partnerships and structures that now define the practice of UK government agricultural science. The preceding paragraphs rehearse

arguments for better integration between a Research Council and Government Departments in funding a laboratory that performs a spectrum of basic science through to applied research and development. Given these arguments in 2002 there is much in the 1972 White Paper to reflect upon. We note that in the specific respect of a laboratory such as Pirbright the essence and content of certain passages may be invigorating and worth revisiting (annex 6).

# **Scientific Policy**

- 2.57 During our visit to Pirbright senior management put forward the view that that scientist should not be involved in setting policy. Whilst it is true that Ministers ultimately <u>set</u> policy, that policy must be informed by the best available scientific advice following the key principles developed by the present and immediately past Government Chief Scientists.
- 2.58 Pirbright's independence and its scientific expertise is perceived by many we consulted to be critical to the quality and reception of its advice within both the UK and overseas.
- 2.59 Many agencies use Pirbright's scientists for advice on scientific policy. We view Pirbright's relative independence of direct management by government departments as important in this policy advice role. Some policy advice is formulated and delivered at the level of the individual scientist. However, much is delivered at a corporate level. We perceive a need within Pirbright/IAH for improvement of systems whereby timely and appropriate policy advice is formulated.
- 2.60 Moreover, our view is that there is room for improvement in the systems whereby Pirbright and its scientists are able to provide Government, government departments and non-government organisations with timely scientific advice.

# The Management and Physical Location of Pirbright

- 2.61 Management at various levels has been a central theme in many of our discussions. There needs to be more co-ordination (within a long-term vision) of animal disease research and surveillance in the UK. In this document we have identified a number of problems and some possible solutions within this general theme. These range from better high-level recognition, assessment and valuation of strategic research and regulatory functions between agencies through to improvements in procedural and governance aspects of research portfolio funding and succession and infrastructure planning.
- 2.62 We started this document by reference to the history of how Pirbright presents itself today as a component of a multi-site Institute for Animal Health. We have made reference earlier to the advantages and disadvantages of Pirbright's physical isolation.

2.63 The two southern IAH sites of Compton and Pirbright are not located in major scientific centres and are some distance from nearest Universities, e.g. Compton 20 miles from Oxford, 15 miles from Reading and Pirbright 7 miles from Guildford. Moreover, in Pirbright's case the extra danger of scientific isolation is compounded because of the containment issues associated with exotic disease research. Given these points, it is a major managerial challenge to prevent Pirbright from becoming intellectually isolated or internally complacent.

#### **Critical mass**

- 2.64 We see Pirbright as being below critical mass for a modern bioscience centre (annex 7). 132 people are employed at the Pirbright site. Pirbright's management view is that there are 13 project leaders but there were only 9 scientists submitted to the QS portion of the most recent BBSRC IAE, which is designed to assess PI's regardless of their funding. Given that this is a component laboratory of a research institute then inclusion in the IAE must be the best definition of a PI. A figure of 9, even for a relatively specialised laboratory, is well below the critical mass that would be expected of a modern independent bioscience operation.
- 2.65 Given the research PI base of Pirbright a forward plan for academic developments is necessary in order to enhance its scientific coherence and capability.
- 2.66 Our view is that these future plans may well involve strategic alliances with other sites in UK or equivalent labs in Europe. Naturally, discussions of PI critical mass will need to be balanced with decisions over how to resource the concomitant running costs.

# Pirbright within IAH

- 2.67 The managerial and scientific need for Pirbright to operate within a larger Institute structure was rehearsed with us on many occasions. Given the size of Pirbright we do not believe that it can operate effectively as a separate entity and therefore, that it should remain part of IAH. However, analysis of the outputs suggests that there is still very little effective collaboration between staff at Compton and Pirbright (e.g. collaborative articles). The issue of what is a reasonable scientific coverage for Pirbright and the expertise missing or underrepresented (epidemiology, modelling, genomic technologies, integrative biology?) should be assessed alongside issues of laboratory infrastructure.
- 2.68 The recent BBSRC visiting group noted that there is an inappropriate Divisional structure in IAH, which mitigates against multidisciplinary approaches. We endorse the view that IAH needs an urgent review of its Divisional structure. Any new grouping must produce multidisciplinary benefits for what is, in effect, a small-to-average biological research centre in comparison to many of the integrated Schools of Biological Science in UK universities. We recognise that the current discipline based organisation was a

serious attempt to ensure integration across the institute. However, in the specific case of Pirbright we believe that there is a need for clear scientific leadership and vision to define this site as a major scientific centre. A clearer scientific identity within, and for, Pirbright need not conflict with internal managerial effectiveness and organisation within IAH. We believe that, because of its special functions, Pirbright deserves both discipline and site leadership within the IAH organisation.

2.69 We noted that the current IAH Director has taken on a huge task with both managing the multi-site IAH and running his own research programme. Key senior posts have been difficult to fill and much energy has been expended. However, we see that such managerial positions are a priority and we echo the views of the Visiting Group and Governing body that these need to be filled as quickly a possible in order to give the post of Director more time for 'leadership' rather than day to day management.

# Pirbright's location

- 2.70 A few UK correspondents commented that Pirbright would be better moved and embedded within/next to a University based biological/Veterinary/Biomedical establishment. Given our opinion that substantial infrastructure cost will need to be incurred at Pirbright over the next few years, then moving the Institute is a proposition we addressed early in our discussions.
- 2.71 We could only support the closure of Pirbright and its relocation elsewhere if that plan were part of a single, major new infectious disease facility built as a response to recent events. The costs involved here are very far beyond the capacity of the present funding agencies involved in Pirbright.
- 2.72 However, even embedding an exotic disease, large animal, category 4 containment centre within such a "flagship" development invokes a host of managerial and biosecurity difficulties. We have no support for the concept of merely moving Pirbright in order to be closer to a major biological centre. Again, given the enormous cost, there still remains the managerial and leadership issues of ensuring greater connectivity for the research conducted in the facility. We identify management, integration and coordination issues for Pirbright that remain unchanged by moving the activity. There would have to be clear benefits to moving the category 4 containment facilities that could not be achieved by investment in the existing site. There are both social and political considerations here, in addition to the scientific.

#### Pirbright's interactions

2.73 We have described elsewhere that Pirbright operates as a hub in a complex set of national and international interactions in exotic disease research and policy. One particular interaction is with the main site of the Veterinary Laboratories Agency (VLA) which is located close to Pirbright at Addlestone, Weybridge. It currently performs a similar function to Pirbright with regard to some exotic diseases. Owing to its differing background, funding and range of activities it

has developed a different culture. It is essential that these two organisations work closely together to achieve specific benefits. These areas of interaction include: scientific, cultural and procedural (in areas such as bio-security, quality control standards and systems and regulatory compliance). A better interaction here could assist the veterinary expertise in research. Moreover, the establishment of a coherent relationship now is seen as essential to their ability to work together effectively under crisis conditions in the future.

# High level co-ordination of policy and practice in exotic diseases

- 2.74 We now return to our view that there needs to be more co-ordination of actions policies and practices within a long-term vision of animal disease research and surveillance in the UK.
- 2.75 We have considered preliminary proposals from DEFRA that this coordination could best be achieved by a Virtual Centre for animal disease research. This would operate as an umbrella organisation Exotic Diseases of Animals Laboratories (EDAL) involving Pirbright, Weybridge (VLA) and Animal Health Trust. It is recognised that these laboratories have their own particular priorities, functions and target diseases but there is a strong case for them to work more effectively together. It has been suggested to us that one way of achieving this, and to foster synergy, is to form an umbrella organisation under a strong Head with a budget to promote co-ordination of activities. For DEFRA the key function of EDAL would be in contingency planning, such as rapid scale-up of diagnostics with validated protocols and reagents.
- 2.76 The Virtual Centre would have a 'Board' possibly composed of the CVO, BBSRC CE and Heads of the component laboratories. The chair would either rotate or it could be a new post. The board would work to foster coordination, collaboration and synergy in animal disease activities across the labs. It would also take a strategic high-level view within the UK, and internationally, to advise on funding needs for long-term basic and applied research. If such a structure were to be developed more local, Agency/Laboratory specific issues would remain to be tackled. The options for an effective management structure of the Virtual Centre, the possible roles of the individual sites and funding source/level are unclear at the present time but all would be key to its success.
- 2.77 The committee expressed major reservations as to the effectiveness of 'Virtual Institutes' and found great difficulty in identifying an example of good practice of such a structure. We emphasise our view that that there are completely different philosophies in the component Institutes and our opinion is that Pirbright needs to maintain its present research-led emphasis.
- 2.78 EDAL is but one of a number of possible innovations that may provide a managerial opportunity at the highest level for improvement in Pirbright's

overall contribution to disease control and communication of policy advice in the UK. We would suggest that models for the status and *modus operandi* of any putative higher-level organisation be examined. There are existing models, particularly in the health sector, that may provide insight. For instance, the National Biological Standards Board that oversees the National Institute for Biological Standards and Control, and was established by the Biological Standards Act of 1975, could be examined.

2.79 Whatever the chosen mechanism we believe that an improvement in Pirbright's stability, research effectiveness and communication of policy advice is necessary. Again in this debate it is useful to reconsider historical intentions which appear not to have been realised (annex 6).

# Governance

- 2.80 Finally, some views on governance. The governance of Pirbright is sectored and appears complicated. BBSRC owns the site and buildings and formally employs the staff. BBSRC has legal responsibility for redundancies, but now expects its Institutes to meet these funds except in the event of major Councilled restructuring. Redundancies require BBSRC's Chief Executive approval as the formal accounting officer.
- 2.81 DEFRA has the status of a funder and owns nothing except the Intellectual Property on the research it commissions. There are long standing issues over the assignment of this IP to Institutes but this is now being remedied in line with the Baker Report.
- 2.82 IAH is a registered charity and company limited by guarantee. Members of the Governing Body are Trustees and Directors. The Governing Body provides an excellent source of support and wisdom for the director and staff, it operates a level of judgement over scientific and fiscal issues but certainly, as put to us by one member, "does not view itself as running the Institute". Formally although the BBSRC chief executive is not on the Governing Body she would be regarded under the Companies Act as a 'shadow director' because of the influence that she can exert.
- 2.83 The governance of IAH is complex and the present arrangements appear to be particularly problematic for a laboratory with key statutory roles and functions. Our discussions over specific items of policy and practice at Pirbright suggest to us that the present sectored governance arrangements require attention and could be improved.

# **CHAPTER 3**

# The IAH-Pirbright Laboratory: conclusions and recommendations

# The Role of Pirbright

- 3.1 There is a continuing danger of known and novel exotic diseases of large farm animals entering the UK. Increasing international travel, population (and livestock) movements, removal of international borders to trade, climate change and threats of agricultural bio-terrorism lead us to the view that the UK has an absolute requirement for an Institute that fulfils the roles set out in Chapter 1 of this report.
- 3.2 **We conclude that** Pirbright's role is, and will continue to be, highly relevant.

# **Pirbright's Location**

- 3.3 We could only support the closure of the Pirbright site and the relocation of its research activities elsewhere if that plan were part of a single, major new infectious disease facility built as an innovative response to recent events. The costs involved here are very far beyond the capacity of the present funding agencies involved in Pirbright. (see paras 2.70 and 2.71)
- 3.4 We identify management, integration and coordination issues for Pirbright that remain unchanged by moving the activity. There would have to be clear benefits to moving the category 4 containment facilities that could not be achieved by investment in the existing site. There are both social and political considerations here, in addition to the scientific. (see para 2.72)

Recommendation 1: In the event of no new large scale, national plan for infectious disease research facilities then investment in the Pirbright site appears to be the most cost-effective way of helping to achieve the required improvements in the UK's research and surveillance capability on infectious diseases of animals that we consider both necessary and urgent.

# **Facilities and Infrastructure**

#### **Laboratories and Estate**

- 3.5 **We conclude that** Pirbright's specialised infrastructure needs (with emphasis on the regulatory role, containment facility and the importance of biosecurity) are different from those of other BBSRC Institutes. The new IAH Director should ensure that these costs and responsibilities are clearly identified. BBSRC's Council needs to maintain an awareness of these specific differences, which should be made more manifest within IAH and BBSRC planning. In addition, DEFRA should consider a longer-term window for awarding funding to Pirbright for bio-security. (see paras 2.20, 2.21 and 2.24)
- 3.6 Some of the laboratories and other areas of the Pirbright estate are not close to the standard expected of a modern bio-medical facility and are well below that expected of a facility of such importance. (see paras 2.22 and 2.23)

# **Staff/Student Housing**

3.7 **We conclude that** given the physical location of Pirbright a programme of substantial investment in the housing stock for key staff, students and research fellows is key to Pirbright being able to operate as a front–line research centre in the UK. (see para 2.36)

Recommendation 2: The condition of much of the Pirbright Laboratory, site infrastructure and associated housing is unsatisfactory and there is a clear need for investment over the next five years in new laboratories and facilities. This should be part of a phased medium-term (10-year) rolling plan for the Pirbright Estate to be developed by the new Director with BBSRC and in consultation with DEFRA. We further recommend that IAH, in concert with BBSRC, develop a realistic and achievable plan for renovating its housing stock. We view these as urgent issues.

# **Equipment**

3.8 **We conclude that** aspects of the equipment infrastructure at Pirbright require immediate investment. (see paras 2.26-2.29)

Recommendation 3: We recommend that the new Director should develop a medium to long term plan for platform technologies commensurate with the nature of a modern bio-medical research facility, and that immediate investment is then made in the light of this plan. A series of effective strategic alliances (within and outwith IAH) should be developed in order to provide access to platform technologies that are not to be developed in Pirbright.

# **Basic, Strategic and Applied Research**

- 3.9 In terms of overall quality of science our analyses endorse the BBSRC IAE Visiting Group's assessment of a degree of excellence within Pirbright's research output and the standing of its scientists within their immediate field. (see paras 2.5-2.9)
- 3.10 We have concerns as to whether the Pirbright Laboratory is sufficiently strategically ambitious in its choice of scientific targets and areas. We recognise that aspects of this concern involve the interplay between individual scientist's interests and the funding practices, metrics of success and objectives set by the funding agencies. (see paras 2.10, 2.11 and 2.67)

Recommendation 4: Our judgement is that in certain areas of science the Pirbright portfolio has become unbalanced and we recommend that this should be remedied by taking opportunities to refocus and by the addition of key areas of research which may require some additional resource. Given the complexity and importance of its remit we consider that there is a need for more scientific leadership at the Pirbright site.

# The Management of Pirbright

#### **Critical mass**

- 3.11 Given that Pirbright currently has only nine principal investigators (as defined by the recent Institute Assessment Exercise) we believe that it is currently operating below critical mass for an independent bioscience research laboratory. (see paras 2.64-2.66)
- 3.12 **We conclude that** because of the low critical mass Pirbright needs to be part of a larger research institute. (see para 2.67)

#### Pirbright within IAH

- 3.13 There is a need for a forward plan for academic developments and collaborations necessary to enhance (as well as to maintain) the scientific coherence and capability of Pirbright. Aspects of this may well involve strategic alliances in the rest of Europe.
- 3.14 Improvements in critical mass will need to be balanced with decisions on how to resource the concomitant running costs.
- 3.15 We recognise a need for scientific leadership and clearer vision to define Pirbright as a major scientific centre within the UK. This scientific identity for Pirbright need not conflict with internal managerial effectiveness and organisation within IAH. Nevertheless, we do recognise that providing effective scientific identity with integrated site management will present a challenge to the new Director. (see paras 2.68 and 2.69)

Recommendation 5: We recommend that Pirbright should remain part of IAH but maintain and enhance its scientific identity. The Director and senior staff need to be able to devote more time to 'leadership' rather than day-to-day management. To aid this, key managerial positions within IAH should be filled as a matter of urgency. This echoes the views of the Visiting Group and Governing Body.

# Scientific Staff

### **Retention and Succession Planning**

- 3.16 There is an urgent need to identify replacements for key staff due to retire in the next 3-year period. This offers opportunities for an integrated plan for the scientific expertise and critical mass required at Pirbright. (see paras 2.32-2.34)
- 3.17 Independent Research Fellows offer an excellent opportunity to develop long-term succession in research related to exotic diseases. (see para 2.35)

Recommendation 6: We recommend that the new Director of IAH develops an integrated plan with some urgency for scientific expertise and critical mass required at Pirbright. As part of this, the Director and individual PIs should develop a strategy for attracting and supporting Research Fellows.

#### **Veterinarians in Research**

- 3.18 We add our voice to the many others that have identified the ongoing weakness of the UK system to attract vets into research as an important issue. We have specific worries over the lack of vets trained/researching in exotic diseases of animals and this is likely to be critical to aspects of expertise succession planning at Pirbright in the near future. (see paras 2.37 and 2.38)
- 3.19 Our view is that training, both nationally and internationally and at a variety of levels from the individual to the formal course, should be maintained and enhanced as part of Pirbright's remit. (see paras 2.39 and 2.40)

Recommendation 7: We recommend that Pirbright reinvigorates its interaction with the Vet Schools over the specific issue of research training in exotic infectious disease. Innovation from all parties is required. In addition to further attempts being made to open effective dialogues with the Vet Schools, links to other infectious disease centres in Universities should also be explicitly strengthened.

## **Funding and Funders**

### **BBSRC and DEFRA**

- 3.20 It is our strong belief that an Institute such as Pirbright needs more stable core funding to conduct effective longer-term multidisciplinary research. (see paras 2.46-2.50)
- 3.21 **We conclude that** an integrated, long-term portfolio of research agreed by the major funding agencies is a key to success in future exotic animal disease research in the UK and must be developed.
- 3.22 We suggest that there are opportunities for DEFRA to develop a 'Portfolio' of research within which themes may be managed over a 4 year window. Naturally, this necessitates effective policy review mechanisms both within Pirbright and DEFRA.

Recommendation 8: We recommend specifically that a longer-term pattern of funding for key areas of Pirbright's work be developed by DEFRA to complement BBSRC's quadrennial post-IAE awards.

#### Assessment

3.23 With greater integration and longer term funding patterns, Pirbright and its scientists should receive an integrated assessment of their work as an encouragement to interdisciplinary and connectivity of the science (basic/strategic/applied) within a laboratory. (see para 2.55)

Recommendation 9: We recommend that DEFRA join the BBSRC in a quadrennial assessment of the work of Pirbright which assesses basic/strategic/applied science in an integrated manner.

## **International Status and Activities**

### EU and International work as a Reference Laboratory

- 3.24 **We conclude that** there are great strengths in Pirbright's staff and professionalism in terms of its role as a National or International Reference Laboratory for various diseases. This role should continue, but there is a need for greater clarity and a unified view of fiscal responsibility across government departments to assist Pirbright's European and International activities where they are of benefit to the UK. (see paras 2.14-2.16)
- 3.25 However, we identify an inadequate Inter-Government department/agency forum for decision making, management and funding for Pirbright's regulatory and overseas role. This regulatory and overseas role should be part of an agreed realistically funded portfolio between government departments. (see para 2.17)

3.26 In concert with its regulatory roles it is important that Pirbright should play a key role in programmes within EU Framework 6.

Recommendation 10: We recommend that BBSRC, DEFRA and other interested parties, e.g. DfID, should specifically examine Pirbright's International and EU commitments as part of their policy and joint funding portfolio. The IAH Director should also set a specific strategy and targets for Framework 6 and other EU R&D funding in concert with BBSRC and DEFRA.

#### International Vaccine Bank for FMD

3.27 We question whether the present arrange is an appropriate, cost-effective means of maintaining this facility or whether other commercial/semi-commercial arrangements should be made? (see paras 2.18 and 2.19)

Recommendation 11: We recommend that a real-cost/real-value (in both financial and strategic terms) assessment be conducted by the incoming IAH Director with DEFRA.

# High-Level Co-ordination of Policy and Practice in Exotic Diseases

## **Scientific Policy Advice**

3.28 Pirbright's relative independence of management by government departments should be maintained as a central buttress of its important policy advice role. But there is a need to improve the routes whereby Pirbright scientists are able to provide Government, government departments and non-government organisations with timely and appropriate scientific advice. (see paras 2.57-2.60)

Recommendation 12: We recommend that Pirbright/IAH reviews, and where necessary improves, its capability to influence and inform policy.

- 3.29 **We conclude that** there needs to be more effective co-ordination of actions, policies and practices within a national long-term vision of animal disease research and surveillance in the UK. (see paras 2.74-2.79)
- 3.30 Whist affirming the need for better high-level coordination we recognise the different philosophies in the Institutes and Agencies and our opinion is that Pirbright needs to maintain its present research-led emphasis.
- 3.31 Models for better coordination (such as Exotic Diseases of Animals Laboratories, (EDAL) have been rehearsed with us and may provide an opportunity for improvement in Pirbright's overall contribution to disease control and communication of policy advice. There are, however, caveats to the likely effectiveness of a "virtual institute". (see paras 2.75 and 2.78)

Recommendation 13: We recommend that models for the status and *modus operandi* of a higher-level UK organisation for the control of exotic diseases of animals need to be investigated and assessed.

### Governance

3.32 Our discussions over specific items of policy and practice at Pirbright suggest to us that the present sectored governance and responsibility arrangements (Governing Body, BBSRC CE and staff, BBSRC Council) appear to be particularly problematic for an organisation with a statutory function. There is a danger that key responsibilities fall between two stools and initiatives/funding become too disconnected. (see paras 2.80-2.83)

Recommendation 14: We recommend that governance responsibilities of IAH (Pirbright) be examined by the new Director, IAH Governing Body, BBSRC and DEFRA, and where necessary improved.

## **Pirbright Review Committee:**

## **Terms of Reference:**

- 1 to investigate the role of Pirbright
- 2 to define the infrastructure and resources required for Pirbright.
- 3 to examine the basis of financial stability and support for the Institute
- 4 to determine the role, relationship and long term commitment of sponsors other than BBSRC
- to determine the managerial structure and relationship of the Pirbright site to IAH as a whole.

## Membership:

Chairman:

Professor Keith Gull Professor of Molecular Biology

School of Biological Sciences, University of Manchester

Dr Richard Cawthorne Deputy Chief Veterinary Officer,

Department for Environment, Food and Rural Affairs

(DEFRA)

Dr Nick Coulson Head of Veterinary, Fisheries and Aquatic Sciences

Division. Science Directorate.

**DEFRA** 

Professor Tony Minson Division of Virology, Department of Pathology,

University of Cambridge

Professor Tony Nash Laboratory of Clinical and Molecular Virology,

University of Edinburgh

Professor John Preston Chairman, Provensis Ltd and Gendel Ltd.

**Secretary:** Head of Science Strategy

Dr Paul Burrows Biotechnology and Biological Sciences Research Council

Polaris House, Swindon

## Consultation

The following consultation letter was sent to 56 individuals mostly drawn from leading animal health laboratories or responsible Government Departments overseas. We had 34 replies (~61%), which is high response rate for such an exercise:

Dear

#### Re: Review of the role and structure of Pirbright

I would like to seek your views on the role and structure of the Pirbright laboratory in the UK.

As you may know, Pirbright is part of the Institute of Animal Health (IAH), which is funded largely by public money. It is a Reference Laboratory or World Reference Laboratory for eight OIA List A diseases, and has an international reputation for its work on Foot and Mouth Disease, Bluetongue and African Swine Fever.

I am currently Chairing a Committee of UK experts from Industry, Academia and the UK Government. We have been asked to review the role of Pirbright and recommend how it should be structured and funded in the future. Our Terms of Reference are attached.

To help the Committee understand the quality of the work that Pirbright does and the function and impact of the laboratory, both nationally and internationally, I would like to consult you and ask for any views and opinions that you can share with us.

You can see from our Terms of Reference the issues likely to be of interest to the Committee. The BBSRC has recently conducted a review of Pirbright's science and hence I'm concerned not to go over the same ground. My major interest is to have your views on Pirbright's impact – nationally and internationally – on the current and future understanding and management of exotic diseases of animals.

Please do not feel constrained in your reply since my Committee would be happy to receive views on any matter regarding Pirbright that you consider to be relevant. I intend to conclude the review by June this year so it would be helpful to have a reply before the 5<sup>th</sup> April. I will be happy to send to you the conclusions of our report once it is available.

If you would rather speak to me directly or email then my contact details are on the heading to this letter and I would be delighted to hear from you.

Can I thank you in advance for your time and consideration in this important matter.

Yours sincerely,

Professor Keith Gull

Enc.

## The Pirbright Review Committee is grateful to the following for their responses to the consultation.

Professor M. J. Clarkson, Faculty of Veterinary Science, University of Liverpool, P.O. Box 147, Liverpool. L69 3BX

Dr. E. Correa Melo, Director, Pan American Foot-and-Mouth Disease Centre, Caixo Postal 589 - ZC/00, Rio de Janeiro, BRAZIL

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Dr. T. R. Doel, Merial, Ash Road, Pirbright, Woking, Surrey. GU24 0NQ

Dr. M. Francis, Schering Plough Animal Health, Breakspear Road South, Harefield, Uxbridge, Middlesex. UB9 6LS

Professor E. P. J. Gibbs, Department of Pathobiology, Box 110880, College of Veterinary Medicine, University of Florida, Gainesville, Florida, 32611-2073, USA

Dr. Christian R. Griot, Director, Institut für Virus Krankheiten und Immunprophylake, CH-3147 Mittelhaüsern, SWITZERLAND

Dr. B. Haas, Federal Research Centre for Virus Diseases of Animals, Paul Ehrlich Strasse 28, D-72078 Tubingen, GERMANY

Dr. P. Have, State Veterinary Institute for Virus Research, Lindholm, DK-4771 Kalvhave, DENMARK Dr. M. Jeggo, International Atomic Energy Agency (FAO), Wagramerstrasse 5, PO Box 100, A-1400 Vienna, AUSTRIA

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Swedish Board of Agriculture,
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SWEDEN

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Potters Bar,
Hertfordshire EN6 3QG

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Professor M. A. Stanley, Department of Pathology, University of Cambridge, Tennis Court Road, Cambridge CB2 1QP

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Dr. P. W. Wells, Novartis Animal Health, 4 Warner Drive, Springwood Industrial Estate, Rayne Road, Braintree, ESSEX CM7 2YW

Professor M. E. J. Woolhouse, Centre for Tropical Veterinary Medicine, University of Edinburgh, Easter Bush, Roslin, Midlothian EH25 9RG

Dr. Hagai Yadin, Head of FMD Laboratory, "Kimron" Veterinary Institute, C/o Ministry of Agriculture,PO Box 12, Beit-Dagan 50250, ISRAEL

## **ANNEX 3**

## **Institute for Animal Health Budget 2001/02**

IAH
Budget 2001/2002 INCOME

	£'000	£'000	£'000
	Total	Pirbright	Other sites
BBSRC Income			
Competitive Strategic Grant	6,688	2,087	4,601
BBSRC Competitive Grants - Confirmed	2,349	237	2,112
- Unconfirmed	228		228
Contract / Grant Income(exclude specific capital funding)			
All DEFRA contracts - Confirmed	7,221	3,014	4,207
- Unconfirmed	2,122	393	1,729
European Union (EU) - Confirmed	1,008	181	827
- Unconfirmed	175	140	35
Industry / Levy Boards / Industrial LINK - Confirmed	1,315	721	594
- Unconfirmed	223	123	100
Govt Depts. / Public Sector / LINK - Confirmed	1,320	70	1,250
- Unconfirmed	542	39	503
Trusts, Foundations, Charities - Confirmed	107	107	0
- Unconfirmed			
Overseas – Confirmed			
- Unconfirmed			
Studentships – Confirmed	36		36
- Unconfirmed	33		33
Other – Confirmed (Univ)			
- Unconfirmed			
Miscellaneous Income			
Royalty / Licence Income	400		400
Sale of Produce	1,050		1,050
Rent and Hostel Receipts	1,013	500	513
VAT recoverable	569	200	369
Interest receivable	50		50
Others (specify items over £ 50 k below)			
Service level agreements with tenants	898	100	798
Restaurant sales	139	39	100
Childcare	119		119
TOTAL INCOME	27,605	7,951	19,654

Annex 4

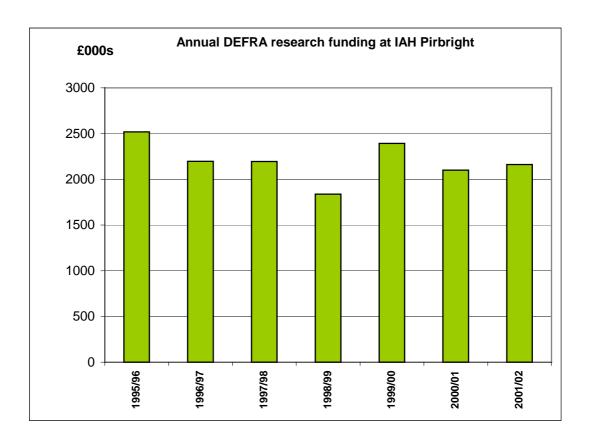
## **DEFRA Projects and Funding at Pirbright**

Description	Number of Projects	2000/2001	2001/2002	2002/2003	2003/2004	2004/2005
Diagnosis of exotic virus infection	2	73,100	216,122	251831	24,300	0
African swine fever	2	182,800	249,486	255,722	60,600	0
Statutory diagnostic services for exotic virus diseases	These projects are renewed on an annual basis. 2002/2003 projects currently being negotiated.	524,400	538,100	570,615	0	0
Bluetongue and related viruses	3	302,953	352,961	336,124	189,808	148,408
Molecular studies on FMDV	1	281,158	288,015	70,289	0	0
Vaccine development for foot-and -mouth disease viruses	2	129,663	132,904	31625	252,919	261,030
Disease diagnosis & control	4	242,150	384,273	393,860	132,750	0
TOTALS	17	1,736,224	2,161,861	1,910,066	660,377	409,438

**Grand Total:** £6,877,966

Average Cost per Project = £404,586

## Annex 5



# The 1972 White Paper: Framework for Government Research and Development: A retrospective glance.

Following on from the 1971 Green Paper which included reports from Lord Rothschild, this white paper defined the customer/contractor principle for organisation of government applied research and development. The preceding paragraphs rehearse arguments for better integration between a Research Council and Government Departments in funding a laboratory that performs a spectrum of basic science through to applied research and development. Given these arguments in 2002 there is much in the 1972 white paper to reflect upon. We note that in the specific respect of a laboratory such as Pirbright the essence and content of the following passages may be invigorating and worth revisiting:

### Paragraph 7.

'An essential feature of this approach is provision for continuing discussion and partnership between customers and contractors and with other interested sections of the community.'

### Paragraph 9.

'The government accepts that contractors will in many cases be better able to contribute effectively to these exchanges if they have some freedom to undertake work which, while being financed by the customers, is not immediately related to a specific programme of work'.

### Paragraph 26

(MAFF and DAFS) ... 'are now discussing with the ARC the establishment of a joint consultative machinery to assist them with the consideration of research and development projects, programmes and priorities. It will include....'

### Paragraph 52

'Expenditure on new capital facilities will be met by customer departments to the extent that the facilities are related to their requirements'.

### Paragraph 54

'The government believes that the partnership and cooperation between departments and Research Councils is an essential feature of this approach and that the new arrangements must be designed to ensure that these aims are met'.

### Paragraph 61

### THE FUTURE

'The essence of this approach is the need for better discussions and partnerships between all involved in these complex and difficult processes whether in government or outside it.'

## Annex 7

Research groups at the Institute for Animal Health. Pirbright groups and staff in bold

Theme	Immu	nological Mecha	anisms	Genetics		Structure	and Function o	f Pathogens			TSEs		Epidemiology
Programme	Bovine Immunology (128) Vacant	Avian Immunology (129) Jim Kaufman	Porcine Immune Cell Immunology (130) Tom Wileman	Mapping Disease Resistance Genes (126) Nat Bumstead	Biology of Protozoan Pathogens (107) Chris Bostock	Bacterial Pathogenesis (127) Phil Jones	Structural Biology of Viruses (132) Andrew King	Molecular Biology of Viruses (133) Tom Barrett	Host-Virus Interactions (137) Graham Belsham	Structure and function of Prp (134) Vacant	TSEs in sheep (135) Moira Bruce/ N Hunter	Modelling Pathogenesis of TSEs (136) Moira Bruce/Jean Manson	Epidemiology and Diagnosis of Exotic Infections (131) Alex Donaldson
Groups	Bovine Immunology (Chris Howard)	Avian MHC (Jim Kaufman)	Porcine Immune Cell Immunology (Tom Wileman)	Avian Genetics (Nat Bumstead)	Protozoan Immunology (Adrian Smith)	Bacterial Virulence (Ed Galyov)	Orbivirus (Peter Mertens)	Coronavirus (Dave Cavanagh)	African Swine Fever (Linda Dixon)	PrP Structure & Function (Vacant)	TSE Sheep Scrapie Genetics (Nora Hunter)	TSE pathogenesis (Moira Bruce)	Arbovirology (Philip Mellor)
	Respiratory Tract (Geraldine Taylor)	Avian Lymphocyte Different't'n (Fred Davison)		Genetics of Disease Resistance (Yvonne Boyd)	Eimeria Development (Fiona Tomley)	Milk Quality (Eric Hillerton)	Picornavirus Structure (Andrew King)	Avian Poxvirus (Mike Skinner)	BVDV Molecular Biology (John McCauley)		Mathema tical Biology (Matthew Baylis)	TSE Mouse Genetics (Jean Manson)	Exotic Diseases (David Paton)
	MHC (Shirley Ellis)	Avian Oncogenic Viruses (Venu)		,	Eimeria Genome (Martin Shirley)	Avian Salmonella (Paul Barrow)		Morbilliviru s (Tom Barrett)	Picornavirus Protein Synthesis (Graham Belsham)			Neuropatholo gy of TSEs (Jan Fraser)	Experimental Epidemiology (Soren Alexandersen
	Pestiviruses (Bryan Charleston)	Avian Molecular Immunology (John Young)				Mammalian Salmonella (Tim Wallis)							
		Avian Cytokines (Pete Kaiser)				Streptococcal Pathogenciity (James Leigh)							

Theme			
	User Interactions		
Programme	CARD	Statutory	
	(Mervyn	Diagnostic	
	Burrows)	Services	
	·	(Alex	
		Donaldson)	
Groups		World	
-		Reference	
		Lab (David	
		Paton)	
		Regional	
		Reference	
		Labs (John	
		Anderson)	