HOUSE OF COMMONS

# Environmental Audit Committee

## Sub-Committee on Polar Research

## Oral evidence: The UK and the Antarctic Environment, HC 381

Monday 18 March 2024

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Watch the meeting

Members present: James Gray (Chair); Philip Dunne; Barry Gardiner; Cherilyn Mackrory; Jerome Mayhew; Anna McMorrin; Dr Matthew Offord.

Questions 198 - 312

### Witnesses

I: Dr Joanne Johnson, Geochemist, British Antarctic Survey; Dr Inès Otosaka, Co-Director of Science at the Centre for Polar Observation and Modelling (CPOM), and Lecturer at the Department of Geography and Environmental Sciences, Northumbria University; Professor Michael Bentley, Professor, Department of Geography, Durham University; and Professor Ian Willis, Professor of Glaciology, Scott Polar Research Institute, Department of Geography, University of Cambridge.

II: Professor Dame Jane Francis DCMG, Director, British Antarctic Survey; Dr Iain Williams, Director of Strategic Partnerships, Natural Environment Research Council (NERC); and Nigel Bird, Director of Major Programmes and Resources, Natural Environment Research Council (NERC).

Written evidence from witnesses:

Professor Mike Bentley (Professor at Durham University) et al.

Centre for Polar Observation and Modelling (CPOM)

British Antarctic Survey

# Examination of witnesses

Witnesses: Dr Joanne Johnson, Dr Inès Otosaka, Professor Michael Bentley, and Professor Ian Willis.

Q198 **Chair:** I welcome you all to this meeting of the Environmental Audit Committee Antarctic Sub-Committee, which as you know is conducting an inquiry into the UK and Antarctica covering a spectrum of issues to do with our relationship with Antarctica. The Committee had a very enjoyable and successful visit to Antarctica on the RSS Sir David Attenborough earlier this year, so we come with some degree of experience but none the less we very much welcome your expertise.

Can I ask you, please, for the sake of the record, to introduce yourselves?

***Dr Johnson:*** Hello. I am Dr Joanne Johnson. I am from the British Antarctic Survey where I have been working for the last 21 years. I am also the lead of one of the International Thwaites Glacier Collaboration projects.

***Professor Willis:*** Good afternoon. I am Professor Ian Willis, Professor of Glaciology based at the Scott Polar Research Institute at the University of Cambridge, where I have been for over 30 years. I have some experience of doing fieldwork in Antarctica as well as the Arctic and many other places.

***Dr Otosaka:*** Good afternoon. I am Dr Inès Otosaka. I am a lecturer at Northumbria University and I am also the Director for Operations of the UK Centre for Polar Observation and Modelling. I also co-lead an international project, IMBIE, which aims at reconciling satellite observations of ice sheet mass loss in Antarctica and Greenland.

***Professor Bentley:*** Good afternoon. Mike Bentley. I am Professor of Polar Geoscience at Durham University. I have been working in Antarctica for nearly 30 years, including nearly two years in aggregate on the continent. I chair the UK National Committee on Antarctic Research.

Q199 **Chair:** Perhaps I could start with some very basic questions—I hope you do not think they are too basic.

Thinking about the purpose in scientific research in Antarctica, what British research has achieved over the 30 or 40 years that we have been doing it and specific global impacts what have we achieved by the science? What is the purpose of scientific research in Antarctica?

You do not all need to answer all questions, but you can if you wish.

***Professor Bentley:*** UK scientists working in Antarctica are looking to do high-quality science with public value. Obvious examples from the last 30 to 40 years include the discovery of the ozone hole, which had huge international ramifications within years and led to the Montreal Protocol and an independent report suggesting saving the UK over £1 billion a year about 30 years later.

British scientists have led work discovering the thinning of the ice sheets, particularly in the Amundsen Sea area. The rate of climate change in British Antarctic Territory, the area we operate in, is particularly fast and that has global importance. We do a lot of work on ecosystems, things like observing Emperor penguin colonies, understanding endangered species and so on. All those discoveries have immediate application globally, quite often in Treaty-level types of organisations.

Q200 **Chair:** Apart from those things, what about some other things?

***Dr Johnson:*** The UK and BAS have consistently produced very high-level information that has been used by the Intergovernmental Panel on Climate Change, which provides member Governments and observer organisations with the authoritative consensus on how vulnerable the earth's climate system is. An example from the IPCC's Sixth Assessment Report: the UK contributed 30% of the citations in the chapter on Cryosphere and Sea Level Change. The US contributed about 50% but 30% is quite high.

***Dr Otosaka:*** The UK is world-leading in Antarctic science. Taking the number of publications by UK-based scientists as a metric of success, you will see that they publish around 350 papers on Antarctica every year and that represents about 15% of all scientific outputs in Antarctic science.

**Chair:** One-five?

***Dr Otosaka:*** Yes, 15%. That is world-leading. The UK has a very strong presence in Antarctica, aptly dealing with very complex scientific challenges.

**Chair:** Professor Willis?

***Professor Willis:*** I don't have much to add but I reiterate that UK scientists punch above their weight. You have heard some statistics on publications. The UK publishes a high proportion of the research in Antarctic, second only to the USA if you look at the last 20-30 years. That has changed recently: China now does more research in Antarctica and now produces the second highest number of publications in journals. The UK is a close third. The balance is shifting somewhat but the UK still punches above its weight.

Q201 **Chair:** You are making it plain that we are doing more than our small size would justify, that we are leaders in Antarctic science, broadly speaking. There is no question in your minds about that?

All right. What would have happened had we not done so? Would others have stepped in? Also, do we have to do in Antarctica? Could this stuff not be done remotely?

***Dr Otosaka:*** If I could start, Antarctica is key for the UK because when Antarctica melts it contributes to rising sea levels around UK's coastlines because when Antarctic ice melts, it affects the other side of the planet. Sea level changes are very important to the UK and the science we are doing in Antarctica is linked to other elements in the climate system that

affect the UK. There is some very important science to be done in Antarctica.

Q202 **Chair:** So your point is that we punch above our weight and you believe that is of great benefit to the UK. All right.

Secondly, can I ask you how it is done? We have a plethora of universities, other institutions and, of course, BAS in the lead. How is scientific research on the continent divvied up among those who are interested and how is it controlled? Who does the research report back to? Who co-ordinates the outcome of British scientific research in Antarctica?

***Dr Johnson:*** I will talk about the funding. Because of the way the UK does quite a bit of research, we need to apply for funding to NERC and other agencies, such as EU funding and DEFRA's Darwin Plus scheme. Funding through NERC and many of the funding agencies is an open competitive process and most proposals that go in for Antarctic research are highly collaborative, including with many other nations. Also, within the UK, there is not just BAS but lots of university partners and other people here today can fill in on that.

***Dr Otosaka:*** BAS does around half of the British science in Antarctica. The other half is done by universities. We have a wide range of expertise across the UK. It is not just about going to Antarctica and field campaigns; it is also about using satellite observations to generate long climate records so we can identify changes and measure trends in Antarctic sea ice and land ice. It is also about developing our numerical models so that we can provide robust projections of, for instance, future rises in sea levels.

Q203 **Chair:** We know what is already being done; we know it is all first class. My question was about how the research is co-ordinated.

When this Committee held its inquiry into the Arctic, one of the conclusions we came to was that there is very little co-ordination among the 78 universities that do some kind of Arctic science. Is it different in Antarctica because of the bigger presence of BAS? How can we be certain that a scientist from Cambridge is not doing the same work as a scientist from Newcastle, let's say, or from overseas? Is there any mechanism by which science in Antarctica is co-ordinated and overlap is avoided?

***Professor Bentley:*** What is a bit different about Antarctica is that we have Scientific Committee on Antarctic Research, which is an international organisation that was set up to advise the Antarctic Treaty on what science should be in Antarctica and co-ordinate what comes back. You will not be surprised to hear that the UK is a big player in the Scientific Committee on Antarctic Research. We lead many of its programmes. That committee does not fund original research, but has a co-ordinating role bringing together international groups, exactly to avoid that problem of different nations attacking the same problem and being repetitious. Co-ordination exists at that level. While not all work comes

under the auspices of SCAR, most is, especially the big programmes. There is good understanding between nations about what each is doing.

Within the UK, the funding environment is highly competitive and what others are doing is well known. It would be very surprising for a research council to fund the same thing twice because there is good knowledge out there about what is being done.

In terms of how we oversee that, BAS will have its own science strategy and the UK National Committee for Antarctic Research and another organisation, the UK Arctic and Antarctic Partnership, which tries to bring the two poles together, published a report a few years ago showing what we think the priorities are, tallied up to international priorities, and what the UK is best positioned to deal with next with the new investment and infrastructure. We have co-ordination at international and national level.

Q204 **Chair:** Can we also be certain that our scientific research is targeted correctly at international or national goals through that mechanism, that it is not haphazard but controlled and focused?

***Professor Bentley:*** Some years ago the Scientific Committee on Antarctic Research conducted a horizon scan looking at what, by international consensus, were the most pressing scientific questions in Antarctic. That scan has driven research for nearly a decade. There have been some refreshes, but a lot of the questions remain the same and we are driven by those same questions.

***Professor Willis:*** I can reiterate on the peer review process, which is the main way science operates internationally. UK scientists are often asked to review international research, which may be collaborative and involve other UK scientists, and vice versa; our research proposals, which we may submit to NERC and other agencies, will be reviewed not only by other UK scientists but by scientists from the US, Europe, Canada and so on. At least three or four people will review a proposal so there are checks and balances there.

***Dr Otosaka:*** Also on the co-ordination point, UK has funding streams for national capability programmes, which are very important for our capability in developing numerical models and further develop some satellite data sets, underpinning all our other Antarctic science activities.

BAS also plays a very important role in co-ordinating field activities. Access to Antarctica is not restricted to BAS scientists but is also open to scientists from UK universities through NERC-funded projects. That is also co-ordinated.

Q205 **Chair:** Can I be a bit provocative, although I am not usually?

People giving evidence to Select Committees always seek to argue that everything is going brilliantly well, as you have all just convincingly done. You have said that British science is superb, brilliantly done, superbly well co-ordinated, making a useful contribution to the world and well targeted.

What would you like to see changed? What is wrong with it? What

elements are not great—what you would like to change in the way we conduct science in Antarctica? Be adventurous. Be bold.

***Dr Johnson:*** I would like to say something more about the funding although I know I have already mentioned it.

When applying for grants through NERC in particular, the most amount of funding we can get for one project at the moment—I am pretty sure I am right in saying—is about £4 million to £5 million. That does not go far right now and I do not think that figure has changed for quite some time. It is difficult to put good projects with Antarctic logistics or international collaboration together. We need big, ambitious funding and longer timescales.

Q206 **Chair:** I am rudely interrupting but we are going to come back to funding in a moment.

Leaving aside funding—people always want more funding—I want to know what is wrong with the structure, the way the science is conducted, what can be changed and what is going to change in the future? Is it going to be all about data and could therefore be conducted from a lab in Cambridge rather than Rothera? What would you like?

But let me put it differently. We will be producing a report and we hope the report will be consensual and that the Antarctic and scientific community will welcome it. We would like to have some useful proposals in that report, things that you would like to see. I am looking to you for some ideas about things that you would like to see changed in the way that science operates in Antarctica. What does the future hold? Leaving aside more money, which I think is correct and we will come back to it in a second, in terms of structure, co-ordinating and the future, what would you like see change in the delivery of science in Antarctica?

***Professor Bentley:*** I can make a couple of direct suggestions. One is that Antarctic science by its nature is intensely collaborative internationally but our funding systems are largely set up for national science. Although our funders have got better over time at making bilateral arrangements, multilateral arrangements are still tricky to pull off. Quite often there is double, triple, quadruple jeopardy in things being reviewed simultaneously in different countries so better mechanisms for doing multilateral science would help.

Another suggestion has to do with change. Science is changing and you have talked about how it might look different. We have more autonomous vehicles and sensors and lot more sophisticated engineering, and matching those things with the people who need them can be quite tricky. Access to them needs to be much more straightforward as they come to market. That would be very helpful for a lot of researchers who do not then have to get to know the right engineers to be able to use them.

**Chair:** Okay. So big science, longer-term projects, longer-term funding, more international collaboration and access to new tech.

***Professor Bentley:*** To be clear, there is already a lot of international collaboration, but make that even easier through our funding mechanisms.

Q207 **Jerome Mayhew:** I will start with Dr Otosaka but the questions I am going to ask are for the panel as a whole and are about logistical support for science in Antarctica. We know that there has been a big scheme of investment and improvement in logistical support, but I am going to start with you, Dr Otosaka, and ask how robust are the mechanisms we have in place to support science in Antarctica?

***Dr Otosaka:*** Support for Antarctic science and going to Antarctica to do science has been in place for many decades already. It has already been quite successful thanks to the role of BAS. I can talk about one example. We are working on a project called DEFIANT, a NERC-funded project looking at drivers of changes to sea ice in Antarctica. It is a very interesting project with a quite important field component. We had encountered some delays due to the late introduction of the RRS Sir David Attenborough and also—

Q208 **Jerome Mayhew:** Delayed by how many years?

***Dr Otosaka:*** We have not been able to use the ship yet. We are hoping to use it next year instead, if we get an extension for that project.

Q209 **Jerome Mayhew:** When were you originally meant to be using it?

***Dr Otosaka:*** In 2022-23. However, we did manage to have an airborne campaign. We were based at Rothera and were there in the middle of the renovation work. It was a very successful campaign. We used the DASH-7 for science, which was the first time that had been done in 25 years. It was a great success despite all the activity at the base, which was not all science-related. We still managed to collect all the data we needed.

Q210 **Jerome Mayhew:** Just drawing you back to the question, you made reference to the RRS SDA and the DASH-7 and you also have five Twin Otters based at Rothera. You have Rothera as a base. There are two more Antarctic bases and two others, Bird Island and King Edward Point, which are sub-Antarctic. Is there an argument for more infrastructure or do you think the planned and delivered programme of infrastructure development has been correct and about right?

I will open that question to the rest of the panel. Where do you place the historic development of infrastructure in Antarctica?

***Dr Johnson:*** We do indeed now have really good modern infrastructure, which in particular places us in a very strong position for lots of international collaboration.

It is probably the case that the modernisation programme has being going for quite a long time and that perhaps a relaunch of what is available, so that everybody knows what is available, could well attract a lot of national and international collaborators and that would be very good.

My experience of working in very remote sites in West Antarctica as part of the international Thwaites Glacier collaboration has been extremely good. We also have had very good support from BAS in connection with the US Antarctic programme. We are in a very good leadership position with this new modern infrastructure.

Q211 **Jerome Mayhew:** In talking to residents at Rothera over New Year and also from some written contributions to our report, there were some suggestions that the construction process has become a bit of an objective in its own right and that science—perhaps necessarily, but perhaps not—has been playing second fiddle, because the infrastructure has become a life of its own. Is there some justification for that. What is your view?

***Dr Johnson:*** Well, yes, if you are going to build a base in Antarctica, you need space at the station for the people who are going to build it so there will inevitably be some disruption. There is quite a bit of frustration among scientists about the recent lack of bed nights at Rothera in particular, but at some point—fairly soon, I hope—an end to the infrastructure modernisation programme. Then we will expect capacity to increase again. We need to make sure that does happen and that the space is available to people.

Q212 **Jerome Mayhew:** Let's get beyond the construction period, which they say will be the end of this year. We have all this shiny new kit. How easy is it for scientists to access this equipment, for example the SDA? When you do have a programme that gives you access, are the scientists sufficiently in control of what happens and the use of what is available? Or do you feel constrained by BAS or NERC or other organisations involved?

***Professor Willis:*** From my recent experience I do sense that certain projects have perhaps been compromised or put on hold but hopefully that is just in the short term and paying for real longer-term benefits. I think the Discovery Building and the SDA will improve things for the UK and for Arctic science generally.

I am sorry—I have forgotten the question now.

**Jerome Mayhew:** Control over the assets.

***Professor Willis:*** I have benefited from what I like to think of as a mini-Thwaites project. It was a small international collaboration involving NSF and NERC funding, US scientists and my own. It was straightforward. There is an extra proposal for the use of the infrastructure, for flights in, for beds at Rothera, for flights further into the field and it worked. There were inevitably some delays, some weather-related, some equipment-related, but I was very much struck by BAS's ability to deliver on our scientific goals.

You ask about what control we had over the assets. We determined what science we wanted to do, it was peer-reviewed and agreed. We were not

questioned by BAS and logistics enabled the science to happen. My experience was good.

***Professor Bentley:*** There is slight difference with the terrestrial science where, I agree with Ian, BAS field operations are very helpful; BAS will enable and get things done if it possibly can.

I think there is a change in thinking about how marine science works. You have seen the SDA. It is huge ship and has the capacity to run several projects simultaneously. We are moving from a situation where one grant ran the ship to one with multiple grants on the ship at the same time, and that requires a change in thinking about the control of assets. NERC and BAS are thinking about that and coming up with new ways of saying, "The SDA will be in this area at this time and we are looking at grants to be on the ship." No one grant will be able to control the ship in the way they used to be able to.

Q213 **Jerome Mayhew:** The SDA is a controversial project. I have heard that from a number of sources. Not everyone is a fan of moving from a two-ship policy to a one-ship policy, with the level of access and the disturbance of having to use a very expensive ship to do logistics resupply. From written evidence we have heard about delays associated with the SDA. What is your take on it? I know the SDA is shiny and wonderful and it is a pleasure to be aboard. But is it part of the problem because we have made it too big and have focused too many resources on one ship rather than two?

***Professor Bentley:*** If you think about the SDA alone, that is a problem because it is too big and can only be in one place at a time and we have gone from two ships to that. The model we are moving towards is the SDA plus one, chartering other vessels to deal with moving around the toilet rolls and baked beans and even for science tasks for which you do not need an icebreaker. However, that costs additional money to charter those extra ships; if you are looking for suggestions, an injection of money would help to free up the SDA to maximise the delivery of science and deal with the backlog of marine science, which we are dealing with because it arrived in the middle of a perfect storm of covid, the delayed introduction and the shift to a single ship.

Q214 **Jerome Mayhew:** Do you think NERC pulled the wool over the Government's eyes saying, "Don't worry. We are going from two ships to a one-ship policy and therefore we should spend a lot of money on one ship", but we get the one ship costing £200 million and then NERC said, "Well, we do need the other ship but we still have the very shiny science ship."?

***Professor Bentley:*** NERC are not alone in having done this. Australia has moved to a single-ship model is also evolving that model where they see that the logistics need more support than they originally realised.

Q215 **Jerome Mayhew:** Let's look at it another way—my final question. I hope everyone can contribute.

We have invested a huge amount of public money, taxpayers' money, in the SDA in particular, but also Rothera. So we would expect a real uptick in the volume and quality of scientific research to come out of it. Can you point to data that demonstrates that?

***Dr Johnson:*** It seems to me that it is very early days to be doing that. The SDA has just made its first science cruises in this last year, supporting two very big projects, BIOPOLE and PICCOLO; they seem to have been very successful, but they have only just gathered the data. You will not see the outcomes, the publications and the follow-on grants yet. That is my answer. You need to wait and see.

**Jerome Mayhew:** What about the rest of you?

***Professor Bentley:*** I agree. I think it is too early to tell. The SDA has just done its first science cruise. The building at Rothera is not finished yet. We do not have data to show yet. I think there is an enormous pipeline of work, certainly marine science—good, peer-reviewed, international quality science—that is just dying to get on to that new ship and use its capabilities.

***Professor Willis:*** Another thing to remember is that, while the SDA is one ship, as we have heard, the model is one ship plus support as necessary. More science, more scientists, more programmes can use the SDA at the same time by dint of its being a larger, modern vessel. Once we start to get through the backlog of projects, I anticipate that the amount and, I hope, the quality, of science will pick up.

***Dr Otosaka:*** We must also see if we can work with other international partners. Germany has a very strong Antarctic programme and also has a research vessel, the Polarstern, and we can sometimes partner with Germany to send scientists and crews on the Polarstern to collect additional data. That is another avenue to look at.

Q216 **Dr Matthew Offord:** I want to elicit your views about the funding available for UK Antarctic researchers. How do researchers typically go about seeking funding? What kinds of problems do they face?

***Dr Johnson:*** I am going to mention again the lead times for projects that require Antarctic logistics. Some really big recent projects—the Thwaites Glacier Collaboration is one; the BEAMISH drilling on the Rutford Ice Stream is another—have taken a decade to spin up before they even started the work, negotiating who is going to be involved and thinking about the logistics, which are on a very big scale. This is challenging work, drilling through the ice sheet in the case of BEAMISH and with Thwaites loads of different work all going on in the same place at the same time and all requiring big logistics. These things take loads of time.

Take current timelines for NERC funding. You may have a five-year project and within the five years, if you were working through, say, the Halley Research Station, you may have to deal with a ship call that happens only every three or four years and you might not even get to do

your field work until year 3 of the project if you cannot plan far enough ahead. As a principal investigator, it can be very difficult to put your project together and you may only have a five-year project timeline. We need much longer for funding itself and for the funding cycles that NERC and other agencies deal with just to make sure that all these things fit together.

I have also already mentioned that the amount of money, certainly in NERC's funding schemes, is just not enough now to do the things we want to do. We need more bigger and ambitious amounts of money, I am afraid to say.

Q217 **Dr Matthew Offord:** You mention long-term funding, which we will come on to, but the issue I was trying to point to was where the initiatives come from. Is it something that you go to NERC for? Or does NERC say, "There is funding available for this specific kind of work"—climate change for example—where alternatively many other UK-based researchers might say, "That's not entirely what we are interested in, we wish to do something else."

***Dr Johnson:*** NERC has what are called highlight topics, which the community are influencing because we can put forward ideas for them and then NERC will look at them and decide which ones they want to fund. Those are across the whole range of environmental sciences, not just Antarctica. That is a key way that we can influence, but most of the time we are reacting to what funding calls are available and coming up with the ideas. I am sure NERC is already very proactive, but it would be great if NERC could play a role in listening to the community and working out what we want, taking those ideas forward and talking to people to make those big funding schemes available. Others will have thoughts on this, I am sure.

***Professor Bentley:*** I could add that for UK Government funding, which we largely receive through NERC, there are three main streams. There is the national capability stream, which is the core funding for BAS to do its stuff providing the assets and infrastructure for scientists. There is what is called discovery science and that is for ideas bubbling up. There are two calls a year for that fund across the whole of environmental science so Antarctica can take its chances there.

Then there are different forms of strategic programmes, and they are nearly always in some way influenced by the community; they do not come out of nowhere. They can either be highlight topics that bubble up or maybe the NERC executive or the UKRI executive will say, "We think there should be a very large programme on this". That can then come out as a strategic programme, which then scientists will apply to. Every single one of these is competitive when it is finally announced.

***Professor Willis:*** I can reiterate and summarise; it is sort of a bottom-up and then top-down approach. Ultimately, scientists—from talking to one another internationally and going to conferences—are identifying the

problems that the world faces and NERC can then influence the calls and we then have the competition.

For the Antarctic there is also something that I know some people have benefited from, the Collaborative Antarctic Science Scheme, which enables almost individuals, certainly a small group, to apply for BAS logistics. This is particularly useful for early career scientists. I know some have benefited from the scheme, testing the waters, getting familiar with working in Antarctica. We do need longer-term bigger international science—and we will probably come onto that—but we must also think about early career scientists and getting them onto the first rung of the ladder.

Q218 **Dr Matthew Offord:** Would you say that is currently a flaw?

***Professor Willis:*** I would like to see more opportunities for early career scientists.

***Dr Johnson:*** Can I add to that? Because we have had delays in fieldwork due to Covid, but also the infrastructure modernisation programme, we lost time when we have not been able to train those early career researchers because they have not been able to go to Antarctica and they have not been able to use the infrastructure. We are at risk of having a next generation who do not know how to do polar research in the way that we have. I feel strongly that we need to target that; whether that is with specific funding where we can bring those early career researchers in or the CAS Scheme, as was mentioned. That is important for the future.

***Dr Otosaka:*** At least half of Antarctic science is done from satellite and numerical models and half from underground, so it is not just about fieldwork. Fieldwork is an important component of Antarctic science of course, but it is also important that we look at other streams of funding. For instance, UK-based scientists can also apply for funding through the European Space Agency for anything to do with satellite data for development of new sensors or new retrievals of parameters of interest around Antarctica.

The UK is now back in Copernicus, which is very good news for the UK research community, and we are also back in Horizon Europe, which is also very good because it provides more opportunities for collaborative work with our European partners, which is also key in Antarctic science.

Q219 **Dr Matthew Offord:** Dr Johnson raised the issue of long-term funding, but of course there are different kinds of long-term funding. One could be a long-term project based on a decade, for example, and researchers fit in within that process. I was not sure if you were saying that the stability of that funding could change over time; greater costs could be incurred, putting in jeopardy the final years of the research project. But there are also the long-term projects that enable research to be taken over time by undertaking snapshots, for example.

One of the issues about invasive species has been that people would like

to see more longer-term research occurring in order to see if there is a developing pattern emerging. Of those two scenarios where would you see greater stability being needed?

***Dr Johnson:*** Am I allowed to say in both?

**Dr Matthew Offord:** Yes, you can. Of course you can.

***Professor Bentley:*** There is no doubt that those long-term measurements underpin a lot of what we do and a lot of the discoveries we have made have come through that long UK presence in some cases. We are unique in that respect, certainly in the peninsula. I do not know how to say this, but sometimes they are not very sexy and the way that we assess science in this country is sometimes by looking for big-bang papers; I think sometimes the way we assess long-term monitoring could be more generous to those unique and important long-term monitoring data sets.

For example, the research evaluation framework, which the centre surveys have their own version of, looks for originality, significance and rigour, and originality is quite a difficult criterion to hit if you are just monitoring a penguin population, but if you ask me about uniqueness and importance then it matters. So there is something about the way we assess them.

As for the long-term funding for the other sorts of research—Jo's earlier point—the problem is partly about how long it takes to ramp up to do things in Antarctica, and then you get this quick flurry of activity and then you are ramping down. We are looking for more continuity once we have ramped up. Of course we would expect there to be reviews in that—is the programme delivering what it said it would?—but there needs to be some way that we can use that ramped-up capability to then deliver more science rather than these very expensive, quite short term projects.

***Professor Willis:*** This is obviously too late: Thwaites Glacier has been recognised as an exceptionally important area that needs more research and a phenomenal amount of funding has gone into that with the international collaboration, but again it will be for five years and then the ramping down will start. Yet it remains exceedingly important. A longer-term framework beyond five years for big projects is—

Q220 **Dr Matthew Offord:** So would you say that that is one of those specific gaps in funding opportunities?

***Professor Willis:*** Continued work?

**Dr Matthew Offord:** Yes.

***Professor Willis:*** Yes, it is one of them. For a glaciologist, it is the big important system. The glacier has the potential to raise sea levels by itself more than many other systems put together and it is the one that is changing the most.

Q221 **Dr Matthew Offord:** You say "one of them", are there any other funding

gaps in the current models?

***Professor Willis:*** As a glaciologist—this has been mentioned already—I think of East Antarctica. If we had been sitting here 10 years ago, certainly 15 years ago, we would have been thinking it was stable and not changing and yet there are parts of East Antarctica that are changing very rapidly, three glaciers in particular. These are in the Australian sector—Totten Glacier is often mentioned and Queen Mary Land and Wilkes Land right over on the east coast. I would envisage targeted research in those areas that almost certainly would involve some international collaboration with Australia. That is me as a glaciologist interested in Antarctica, which—as we have already said—is of global significance.

**Dr Matthew Offord:** I think I will leave it at that point.

Q222 **Chair:** One supplementary; Professor Bentley used the expression "sexy", which struck a note with me because—less smirking in the back row there—one of the things that we have heard and people are thinking about is all the money now is going to climate change and many other areas of Antarctic science have been slightly neglected or downgraded, because the sexy bit is climate change. Is that a fair allegation?

***Professor Bentley:*** It is not climate change per se, it is that the impacts of climate change are being felt in every part of the Antarctic system, whether it is the ecosystems, the take-up of carbon in the oceans, the geochemistry of the ocean, the sea ice, the glaciology, the terrestrial ecosystems. It is the effects of climate change that are the dominant driver and that is why so much money is going into so-called climate change research, but a lot of it is the impacts of climate change. Very little of the research is saying how fast is it changing. We kind of know that now.

Q223 **Chair:** We know that; therefore, it has consequences. So you would not detect skewing away from more traditional areas of scientific research?

***Professor Bentley:*** I think in a limited-funding world we have to maximise that public value that we talked about right at the beginning. Many of the baseline measurements feed into that. I would be very wary of cancelling of the long ones because they did not relate to climate, but I think a lot of them do.

Q224 **Cherilyn Mackrory:** Dr Johnson, could you tell me a bit more about the UK's contribution to international collaboration projects such as Thwaites, if you want to use that as an example?

***Dr Johnson:*** Sure. The International Thwaites Glacier collaboration is, for those who do not know, a partnership between NERC and the National Science Foundation in the USA. It is coming to an end now, it finishes next year, but it has been five years with the spin-up time that we were talking about earlier. The UK has played a leading role in this programme. We went in as equal partners with the USA and I think that is important because it has enabled us to lead from the front rather than joining a big collaboration that was already forming.

That has had the benefit of bringing in other nations that are not the US or the UK—so Germany, Sweden and South Korea as well—and they have brought enormous benefit to the programme with different instruments that we have been able to use, other infrastructure; the Koreans have a big research ship called the Araon. That has been a successful example of how international collaboration can work and how we have been leading that from the beginning.

Within the programme there are eight science projects and each of those projects is led jointly, so we have two leads, one from the UK and one from the US. Again, it is very equal in the way that it has come around. This has undoubtedly been a flagship programme for NERC and there has been a cost associated with that, but it has attracted loads of partnerships; it has placed us in a good position. The outcomes, the science that has come out, have been impactful. It has shown that there is an awful lot more we still need to know, but overall it has been fantastic.

The collaboration with the USA was deemed to be necessary because of the huge logistical requirements needed for this programme in a remote part of West Antarctica, which is 1,000 miles from the UK research station and also in the other direction from the US research station, so incredibly remote. I understand that the UK felt it would not be able to launch that kind of programme on its own and so needed the deep-field logistical capability of the US Antarctic programme, which has enabled the delivery of huge amounts of heavy fuel and equipment to that region using the military capability of the US Air National Guard. We have benefited but we have also put in logistical infrastructure of our own from the UK.

Q225 **Cherilyn Mackrory:** We were talking earlier about how things are funded. Was this a UK NERC idea that we managed to get funding from the US to assist us with, or was it a joint idea we came up with and decided to go for together? How did that work?

***Dr Johnson:*** I was not part of that at the time; my understanding is that it has evolved together, but the UK had a prominent role, leading the way. Some BAS research identified that that region was very critical and the US was then brought in at a relatively early stage, I believe, because we knew that we could not do it on our own.

Q226 **Cherilyn Mackrory:** If there was going to be a Thwaites 2, because you said the research needs to carry on, are those discussions taking place and would that be UK-led again? How would it work if we wanted to resurrect it or create a second project?

***Dr Johnson:*** I think it is quite up in the air. People are talking about it and, yes, we need to do something, but we still need to finish what we are doing as well. Yes, there is a desire, but I am not sure that I know how that works.

Q227 **Cherilyn Mackrory:** I want to open that up to anybody else. For an idea like that or a continuation like that, how do people get their research

funding? Is it that the project is there, we know there is a project that needs to be completed? How would your scientists get the funding?

***Professor Bentley:*** In the case of Thwaites, the scientists have to make the case to the funders first of all. We hosted a meeting in the UK at the Royal Society, a whole lot of American colleagues came over and we debated the science, just as you would at a scientific conference. In that case, unusually, some funders were at the meeting and so there was then discussions about, "These are the science questions we think are outstanding that can only be answered at Thwaites Glacier, and it will require these assets to do that".

The follow-on has become acutely difficult because some of the logistical problems we have talked about are not unique to the UK. You may have heard that, for example, the US has said they can take on no major programmes working out of their main station for a number of years. That rules out carrying on with Thwaites in the ways that we would like to do. It has come at a slightly difficult time because very clearly we have come some way to answering some of the science questions but there is still work to do.

Q228 **Cherilyn Mackrory:** It all sounds very chicken and egg. How could we improve that process? What would your ideal be, if you think, "We have this science we need to do; obviously we do not want to waste taxpayers' money". How could we make this easier for you guys?

***Dr Johnson:*** I think we need a very long forward look. Because there is such a long spin-up time and discussion time, as Mike said, we scientists almost need a programme going 20 years into the future so that we know what we are aiming for.

Q229 **Cherilyn Mackrory:** It feels like you are cherry-picking what comes up at the moment, am I right? It is quite reactive.

***Dr Johnson:*** It can be.

***Professor Bentley:*** It is the scientists who are driving it. The funding agency are not magicking these things up; the scientists are driving it but sometimes the structures require us to go at it in quite short-term jumps. I think we could make some longer-term progress with longer-term funding.

Q230 **Cherilyn Mackrory:** In other aspects of international collaboration, we have mentioned Horizon, and obviously we have solved that problem now. What else should we or could we be doing as the UK in our international collaboration? What works well; what do we need to do better?

***Dr Otosaka:*** In terms of what works well we also receive some funding from the space agencies and we are leading long-term projects on behalf of the European Space Agency. For instance, we are leading on a project to retrieve essential climate variables, parameters that are of interest to monitor the health of the Antarctic ice sheet using satellite observations through the Climate Change Initiative Programme of ESA. That is a very

successful programme and we have been able to repeat and extend projects as well.

We are also providing our observations to a wide range of international partners. The IPCC is using our mass change observations. They are also being used by the World Meteorological Organization and by the US Environmental Protection Agency as well. We have lots of different projects that we can get funded through the European Space Agency, so that means working with lots of our partners across Europe as well. That is definitely another way to get funding for Antarctic science and to collaborate with partners, especially in Europe.

NERC funding is usually for mainly UK-based scientists being funded on Antarctica. There is the Thwaites project that we have just heard about, but it is not very common for NERC to do that kind of big project in collaboration with the US, for instance. It would be nice if we could do more of these kinds of projects and also maybe with different partners as well.

Q231 **Cherilyn Mackrory:** Anything outside of funding that you would wish to add?

***Professor Bentley:*** Co-ordination of ships is always a challenge, but I think there is work being done to address that: for example, International Polar Year is coming up, and there are conversations about having different ships from different nations making simultaneous measurements in key parts around the Antarctic Ocean. It is sort of in hand, but the structures and the mechanisms to fund it are still the problem, to go all simultaneously.

Q232 **Chair:** Can I pick up on one little point that you mentioned, Professor Bentley? I had not heard about the Americans pulling out of major long-term projects. What is the background to that?

***Professor Bentley:*** The Americans are rebuilding McMurdo, which is their major logistics hub, and they have had some challenges with that, some that may be familiar from the Antarctic infrastructure programme. While they have not stopped science, they have said, "We can't support any new, big programmes". So there is still science going on through McMurdo, make no mistake, but they have specifically asked the community not to propose anything big, or if they do, they would to have to have a pretty serious conversation about how it is supported.

Q233 **Chair:** That is seriously bad news, isn't it? They are such much contributors to Antarctic science that if they stick by that it is quite a big hole, isn't it?

***Dr Johnson:*** Can I add to that? They may not be allowing scientists to use the infrastructure but people from the US can still put in joint proposals with the UK; that is something that I have just done, so it is very much in my mind. By doing that, NSF is then contributing potentially millions of pounds towards projects that we are leading, using BAS infrastructure, and that scheme continues. So it is not all doom and

gloom; in fact in some ways it makes it more likely that they would bid into our projects and want to join us because they do not have capability of their own at the moment.

**Chair:** So they can use our stuff, but we cannot use theirs?

***Dr Johnson:*** For the moment, but we want to use ours, because it is good on the whole.

**Chair:** Thank you very much, all four of you. It has been most kind of you to have spent the time this afternoon. I hope that when the report comes out you will find it interesting and correct; I am sure it will be—our learned advisors are extremely good in these matters. But also, I hope that you will find that it makes a useful contribution to the conversation and discussions about science in Antarctica, which is incredibly important. Your evidence to us has been extremely useful so thank you very much indeed. Now, perhaps I could ask our second panel to join us.

## Examination of witnesses

Witnesses: Professor Dame Jane Francis, Dr Iain Williams and Nigel Bird.

Q234 **Chair:** I will start by welcoming three very great friends of the Committee who are back to give evidence to us again, and who very kindly hosted us on board the Sir David Attenborough recently. Before I ask you to introduce yourselves for the record, can I say that it is worth putting on the record that the British Antarctic Survey as a whole has been of immense help to this Committee, both in terms of evidence and in terms of helping us in Cambridge, Rothera and on the SDA. Rarely have I seen a greater contribution made to a Select Committee than BAS has done, so thank you very much for it. It has been extremely helpful. I think you know that we hope that the report we produce will be something that you will find interesting, useful and welcome. That is certainly our intent in having you here. That is the background to asking lots of very aggressive questions. Perhaps for the record I could ask you to introduce yourselves, if I may. Iain, perhaps you could start.

***Dr Williams:*** Good afternoon. Iain Williams, Director of Strategic Partnerships at NERC.

***Professor Dame Jane Francis:*** Jane Francis, Director of the British Antarctic Survey.

***Nigel Bird:*** Good evening. My name is Nigel Bird, I'm the Director of Major Programmes and Resources at the Natural Environment Research Council.

Q235 **Chair:** Can I start, Dame Jane, by focussing on the role of BAS? One of the things that we found quite interesting on our visit was the relationship between BAS as a scientific organisation and BAS as a sort of geopolitical British presence in Antarctica. How do you distinguish between those two things or are they the same?

***Professor Dame Jane Francis:*** We have a memorandum of understanding with DSIT, the MOD and the Foreign, Commonwealth and Development Office. There are two parts to our mission in the MOU; one is to do world-class science and the other is to support the UK presence in Antarctica.

The UK science agenda has nothing to do with the FCDO. The FCDO does not tell us at all what to do; that is purely a UK science community issue and relates to NERC.

The FCDO does not have any money and does not fund us; it helps the Government to fund us to be the presence in Antarctica providing ships and stations that support the UK community in Antarctica, not just BAS but the whole UK community.

Q236 **Chair:** Is there an argument that that would be better done by some outside agency, and that BAS's expertise and fame is to do with science, and that, if your efforts and your money indeed is being directed at ships or bases or building things or running things, you are being diverted away from your real expertise, which is science?

***Professor Dame Jane Francis:*** The science part does not necessarily come from the same funding pot as the logistics. It used to and what used to happen in the past when NERC funded both the logistics and the science, is that if there was ever a big problem with a ship or the logistic support, it used to eat into the science funding pot. What we call the partition of resources at the moment I think is a very good solution to what we do.

Q237 **Chair:** None the less, do you not think there is an argument that says there all sorts of organisations that can do things like running ships and bases, building things and doing all the infrastructure things? Those are practical matters that, for example, commercial companies could perfectly happily do. Why should it be that BAS—which is a scientific organisation—should have expertise in those kinds of logistical matters?

***Professor Dame Jane Francis:*** We have specialist people; the people that run the logistics do not necessarily get involved with the science but one of the benefits is that as engineers and so on, they can help us. Some organisations have engaged commercial operators. The Americans have a commercial operator to run their Antarctic programme. At one point they used Raytheon as suppliers and they have certain other bodies to run their logistic supply.

It is a very difficult relationship. The science sits completely outside that and it does not merge the two. I have experienced that and found it a very unhelpful relationship. In BAS we can tailor our logistics and our logistics expertise to support the science where it is needed, which makes for a much better scientific experience and much better support for science for the whole UK community.

Q238 **Chair:** Can I ask you to do something that is probably very difficult to do because it is such a big and broad organisation? Can you typify for me or

describe to me the important contributions that BAS science has made to Antarctic science, to Britain and to the world? What is the purpose of BAS science?

***Professor Dame Jane Francis:*** A lot of our work is on climate change but there are other things as well. For example, we do space weather research. It is important in the polar regions. The important part of our space weather research—which is very successful—is to understand how solar flares impact satellites, which then impact GPS and the stock market. One of our top scientists is part of the Government's advisory board for risk of space weather. We are advising Government right at the highest level.

We do a lot of climate change research. We look at how melting ice is affecting global sea level change, as you have heard. We do ocean science so we understand how heat and carbon that is being generated by human activity is being taken down into the Southern Ocean and how that has important impacts on our climate now and will in the future.

We are looking at the sea ice loss—which is very current—and how that is affecting the ecosystems, which will affect the fishing industry around Antarctica, so there are incredible economic benefits. Of course we have done the ozone hole from atmospheric science, but we are also looking at ecosystems and loss of biodiversity. There is a huge range of science in BAS, which is also found in the UK science community, that looks at how the polar regions are important for the global planetary environment.

Q239 **Chair:** All of those things quite neatly align, if you like, with British geopolitical interests because, quite plainly, climate change will affect these islands. What would happen if you chanced upon some area of science that was of no benefit to UK plc—I cannot quite think of what that would be; maybe something to do with diseases in penguins, let us say for the sake of the argument—would you find yourself politically nudged towards doing particular things, or do you feel complete scientific freedom and you can do what you like?

***Professor Dame Jane Francis:*** No, I do not think there would be a political part to that. If we found some exciting and important science to do that came up as a new topic, we would follow that science and go through due scientific process. If it was important to understanding the planet, understanding human survival or understanding climate change, we would follow it regardless of geopolitical interests.

Q240 **Chair:** Do you view yourselves as being an independent side of the organisation, free of influence from the Government, free of influence from NERC as well?

***Professor Dame Jane Francis:*** No, because NERC funds the science so we are an integral part of the science process. We are not free of NERC—I am sure some of us would like to be, but NERC funds us so we are not free of NERC. We are in an important partnership with NERC; it is absolutely clear that that is the case.

Q241 **Chair:** Sticking with that NERC relationship, I think you were here in the gallery for the earlier session and one of the things that we were puzzled over in the Arctic inquiry was how science was co-ordinated or was not co-ordinated in the Arctic. One or two people were talking about that question with regard to Antarctica. What sort of role does BAS play in other scientific investigations in the Antarctic and otherwise, universities and so on, other people? Does BAS play a leading role in pulling people together and making sure they do the right thing?

***Professor Dame Jane Francis:*** BAS started to have national workshops to bring all the UK community together. We used to have, and we still do have, biennial workshops that bring all the Antarctic researchers together in one place for that. We then started Arctic workshops as well—they are alternating—so that we bring the whole community together. As Mike said, however, the Scientific Committee for Antarctic Research is the international co-ordinating body that looks at how all of the science that goes on in the UK and across every institution that does Antarctic science is brought together so the maximum value is gained from the science that we do.

Q242 **Chair:** Why does NERC have an Arctic office but not Antarctic office?

***Professor Dame Jane Francis:*** We have an Antarctic office; it is my office.

**Chair:** Right—that answers the question, I guess.

Q243 **Anna McMorrin:** I will ask some questions about the AIMP, the Antarctic Infrastructure Modernisation Programme. First of all, Nigel, I want to ask you about the key strategic objectives in Antarctica. How does the modernisation programme align with and support the UK's broader goals in Antarctica?

***Nigel Bird:*** We have three main aims and a fourth aim for the programme. The first, as Jane has described and you have asked about, is to secure the UK's presence in Antarctica, to keep the built estate fit for purpose.

The second and parallel objective is to sustain our frontier research capability—by sustain, I mean drive towards the frontier our research capability and continue to develop new research capability.

We have a third aim to try to avoid the cost increases that one might expect from very aged assets, to replace assets before their economic point of expiration.

The fourth objective, which we endeavour to maximise, is around public engagement for science and research because we found that much of the Antarctic infrastructure has great public interest and we can use that as a vehicle to enable public engagement about science. Obviously, we start the conversation about the infrastructure, but you want to go on to talk about the scientific outcomes of both NERC and BAS.

Q244 **Anna McMorrin:** The AIMP is funded by NERC and BAS, is that right? Or

the former BAS?

***Nigel Bird:*** Let me tell you about the Antarctic logistics and infrastructure partition of the UK science budget. It is a partition of the UK science budget that is administered by our new Department, which is DSIT. As Jane described, there is a memorandum of understanding between lots of different Government Departments, DSIT and UKRI to describe the activities that should be funded by this partition, and they are mostly driven with a geopolitical lens—"Can we be in these locations, have this many people and do this type of thing?" That enables a very rational budget setting process to take place.

In effect, the Department asks for a shopping list of items and my role in the organisation is to say, "If you want us to do all those things, this is how much that activity would cost. Shall we iterate that list?". That is how the partition works. It has been a very successful mechanism for decision making across multiple Departments.

Q245 **Anna McMorrin:** This is some of the biggest infrastructure investment in Antarctica since the 1980s—is that right?

***Nigel Bird:*** That is correct.

Q246 **Anna McMorrin:** Are you satisfied with the amount of funding and upgrades that are needed and are going in? I suppose that you get to a certain point where you have not done any upgrades for a long time, and upgrades are very expensive. You have issues such as having to move the Halley Research Station because of environmental hazards on the ice shelf. How does this fit in with your budget and are you satisfied with it?

***Nigel Bird:*** I would go on record to say that UKRI and DSIT have met the needs with the partition funding that pays for the operating costs in Antarctica. They have met the requirement that we have set out for them to operate the infrastructure in a value for money way. My role is to tension what the UK science community and BAS might want in terms of their operational requirements, and what the UK might think is an appropriate amount to spend on Antarctic infrastructure, as opposed to all the other parts of infrastructure that one might have to undertake environmental science across the globe, which is obviously NERC's responsibility.

Q247 **Anna McMorrin:** Can I turn to Dame Jane and ask you if you are satisfied with the decisions being made, the funding amount and the scientific capabilities that this modernisation programme is delivering, and what they will deliver for science?

***Professor Dame Jane Francis:*** Yes, I think so. The ship is absolutely fantastic, as we saw. We now have a ship that is the envy of many nations. It has 11-plus laboratories. We can do more than one scientific programme on it, which we could not do before. We had a ship that was a science ship with about one very poor lab; now we have 11 labs. We can do new kinds of science on the ship that we could have never ever done before; really modern science. The ship can go places that we could never have gone to before, so it is a revolution in our marine science.

The new building in Rothera will make life much easier and more efficient in how we deal with science and prepare for science. One of the purposes of modernisation—apart from building buildings that are safer and will not burn down and are not losing heat—is to reduce our carbon footprint as well and make them more sustainable because what we have now is not fit for purpose at all. Some of those buildings are quite dangerous. In future, we will be able to do better science and be better supported, and be safer, which is one of my big topics.

Q248 **Anna McMorrin:** How is this modernisation programme helping with carbon saving and environmental considerations?

I have spoken to Chile about their bases. Energy consumption in at least one of their bases is zero carbon. I think we heard from you that energy was a challenge in Rothera. What are you doing about environmental considerations when upgrading infrastructure? You have a new runway and new buildings. How can you ensure that they have the least impact on the environment possible and are as energy efficient and zero carbon as possible?

***Professor Dame Jane Francis:*** Rothera is a much bigger and much more complex station than anything Chile has, for example. You have to compare like with like. We do have a target to make one of our smaller, more comparable stations as carbon free as we possibly can, so that will make it much simpler.

Q249 **Anna McMorrin:** Which one is that?

***Professor Dame Jane Francis:*** Signy, which is part of the AIMP project. We do have a big renewables project in Rothera to do the best we can to decrease our carbon footprint in Antarctica. The buildings are much better insulated and we have combined heat and power. In the past we had generators that were throwing heat out into the atmosphere, at the same time as using tumble dryers next door. Energy use will be combined now and be much more efficient.

We have solar panels on the building for use in six months of the year, but not through the cold, dark winter, so 50% of the time. We are also looking at completely different kinds of power. We are looking at wind turbines, which are quite difficult in Antarctica because we have a lot of birds around Rothera as you know, so we have to be careful where we place the wind turbines.

We cannot use anything in the oceans because most ocean energy generators require an open ocean surface and we have these big white things called icebergs, which are highly destructive, so we cannot use the ocean. But we are trying as best we can to use everything we possibly can and adapt when new things come online.

Also particularly with the transport, the ship now uses biofuels and that has cut its carbon footprint massively—at a huge cost, I should say—and we are about to use the same kind of sustainable fuels in our aircraft as well. We are trying as much as possible to cut our carbon footprint.

Q250 **Anna McMorrin:** Where will the modernisation programme put the UK's Antarctic infrastructure in comparison with that of other countries?

***Professor Dame Jane Francis:*** It is certainly putting Rothera at the top of a list of stations that are getting there. Now there are quite a few new stations being built and they are all becoming very environmentally concerned about their carbon footprint.

Q251 **Anna McMorrin:** How would you describe the positioning of the UK with that base and a runway in terms of the geopolitics or potential for collaboration or partnership with other countries?

***Professor Dame Jane Francis:*** The runway at Rothera is rather critical: it is the gateway into Antarctica for most other nations because it is the smallest distance between the land area of Chile and Antarctica, so small aircraft can fly across the expanse of the Drake Passage between the two. They cannot fly from Australia to the Australian side of Antarctica or from South Africa; it is too far a distance, so we are the gateway.

Q252 **Anna McMorrin:** You have invested in the DASH-8; is that right?

***Professor Dame Jane Francis:*** Yes.

Q253 **Anna McMorrin:** Isn't it right, though, that the runway at the moment is not long enough for the DASH-8?

***Professor Dame Jane Francis:*** Nigel, do you want to answer that because it is your project area?

***Nigel Bird:*** Yes. Let me go back a step; so BAS is operating four De Havilland DASH-6 aircraft and one De Havilland DASH-7 aircraft at the moment. It is the DASH-7 aircraft that has reached the end of its life. It is 26 years old and we can't buy spare parts and train pilots for it and so on. So we undertook a worldwide competition to buy a replacement aircraft and decided that the De Havilland DASH-8 was the best aircraft to replace the DASH-7. In normal operation, the aircraft can land on the runway.

As part of the safety case that we have been developing we have been looking at what could go wrong and how we could mitigate what might go wrong. One might imagine things like what happens if there is a pilot error or if there is a serious mechanical failure such as a complete brake failure and what the consequences might be.

For those of you that do not know, our runway has ocean at both ends, so consequences of a runway overrun are significant for us. We have been looking at what further modifications we might want to do to the aircraft to improve its resilience. That project is not due to finish until 2031; it still has quite a long way to run. The early findings are that there is still quite a lot of work to do.

Q254 **Anna McMorrin:** Does the runway as it stands support the aircraft that are coming in and using it as the gateway to other points?

***Nigel Bird:*** Today it does. It is for each nation to determine the safety case for its own aircraft, which aircraft it feels is safe to land upon the runway and with what margin they do so. We have an option to further extend the runway if required and we set out that case to Treasury as part of the business case for the modernisation programme. W

e are reluctant to do that unless it is absolutely necessary, so answering these questions in series is the best approach, we think. Obviously extending a runway into the ocean, as I have described, would have an environmental consequence as well as a cost consequence. It is a very expensive place to construct infrastructure.

Q255 **Anna McMorrin:** Can I ask one extra question on this? This is moving away from the infrastructure programme to the science being carried out. Jane, could you say something about the scientific collaboration with other countries, for example on Thwaites Glacier, and the importance of that for the UK and, therefore, for the world?

***Professor Dame Jane Francis:*** Collaboration in Antarctica is critical because there are big science questions to be answered on a huge continent with long-term planning, as you have heard all afternoon, with huge costs and in a remote place. Sharing infrastructure and expertise is critical. I do not know of another community that works together as well as the Antarctic community, and that is completely supported by all our organisations.

The Antarctic Treaty, which encourages co-operation, SCAR, the Scientific Committee on Antarctic Research, and COMNAP, which is all the operations managers, all work together. We all meet together every year and discuss how we can co-operate and share, how we barter, how we work together. It is a fantastic collegiate environment in which to work together, mostly, at the moment.

Q256 **Anna McMorrin:** I want to accentuate that despite the extent of our presence and of other countries, there is a lot that we do not know about the changing climate in Antarctica and the tipping point. Can you tell us a little bit about how much we do not know in climate science and how that impacts us here in the UK?

***Professor Dame Jane Francis:*** You have heard about the Thwaites project a lot. That is about how climate change, which is being caused where most humans live, is affecting the whole globe. Now we think that it is strengthening the winds around Antarctica, which is blowing warmer sea water underneath the ice sheets. We are interested in how, particularly in the Thwaites area—which is the West Antarctic ice sheet, the one that is most vulnerable to ice melts—that warm water is interacting.

The Thwaites project used revolutionary new equipment, underwater robotics, to go down with a camera so we could see where the water was going and what was happening for the very first time. That is where the project has got to so far. We have made phenomenal discoveries but

there is still more to do. We need to know where that water is going next and when it is going.

For me, the interesting question now is the East Antarctic ice sheet. That is the big block of ice that is sitting on a big block of rock. Not many years ago, three years ago, four years ago, I used to say that was stable—it is a big block of rock it is sitting on; it is ice sitting on rock, and we did not think much would happen to it in 10, 20 or 100 years. Even in the last few years, Andy and his satellites in CPOM and people who have been on the ships have seen that there are already changes in the East Antarctic ice sheet.

That is a large block of ice and if that starts changing, that will have fundamental effects particularly on the sea level rise, which will go up exponentially, and on ocean circulation. As all that fresh water is melting from the ice on land, it will freshen the currents around Antarctica. The ice provides cold, dense water that goes to the bottom of our ocean. It affects the whole global ocean circulation all the way around the world, and if we change that, we change the whole way the oceans work, which therefore interacts with the atmosphere. It is a fundamental change to the way our planet works. I think that it is going much faster than we ever thought it would do. There is a lot more to understand.

Q257 **Chair:** Can I pick up one detail point with you, Nigel, about the environmental consequences of the extension to the runway? I must be careful; as a constituent of mine I must be nice to you.

Presumably huge quantities of stone are being dumped in the bay there. First, what were the consequences of what you have done so far and, secondly, what else would happen if the runway were to be longer? There are experiments happening right there in the bay, aren't there?

***Nigel Bird:*** Yes. It would not be without consequence in terms of changing the nature of the bay, depending upon the size of an extension or modified surface that we might choose to put on there. It is too early for me to give you any environmental impact statement on that. We have not decided if that is what we are going to do, so we have not done the environmental impact assessment of such a construction.

I will say that we use rock local to Rothera as it has been determined as the least damaging thing to do, but of course that creates a terrestrial disturbance as well as a marine one. There was a small hill that used to exist and now doesn't, so there is a double impact to the location, although it is less impactful than, say, taking rock from another continent and bringing it to Antarctica.

**Chair:** I am confident that you would be very careful about this. Jerome, did you want to come in at this stage?

Q258 **Jerome Mayhew:** Yes, thank you. Apologies—I had to nip out to deal with another responsibility.

I am concerned because you have to have the longer runway for the DASH-8. We saw experiments with the starfish and—I am no scientist; I

am going to call it the wrong thing—the shallow seabed fauna that are already very much under stress because of the warming temperature. Then to dump several million tonnes—I am guessing it is that scale—of rock, which you have to blast out of the hill if you are going to use it locally—and we can all agree that Rothera is not currently a picture postcard site—I am very concerned that the impact that a decision to buy a different aeroplane is having on the local environment is very heavy. We need to be very careful that the cost does not exceed the value.

***Nigel Bird:*** I agree with that statement. I agree, and that is part of the decision-making process that we will be going through in series, how we reassure ourselves that the safety case for the aircraft stacks up against the extreme environment that we are operating in and how the mitigations we might put in place—which might be changes in the runway surface or length or both—stack up in a value for money case but also an environmental one. That is work to be done.

Q259 **Jerome Mayhew:** If I am right in my memory, the runway is long enough for standard landing; it is the safety—

***Nigel Bird:*** It is the failure case, yes.

**Jerome Mayhew:** It is the failure case. Is it possible that you could have a high-friction surface that could bring an aircraft to a controlled stop?

***Nigel Bird:*** There are two parts to that. The easy answer is yes. We are investigating a series of engineering solutions to reduce the probability of some possible failure cases on the aircraft, for example to put redundancies in there for the brakes and other things that might go wrong. One needs to balance those, of course, against how much maintenance you are requiring yourself to do on your now bespoke aircraft that nobody else operates because it has two sets of brakes. Again, there is a balance to be had about the safe way to operate an aircraft.

It is a tough decision to make. You missed it earlier, but we have quite a long time still to have those discussions. I will say that the manufacturer is very confident and I am not displeased to say that our pilots are rightly concerned for the safety case. They have registered an appropriate level of concern, which is that we need a proper safety case to operate this aircraft, and I agree with them, by the way. I am also responsible for safety like Jane, and I agree with them. Safe operation is our No. 1 criterion.

Q260 **Dr Matthew Offord:** Earlier in the previous session, which I know you were here in the room listening to, there was a discussion about the one-ship policy. We saw some evidence of that one-ship policy and, indeed, we heard lots of comments about it. What evidence do you have to demonstrate that the one-ship policy does not hinder research and science?

***Nigel Bird:*** To put it on the record, NERC owns three ocean-going research ships currently and it does not have a one-ship policy at all. Two

are operated by the National Oceanography Centre in Southampton and one is operated by the British Antarctic Survey.

When we decided to move across to a single ship, when we replaced a ship that we owned and a ship we leased with the Sir David Attenborough, it was always our intent, and it has turned out to be the case, that the funding for the second ship was left with the British Antarctic Survey—in fact, we might better describe it as a one ship-plus model—to enable it to undertake a similar amount of logistics but in a much more flexible way.

I would propose that it has been advantageous to BAS, and I have some stats. We have chartered five ships alongside the Sir David Attenborough since that decision. We have also chartered six different aircraft types to deliver people, fuel and logistics into the deep field of Antarctica. I am aiming to show you that we have brought greater flexibility to our logistic chain by enabling this, "Shall we charter a ship to do a particular activity or shall we charter an aircraft to move us to a completely different location?" Opening up the whole expanse of the British Antarctic Territory has been one of the drivers of the programme.

**Chair:** Dr Williams, it looks as if you want to add something.

***Dr Williams:*** To come back to your question about whether the SDA hinders scientific research because it is our only ice-capable ship at this time, the answer is that it is a very different capability from what we have had before. To give a couple of examples, some of you have seen the moon pool on the ship. That is a hole that runs through the middle of the ship. It is the first UK research ship to have a moon pool and it enables us to take samples and measurements of water under ice, when the ship is surrounded by ice, for example.

It also has new capabilities for atmospheric measurements, which it takes all the time. Whatever activity the ship is undertaking, it is streaming new data on atmospheric measurements. It has what we call a giant piston corer, which enables us to take larger samples of the sediment than we have ever done before. It also enables us to take samples at deeper depths than we have done before. It is a completely different capability so I do not believe it will hinder scientific capability at all. We will have new capabilities.

However, we do have to operate differently, as Jane has alluded to. It is no longer the model of one project, one grant, one ship deployment. Because of its size and scale, we will have to operate differently and have different projects going on on the ship at the same time. That can have advantages as well because obviously you are bringing atmospheric scientists to work with marine scientists simultaneously. There are potential advantages there as well, but it is a different way of operating.

It is a fairly new ship and we are still getting used to it. The way of operating will be different, but what it can do will expand our capabilities, not hinder them.

Q261 **Dr Matthew Offord:** Two other ships—there are three in total—are currently in the remit of the National Oceanography Centre, is that correct?

***Nigel Bird:*** Operated by.

**Dr Matthew Offord:** Operated by.

***Nigel Bird:*** Under a unified marine science programme, co-ordinated by Iain.

Q262 **Dr Matthew Offord:** What kind of science do they undertake?

***Dr Williams:*** They undertake oceanographic science anywhere in the world except where you need an ice-breaker capability.

**Dr Matthew Offord:** Not in Antarctica?

***Dr Williams:*** Not in Antarctica, not in the ice, but before we had the SDA, they did support the gap in a lot of Antarctic work around the islands, as it were. They do go quite far south and north as well. Rather like the Sir David Attenborough, they will respond to the research programmes that NERC funds either through the academic community or through the National Oceanography Centre through our national capability funding. It is a mix of fundamental research and long-term monitoring and observations, much in the same way as BAS science is.

Q263 **Dr Matthew Offord:** The British Antarctic Survey has one scientific ship under its control?

***Dr Williams:*** Not under its control, technically speaking; under NERC's control. NERC plans the ships, both the Sir David Attenborough and the NOC ships, not National Oceanography Centre and not British Antarctic Survey. Those centres do not have priority of use of the ships over, say, research grant-funded through a university. NERC does the planning so there is equal prioritisation across all its—

Q264 **Dr Matthew Offord:** Does NERC have access to other cargo ships?

***Nigel Bird:*** Yes.

***Dr Williams:*** That is done through tendering, yes.

Q265 **Dr Matthew Offord:** It does. Why do you use the SDA then to move cargo around?

***Nigel Bird:*** Because at times it is the most efficient and cost-efficient way of doing it. If the ship is going to Rothera for a particular purpose anyway, we may as well put containers on it and move them from one place to another.

Q266 **Dr Matthew Offord:** It is more efficient to use a scientific ship if it prevents science being undertaken? You still want the SDA for that role?

***Nigel Bird:*** As the ship has a dual purpose to do both of those functions, then yes, sometimes it needs to do both of those functions.

Q267 **Dr Matthew Offord:** It has been described as the most expensive cargo ship. You mentioned the moon pool, which would be fantastic. We would have liked to have seen it, but we could not because there was too much cargo and assorted ancillary equipment and it was not possible to do so.

***Dr Williams:*** We would only use it when there was a science programme that was going to use it and the ship was surrounded by ice, for example.

Q268 **Dr Matthew Offord:** Our original programme said that we would be witnessing it in action and we did not.

***Dr Williams:*** Unfortunately, there was not a science programme on the ship at that time. Of course, the larger science programme, the PICCOLO project, took over immediately after we departed the ship, which was a six-week-plus cruise, something like that, for science activity.

**Dr Matthew Offord:** It was unfortunate that we were not able to witness it then.

***Professor Dame Jane Francis:*** I should say that the ability of the ship to support science is not necessarily dependent on the number of days that the ship is available or doing logistics. It is dependent on the amount of funding for marine research. It is in Iain's court, really, what funding is available to do science projects. This year, this season, has been particularly great because the Sir David Attenborough has done two very large science cruises. It is the first year it has done large cruises and they have been fantastic. It is all about where the funding comes to fund the science cruise.

Q269 **Dr Matthew Offord:** We did touch upon funding earlier. When we were there, we were privileged to see the laboratories, but unfortunately no one was undertaking any work while we were there.

***Professor Dame Jane Francis:*** No, so that was a particular short visit to deliver fuel and to deliver supplies, but there was no funded science programme for that particular period. As soon as we got back, then there was a huge science programme on the ship and it took over the ship. There were actually three science programmes on the ship at the same time to make it more efficient for the next few months.

**Dr Matthew Offord:** You can understand why people say it is a very expensive cargo ship.

Q270 **Jerome Mayhew:** On that point, one of the costs of the ship is that we have had to extend wharves to accommodate its size, both at Rothera and elsewhere. Am I right in saying the design allows for 36 cargo shipping containers to be carried?

***Nigel Bird:*** In certain configurations, yes.

Q271 **Jerome Mayhew:** It is around about that. In my head, a chunk of the size that is required for the scale of the vessel is because you need to have capacity, physical space, to have more than 30 shipping containers on it. Is that a fair characterisation? If so, if you did not have to have the

cargo-carrying capacity, could we have saved tens of millions of pounds on wharf extensions?

***Nigel Bird:*** The two wharves that we rebuilt, one at Rothera and one at King Edward Point, both wharves would have had to have been rebuilt in the same time period because of their age. The wharf at Rothera had already started to disintegrate into the ocean. They were both activities that were ripe for renovation. It is true that the Sir David Attenborough is larger than the two ships we had before, and that did drive cost into the replacement wharf at Rothera. It is bigger than it would otherwise have been, had the ships been a similar size again, so that is true.

As for trade-offs in the ship design itself, ships are a whole series of trade-offs in terms of size, weight, stability and balance. It is not easy to describe what proportion of its cost is attributable to the cargo-carrying capacity as opposed to many of the other capacities that it has. We knew, because it was a strategic intent, that we would have less science days at sea by moving from two ships to one ship. It was a strategic intent. It was not accidental and it was not a casualty.

It was an intent on our behalf as the funder of this activity because we knew we could not sustainably afford not just to operate two ships, not just to fund the research on the ships, but don't forget—and you heard our science colleagues tell you earlier—the other four and a half years' worth of scientific endeavour that gets wrapped around that month on the research ship. It was a deliberate strategy to contain or constrain the amount of science time at sea and to constrain all the cost associated with that activity.

**Jerome Mayhew:** Very interesting.

Q272 **Dr Matthew Offord:** I think that we have established that you use more than one ship throughout the year, so how much are you spending on additional ships being hired?

***Nigel Bird:*** I can tell you that on average, looking back over the five ships that we have chartered, the average cost is £1.5 million. I can tell you that this year—

Q273 **Chair:** The total or each?

***Nigel Bird:*** Each, the average cost, in effect, per mission, if you like.

**Chair:** So £7.5 million a year or thereabouts?

***Nigel Bird:*** That is five in total over that period. It is not five per year; that is five in total over that period.

This year we struck a deal with the German Antarctic programme and shared a research ship, which went to our Halley VI research station and their Neumayer research station. It cost £1.8 million to do that cargo movement this year.

Q274 **Dr Matthew Offord:** Do you still use other vessels such as commercial

craft that could be leisure craft to transport people?

***Nigel Bird:*** Yes.

**Dr Matthew Offord:** Who would that be?

***Nigel Bird:*** Yes, at times the British Antarctic Survey will use commercial cruise ships to drop small parties of people into different locations.

**Dr Matthew Offord:** Like Skip Novak, for example?

***Nigel Bird:*** You will remind me of the name.

**Dr Matthew Offord:** He runs the Vinson of Antarctica and other vessels. It is a high-end holiday expedition.

***Professor Dame Jane Francis:*** Sometimes the only way that some scientists can get from A to B—we do not want to take the Sir David Attenborough because it is extremely expensive just to go from A to B with the large science ships—is that they have passage on a tourist ship. On the whole, that is for things like whale watching or going to penguin colonies or things like that.

We are very careful about how we work with tourist ships, because we know that they would like to use the British Antarctic Survey's reputation and logo for their marketing purposes. They have said that explicitly to me. We do not sell our logo and we do not sell our brand, so we work very carefully on each individual case and make sure that we have an MOU with the tour company. The arrangement is very specific about who is going to go and what they are going to do. We do not allow the tourist ships to use them scientists cheap labour, which has happened in some cases with tourist ships. We are very careful about that.

Q275 **Dr Matthew Offord:** There is another Antarctic ship that is used, RMS Protector, which we visited while we were in the South Atlantic. What contribution does that vessel make to British Antarctic policy? Do you have any input into what activities it undertakes?

***Professor Dame Jane Francis:*** Yes, Protector does help us. It is a ship that is used for military patrol in the South Atlantic. It is directed by the Navy annually. One of the issues that we have is that, as you have heard before, it takes many years to develop a programme. We cannot particularly say, "In two years' time we would like you to be here to help our scientists", because the Protector's programming is done annually. We have found that it is not quite reliable. We cannot set up a large science programme only to be told by them, "Sorry, we have different programmes".

The Protector is very good at transporting scientists and small programmes from A to B or to support them to do some research. This season it was supporting some charities that were looking at penguin colonies. It was doing some data collecting in small amounts. It is programmed by the Navy, so some of our operations people go to those meetings to see what is being programmed and how we can join in.

Unfortunately, it has not been particularly reliable in doing longer-term support. Of course, it does not have any science facilities. It does not have any science labs. It does not have any science equipment. It really is a ship that can transport people from A to B.

Q276 **Cherilyn Mackrory:** We have answered some of the questions already about how BAS collaborates with other research institutions and organisations. Do you want to go into some more practical ways? You talked about the workshops for one. Do you want to give any more detail on any of the other ways that you collaborate?

***Professor Dame Jane Francis:*** A lot of the ways that collaboration starts are from scientists talking to each other at the many Antarctic meetings that we have, very specialist meetings. They talk to each other. They form collaborations. Certainly, in BAS our scientists work with a range of nations to do projects. We share quite a lot of small funding. For example, if there is a space on a ship that is going out, then there is an offer in the community for a ship. There is a new project called POLARIN, which is funded by the EU, to share facilities in Antarctica. Each nation that is in Antarctica has put into a hat what it can share. We can share our ice coring facilities, our sediment coring facilities and things like that. Then people can share. That is already operating in the Arctic, but we have just set up one of these programmes in the Antarctic.

Q277 **Cherilyn Mackrory:** How is that co-ordinated? How do you co-ordinate all that activity?

***Professor Dame Jane Francis:*** A group funded by the EU is the co-ordinating office. There is a website and you can go on to it and see what is available. You hear that there is a cruise going in there with maybe two or three spare berths or something like that and you can apply for them.

***Dr Williams:*** Shall I come in on how it is co-ordinated from the funding point of view?

**Cherilyn Mackrory:** Yes, and then how you collaborate with BAS; that would be fabulous.

***Dr Williams:*** Yes. There are various mechanisms, of course, but we will work from funder-to-funder level. The ideas will come up through the science community. We agree broadly that this is a good thing to collaborate on, and we will work with the other funders to do things like agree funding levels and try to bring it into a common pot so that is not your bit and that is not our bit, as it were. We will have agreements that avoid something we call double jeopardy: for instance, if you quality assure a proposal and it passes yours, but it does not pass ours for quality or originality. We will share the peer review process and those things so we have single competitions for our communities to apply for.

Very often in Antarctic work we might hang that, if you like, on some national capability funding, which is our core funding to BAS as well, to enable the wider community to bid into it, into joint funding with overseas partners. That is from the funding side what we do.

Q278 **Cherilyn Mackrory:** A question from a layperson's point of view. When you are coming up with the projects or when the science community is coming up with the projects, do you have to co-ordinate with BAS to make sure that the correct infrastructure and logistics can be in place before that happens?

***Dr Williams:*** Yes.

Q279 **Cherilyn Mackrory:** Is that the order that that happens in?

***Dr Williams:*** Particularly with the Antarctic, while the community is close knit and that has lots of good advantages, the challenge is, of course, co-ordinating with our infrastructure as well, because there is no point in bringing a proposal if the ships are not available at that time.

Within NERC we have a board called the Polar Research Operations Board—I chair it, these two people are also on it, and Mike Bentley, who you just heard from, represents the community—that tries to bring all that together, all the operational side, with the longer-term look at the research opportunities to make sure that we are planning strategically and long enough in advance to make good plans, without tying everything down too long in advance so that you have no flexibility. That is always the balance that we have to make.

Q280 **Cherilyn Mackrory:** Is that internationally? How does that compare with your international colleagues who are doing a similar job but for different countries?

***Dr Williams:*** That is planning our UK infrastructure but, of course, we are feeding in what we know is happening internationally to make sure that our plans match the joint international programmes. As far as ships are concerned, across all NERC ships now, and including the National Oceanography Centre ships, we have very good arrangements with sharing, what is called bartering arrangements with the ship. We know what other countries are doing and we share capabilities. It happens more frequently in the National Oceanography Centre ships than the polar ships, but it still works very well.

Q281 **Cherilyn Mackrory:** How are we performing compared with other countries? Are you quite happy with the way we have things set up or are other countries doing some things slightly differently that you wish we could be doing in a different way?

***Dr Williams:*** I think that we are pretty good, but you would know more about other countries, Jane.

***Professor Dame Jane Francis:*** I think that we do well in collaboration. One of the things that is a bit different about BAS and about the UK Antarctic community is that we do have NERC infrastructure operated by BAS and we have UK scientists in BAS as well and in the UK community. Infrastructure groups are a real mess in some countries. They just do not know how to organise themselves—I do not mean that as criticism. They have organised themselves in different ways, and then there is a problem about where the funding goes. Some countries have the scientists sitting

only in universities and, therefore, there is a poor connection, if you like, between the university and the logistics.

I think that BAS has it right. I have been visited by members of Governments from other countries who have come to ask me about how the BAS-NERC arrangement is made up, how our set-up is made, because they see it as a good model.

Q282 **Cherilyn Mackrory:** Who are our frequent flyers? Who are our best international partners that we work with a lot because it is easy?

***Professor Dame Jane Francis:*** US, Germany. We work a lot with some of the Scandinavian nations, particularly in the Arctic, of course. We work closely with Australia and New Zealand, although they are over the other side of Antarctica, so it is quite difficult. That is exchange of personnel more than anything else. But we work quite a lot with European nations too.

Q283 **Cherilyn Mackrory:** I read that there is a proposal for Antarctica InSync, which is something that you are keen on, I believe.

***Professor Dame Jane Francis:*** Do you want me to tell you about that?

Q284 **Cherilyn Mackrory:** Yes, a little bit, but in this context—is it the aim to make things easier and how would that work?

***Professor Dame Jane Francis:*** Absolutely. This is one of the biggest planned Antarctic projects. The idea is to bring all nations together. 2032-33 is what we call International Polar Year, which is a very special year when we will focus on Antarctic science. Before that, we are still in the decade of the oceans. The idea is to bring all the nations together, particularly those with icebreakers, to take synchronous measurements of the Antarctic environment, particularly the oceans, but all aspects of the environment at the same time of year in the same types of measurements.

That has never been done before, because everybody goes out as individual nations at times. The idea is that we will have about 10, 15 icebreakers all around Antarctica with projects attached to look at the ocean, to look at atmosphere, to look at the land, to look at many aspects of the Antarctic environment, taking measurements at the same time, even working in the winter, which is a new thing to be able to go to Antarctica and work through the winter months, which is very hostile, and build up a completely new picture of what we know about the Antarctic environment.

Q285 **Cherilyn Mackrory:** How advanced is that project? Is funding in place? Is it ready to go? How many years off are we?

The idea is that it will run probably in winter 2028-29, but it is still in the planning stage because we are planning it this year. We are forming a steering group of people like me, the directors of the national programmes, who will come together to say, "Yes, let's go ahead." Later on this year, we have a very large Antarctic SCAR meeting, the Antarctic

Committee in Chile, where we all get together. There are big workshops to start planning this together, planning the science. From then on, we will be looking for funding from different nations and different sources, ready to start the research in 2028-29.

***Dr Williams:*** Is funding in place? Not yet is the answer to that question, but it will almost certainly be a combination of sources. National capability funding for BAS is ongoing. It is long-term funding that we can plan for. That is not a challenge as far as funding uncertainty is concerned, but it will be combined with our strategic research funding.

Very briefly, let me explain that NERC's funding is split between 60% competitive funding, which universities and centres apply for, and 40% more or less national capability funding, which is our six centres. We will be working through a combination of those sources.

Q286 **Cherilyn Mackrory:** Finally from me, and to anybody, what barriers do we now have to international collaboration? It could be geopolitics; it could be anything. Where are the sticking points? I do not want to lead you on that, by the way.

***Professor Dame Jane Francis:*** The Antarctic Treaty brings together all the nations in Antarctica that work together to govern Antarctica. We have a meeting of all those nations every year. The governance of Antarctica is done by consensus. Since 2019, the consensus is becoming lost a little bit by two nations, one of which has a different political agenda to be a world-leading power. They are going their own way, so they will not agree to anything, even protecting the Emperor penguins, and there is another nation that is quite disruptive at the moment. It is an interesting, challenging time for the Antarctic community, because we are losing that sense of consensus and agreement between all the nations.

Q287 **Cherilyn Mackrory:** Without naming those two nations, because you were very careful not to, but I think we all know who they might be, is everybody else all right? There are no other barriers between like-minded nations, if I can put it that way?

***Professor Dame Jane Francis:*** No, but with those will come political allies. There are some other groups. We are in a very important time when we try to make sure that we keep the treaty as safe as possible.

Q288 **Chair:** On that one detail, the InSync project presumably includes Russian icebreakers, does it?

***Professor Dame Jane Francis:*** Let's wait and see. We have a few years yet during planning, so I hope it does.

Q289 **Chair:** A brief question that I perhaps should have asked when we were talking about the two-ship policy. We heard from the governor of the Falkland Islands that the Pharos has been used increasingly for BAS projects, both in Bird Island and King Edward Point. Is that right? Do they get compensated for that in some way?

***Professor Dame Jane Francis:*** Yes, we have to pay a very large amount of money for all the passages that we have on the Pharos.

**Chair:** They should be quite pleased about it.

***Professor Dame Jane Francis:*** They should be, yes.

Q290 **Chair:** The use of the Pharos has increased, has it?

***Professor Dame Jane Francis:*** I presume so, yes. I have not heard any reports about it.

Q291 **Barry Gardiner:** Can I pick up on what you were saying to Matthew Offord earlier? Mr Bird, can I check with you? Is it always the case that science takes priority over the transportation of cargo and logistics?

***Nigel Bird:*** I am going to answer that question in a long way, because all of the activity we undertake in Antarctica is for a scientific purpose. Marine scientists will often complain about logistics, but logistics is there to support the terrestrial scientists to do their work in Antarctica. The balance we are talking about is the balance of scientific endeavour. Are we delivering scientific equipment and fuel to Rothera to allow field parties to go deep into Antarctica, or are we undertaking scientific marine research?

That is my answer to your question. It is a balance between the activities we are trying to support. There are no logistics for the purpose of logistics in their own right.

Q292 **Barry Gardiner:** You are confident that you are making the most economical use of the resources available to you?

***Nigel Bird:*** Yes, and that is Iain's role to be the arbiter of which scientific endeavour we prioritise over the other.

***Dr Williams:*** I mentioned the Polar Research and Operations Board earlier. One of our first tasks—it has only been running a couple of years—was to look at the prioritisation of all our resources. We published a list of criteria that set that out to help to guide our operations people, but also to explain to the wider community how we will work with these resources.

Q293 **Barry Gardiner:** I want to focus on the funding for the research. You helpfully outlined, Dr Williams, the national capability element—the 40%. Can you set out what science in Antarctica is funded under national capability funding?

***Dr Williams:*** National capability funding does three things across all NERC centres, not just BAS. It runs the infrastructure, which is a very small amount for BAS because of the Antarctic logistics and infrastructure partition that takes the load there. It is slightly different from us.

National capability funding funds long-term monitoring experimental work and, what I might call, large-scale global and decadal scale research. It is those three categories, and the two categories of science are what we

were referring to earlier. That long-term monitoring that is very important in environmental science, of course, and we provide long-term funding to enable time series to be funded. Many of those go on for many decades now.

As an example in the Antarctic, you have seen the weather balloons being launched. They are funded from national capability science. The long-term marine fauna monitoring off Rothera is another example.

Q294 **Barry Gardiner:** You will have heard Professor Bentley earlier this afternoon say that structures often require us to go at short-term jumps, in terms of funding, and arguing for a greater long-term nature. I think Dr Jo Johnson also talked about the limitations of five-year projects and the need for more long-term planning. How do you think you can accommodate their wishes?

***Dr Williams:*** National capability funding is the longest-term planning for science funding within NERC, not least because, although some of it is commissioned on a five-yearly basis, there is an expectation that it continues and we change it, of course, as scientific priorities change and scientific methods change but overall that is long-term funding. On the competitive side, the 60% is for shorter-term grants.

There is a balance to be struck here, isn't there? There is a real risk that if we go for much longer projects, we forward commit all our budget. There is a risk then that new science priorities come along, new methods come along, and we cannot take advantage of them because we have already committed all our budget in seven or eight-year-long projects, and we cannot do anything then until they have come to an end.

There is a challenge here to get the balance right between research programmes that have that length to make an impact but do not commit us so that we cannot move into the future, whichever way the science priorities take us. A long project just commits our budget forward.

Q295 **Barry Gardiner:** So there is some reluctance to be tied in.

***Dr Williams:*** There is a balance to be struck between tying into things that we know are long term, and we expect them to continue to be long term like some of the monitoring, for example, which we know we will need for a long period of time, and what you might say is more explorative research, which we need to have a different balance on.

Q296 **Barry Gardiner:** Ideally, you would like more money to do more of everything.

***Dr Williams:*** Of course.

Q297 **Barry Gardiner:** That I cannot supply immediately. Tell me how the Antarctic logistics and infrastructure partition works. Why is funding not split? You talked earlier—maybe it wasn't you; maybe it was Dame Jane who talked about the mission statements and the memorandum of understanding jointly between FCDO and DSIT. If they are controlling the

mission statement and the MOU, why are they not also splitting the funding between them? Why is funding not split among FCDO and DSIT, as well as NERC?

***Nigel Bird:*** That is probably a question for FCDO and DSIT, but if it is okay for me to answer—

Q298 **Barry Gardiner:** Yes, but I am sure they would be fascinated to hear your own views on whether that should be the case.

***Professor Dame Jane Francis:*** FCDO does not have any money, does it? It has the influence, but it does not have the funding. The FCDO works with DSIT to provide the funding for logistics.

Q299 **Barry Gardiner:** Let me ask this in a slightly more robust way. We have talked about the soft power of science. We have talked, and you have talked very diplomatically, about geopolitical concerns. How do we differentiate the UK's geopolitical presence in Antarctica as distinct from its scientific presence?

***Professor Dame Jane Francis:*** I can do that.

Q300 **Barry Gardiner:** Given that the FCDO does have a role and influence in determining the objectives, the mission statement, should it not be that that is reflected also in putting in some funding?

***Professor Dame Jane Francis:*** I can answer that one. The FCDO is very clear, and it says this in the MOU, that the science that is done is determined by the Research Council, by NERC and scientists and not by the FCDO. However, we do get some funding. It is part of the package of the ALI logistics budget. It is a small amount, which we call government science. Its focus is to do specific science that the FCDO requires. The FCDO requires me and the director of operations to attend the Antarctic Treaty meetings and to do some work to support that.

The Department also requires us to do work on fish stocks and the fishing trade around Antarctica for CAMLR, the Commission for Antarctic Marine Living Resources. That science and the attendance at the CAMLR meeting in Hobart every October to work with the fishing community to look after that is requested by the FCDO. We are required for us to work with the South Georgia Government, but that is on a separate contract.

The FCDO does ask us to do some report writing about climate change that it specifically wants, but that is funded by a small percentage in the ALI budget.

***Nigel Bird:*** Can I supplement that? The partition should enable two things to be true. It should enable transparent reporting of how much it costs to operate the geopolitical part of BAS's remit. It is a partition. It works in both directions, and you should be able to tell from DSIT's annual accounts how much of the science budget was directed into that purpose. In a way, it is of less interest whether it comes directly from DSIT or from the FCDO, as long as transparency is protected.

The other thing that it provides for is that it protects Iain from having to determine whether operating a research station in Sydney is more or less important than air quality in Leeds, which would be a very difficult thing for him to do and would require a whole team of geopolitics behind him to be able to make that decision. It protects us from having to make what is, in effect, two competing decisions simultaneously, or at least puts those in the hands of the stakeholders to whom they matter most. It should do both of those things in a transparent way.

Q301 **Barry Gardiner:** Picking up on what you said about fisheries negotiations, how damaging to the ecosystem in the Antarctic is the pervasive nature of global fisheries?

***Professor Dame Jane Francis:*** You need to ask Jane Rumble, because she is the expert on all of the CAMLR business. The reason why the BAS scientists are involved in the CAMLR process is to do some work to understand what the fishing stocks are, where the breeding grounds are, where particular sorts of fish are found, where the krill are found, and to make a scientific assessment about fish stocks and all the requirements of the fishing industry so that they can go to CAMLR with scientific evidence, therefore, to make sure that the fishing industry around Antarctica is sustainable.

Q302 **Barry Gardiner:** But it is not, is it?

***Professor Dame Jane Francis:*** We do not know at the moment. They are desperately trying to make sure it is. Is it not?

**Barry Gardiner:** I would like to see the biomass stats to see that.

***Professor Dame Jane Francis:*** The other thing that they do is where there are areas that are special and need protection, the scientists will also help work, particularly with other nations, to ensure that the marine protected areas are fought for to keep the fishing out. Those things are important. That is where there are a lot of political requirements for the FCDO to come in.

Q303 **Barry Gardiner:** The majority of BAS's annual budget goes towards infrastructure rather than science. What can BAS do to redress that? Or would you say, in effect, the infrastructure is simply there to support the science and we cannot do one without the other?

***Dr Williams:*** To start that off, our Antarctic science is funded both with national capability funding through BAS and through the competitive funding. From the competitive funding, we fund on average—it varies, it goes up and down every year—18 or so grants per year on Antarctic science. BAS wins 25% of those on average, which is a good number for a single institute, but 75% is won by other institutes—universities primarily—and the majority of those use BAS infrastructure. The BAS funding of infrastructure not only supports BAS, but supports that whole community.

That is pretty common in infrastructure-heavy environmental sciences. More than 50% of national capability funding for the National

Oceanography Centre is infrastructure funding to support the two ocean-going ships.

Similarly, in the National Centre for Atmospheric Science, we have an aircraft laboratory and, again, more than 50% of national capability funding is to support that, which the wider community all benefits from. It is that supporting the wider community element that is important.

Q304 **Philip Dunne:** I would like to put a couple of quick questions to Dame Jane, elevating us up to the policy and strategic level, if we may.

The Government's strategy for the Arctic concluded for the period ending 2020, I think it was. Last year you produced a 10-year strategy for the Antarctic covering the five policy areas. Do you see that as essentially replacing the Government's now out-of-date strategy?

***Professor Dame Jane Francis:*** The 2014 to 2020 booklet was not written as a strategy. It was written because at that point—this is when I first arrived in BAS—there was no documentation anywhere that described how the Antarctic and Antarctic science operated. That booklet is very factual. There are a few major science topics, but most of it is about the ships or who runs the logistics, where the funding comes from that; it is very factual information at that point. It was signed off by Ministers, but it was never written as a strategy.

Last year was a new version of the BAS science strategy. It is a totally different document. That is about BAS. That is about what BAS science is going to do and where it is going to end. The 2014 to 2020 document was a UK booklet about how the UK operated and how it works in Antarctica. Although people do get them mixed up, the two had totally different purposes.

Q305 **Philip Dunne:** Do you think that it would help you if there was clarity from the Government about whether it has a strategy for the Antarctic?

***Professor Dame Jane Francis:*** Yes, it would be quite helpful. BAS has a strategy. We have just had a corporate strategy, which is about how BAS, underpinned by the science, is moving forward into the next 10 years, and what we are doing but this is our strategy, a BAS strategy, and it is not necessarily a Government strategy. There is a gap there.

Q306 **Philip Dunne:** Would NERC welcome a UK Government-wide strategy for the Antarctic? Would it help you in allocating your funding?

***Dr Williams:*** It would form part of the mix of documents we use, including advice from the science community on how we prioritise our science funding. It would be part of the mix.

Q307 **Philip Dunne:** Dame Jane, you have raised questions about the capacity of BAS to be able to fulfil its science strategy in terms of resources for scientists. We talked about funding for science earlier. Do you believe that you have the resources required to fulfil your 10-year science strategy?

***Professor Dame Jane Francis:*** We would like more scientists. The number of scientists working in BAS has decreased over the years simply because since 2008 or 2010 there has been a declining science budget. Generally, it has been flat cash most of that time with a little bit of uplift. There is also an issue with how the UK funds its science organisations, and that was reviewed by Paul Nurse in what is called the landscape review.

One of the issues is that when we, or universities, apply to the Government for funding for a grant, we only get 80% of the costs. We are subsidising a science project by 20%. In a university, that gap is technically filled by money that the universities get as part of the review process that you may have heard about, but we do not have that. Until recently, Duncan Wingham, the last CEO, was able to negotiate 100%. He paid 100% so the money that we required for research, but that has been changed in UKRI. If we apply now for a grant, we will get 80%. I think it is a major flaw in the way that research centres in the UK are funded and I hope that that can be looked at in some way.

Q308 **Philip Dunne:** Is it also the case that you are finding it increasingly competitive to be able to attract scientists, who may be winning more projects from universities than they can through BAS, or just sheer competitive pressure of salaries in the university sector?

***Professor Dame Jane Francis:*** The salaries are a problem, they will always be a problem, but recently UKRI has listened to our arguments that the salaries of particularly scientists and engineers in the research centres generally, not just in BAS but across the piece, were much lower than in our universities and overseas, so we potentially had a brain drain. We have had what we call a STEM uplift. The science and technology engineers and mathematicians have had an increase in their salary.

Q309 **Philip Dunne:** Within BAS?

***Professor Dame Jane Francis:*** Across the whole of the Government research centre sectors, so the pressure is less.

Q310 **Chair:** Very quickly, did I understand you correctly to say that prior to 2014 there was no such strategic document available, therefore things were done ad hoc?

***Professor Dame Jane Francis:*** Not that I am aware of: I came in and Duncan Wingham, who was CEO at the time, asked me to write something that was very clear about how UK science was supported. So I am not aware of one.

Q311 **Chair:** If that has not been renewed since 2020, is there not a case that for this Committee, for example, one of the things we might think about, to call for such a strategy to be drafted by the Government?

***Professor Dame Jane Francis:*** Absolutely.

Q312 **Chair:** A very quick question, which you almost certainly will not answer. UKRI was set up as an umbrella organisation originally, wasn't it? I

understand that 3,500 civil servants work at UKRI. Presumably that is soaking up a very large part of the Government's research funding, isn't it?

***Professor Dame Jane Francis:*** I could not possibly say.

**Chair:** I did not think you would. I was confident you would not but the fact that you grinned and nodded a bit indicates to me that possibly that might be. I will not press you. It is not your responsibility. But it was a thing we did pick up somewhere.

Can I say thank you very much for your answers this afternoon? It has been extremely useful. Even more importantly, your co-operation with the Committee throughout both the Arctic inquiry and now particularly with this Antarctic inquiry, has been superb. You have been extremely kind and accommodating in every possible way. I am most grateful to all three of you and to the other people in BAS and NERC. Thank you very much indeed for that. Thank you for your time this afternoon. I hope that you have not been excessively taxed by our meandering questions.

Inevitably, if there are other things you would like to feed in that you suddenly think that you wish you had said, please do let us know later on. Meanwhile, thank you very much. Your time and effort have been much appreciated.