Catherine Ross

Interviewed by

Richard Sharpe

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Via Teams

Good morning. Welcome to the Archives of Information Technology where we capture the past and inspire the future. It's Thursday 22nd September 2022. I'm Richard Sharpe and I've been covering IT, first of all computing and then computing and networking, since the 1970s. Today we are stretching the definition of IT to include all information technologies, whether they are digital or not, because we are going back into the archives of the Met Office. We've already had four – three – excuse me, three, very interesting interviews with people making their contributions from the Met Office on the technical side, programming and so on and so forth. But now, Catherine Ross is the archivist at the Met Office and she's going to take us through many of the highlights and the history, including the development and use of, exploitation of information technologies. Catherine, good morning.

Good morning to you, Richard.

How did you get to be an archivist then, how does one get there?

The general route into archivy is that one tends to do a history degree and I, like most of my colleagues, did a history degree. So I did history, I studied history at Durham, ancient, medieval and modern history was actually my initial degree, then I stuck with ancient history through Masters and PhD, but at the same time I was working in my college archive. So I sort of got the hang of archives in terms of supporting my college, which was St Mary's up in Durham. And from then I decided that in order to stay involved in history, that archives would be a good career path for me. So that's how I got started and qualified at Liverpool.

I applied to Durham, never got in. You're obviously very bright. Now, you must be very organised to be an archivist, is that right?

It certainly helps, because archives is one of the fields of knowledge and information management, so essentially the general idea is that you are responsible for the collection, preservation and access of materials, whatever the archive might be. So you need to decide what's coming in, you need to make sure that it comes in correctly, that you know where it is and that you can always access it for somebody

else. And also, of course, when you get it out, you need to make sure that you remember where it goes back to so that it never gets lost.

And a lot of this must now be digital?

We do have a reasonable size digital archive now. So within the Met Office we have our analogue archives, and then we have a digital library and archive where we have a number of born digital collections, so those are the things that are being produced digitally now, things like space weather, national severe weather warnings, some of the atmospheric pollution type forecasting. And we also have, I've digitised some of our most important series. That's still a drop in the ocean in the size of the archive here, but it is a significant part of the most useful information that's now digitised, so scanned, and made available as PDFs on that, so that it's just much more accessible around the world for people wanting to access our data.

Can you guesstimate the yards or metres of shelf space that you've got in the archive?

Well, we did do a rough calculation and we reckoned it would be three times the height of Ben Nevis, one year. So, yes, it's quite a long way.

And where is it physically stored?

We are located, it is stored in Exeter, but that is the archives for England and Wales, the archives for Scotland are held in Scotland and the archives for Northern Ireland are held in Northern Ireland, because we believe that they should be held in their country of origin, although they're sort of all Met Office, they belong to their country of origin.

And you're in charge of those as well, are you?

I'm in charge of those, yes. So I have the overarching responsibility for the maintenance, safekeeping of all of those collections, and of course here at Exeter, not only have we got England and Wales, we've got all of the international data, private

weather diaries, rare books, all sorts of other things that sit around that core data collection, and that's all my responsibility as well.

How long have you been there?

I've been here for ten years now, so long enough to just about know where some of the stuff is.

So you're halfway up Ben Nevis?

Yes. Just about, yes.

[00:04:43]

And what is your official title?

So my official title is Met Office Archivist, simple as that.

Oh, that's good.

Yes.

You do exactly what it says on the can.

Absolutely. Although the founder of the Met Office was Meteorological Statist to the Board of Trade, which you would never guess would have anything to do with collecting data or looking after it, so at least we've moved on to the point where now the title actually does just about respect what one does.

And the Meteorological Office title was dropped some while ago just to be Met Office?

It was, yes. It was just a, if you like, a rebranding exercise, it just became a little bit more, it's a little quicker to say, a little more punchy.

Yeah. Because I told my wife we were doing some Archive interviews with the Met Office and she said, oh surely not now, not in the mess they're in. I said, no, no, not the Metropolitan Police, the Met Office. Yeah.

Yes, there is confusion there. We have to point out that we are not the Metropolitan Police.

We want to intertwine the use of information technologies. In talking to your colleagues about the more contemporary uses from the 1970s onwards really, when they started their careers, there's obviously been a massive use of computing, massive in the sense that these are massive machines that have been used. But equally, when you go back to the beginning right the way through into the 1850s and 1860s, we find the use of a very important information technology, probably ***the*** *most important information technology of its time. We'll get to that, I'll pause there, and I'm partially relying on an excellent timeline that you have produced and also on a book called* The Weather Experiment *by Peter Moore, which I'm sure you've come across.*

Yes.

I think that's quite interesting. And we start really in 1853, do we not? An international conference. Where was that then?

So that was the international conference in Brussels that you're referring to there. And then yes, that is, that is really the origins of us as the Met Office and indeed the origins of many international meteorological offices around the world. So why did that happen, why did that come about? It all comes down to a Lieutenant in the US Navy, Lieutenant Maury, Matthew Fontaine Maury, who was injured and placed in charge of the depot of ship logs, which I think most people would have thought was something of a backend job. But he realised that actually what he now had was a mine of information, but that all of these different experiences were things that nobody else had the opportunity to see, and so nobody could learn from them, and he realised that if he could put all of this information into one place, ie a series of charts, it would be really useful to seafarers. He then took that a step further and thought, well, everybody else's logs would add more information, and if everybody got

together on this then we could really create a useful series of charts for the whole world, not just the Atlantic and some of the Pacific. And so he wrote to governments around the world suggesting, you know, this international conference, and the UK was one of many who sent representatives, and out of that was the agreement to found the Met Office for a start, and then to start collecting and sharing data. It's probably the earliest international data sharing agreement in existence.

About any subject at all?

Quite possibly, yes.

And across the world, these were relatively peaceful times in the 1850s, although we do have the American Civil War coming up and we do have the conflict in Crimea yet again, coming up with the Russians. But relatively peaceful time. And we're talking about a Pax Britannica, are we not?

Yes, I mean I suppose it's sort of wider than that in that, you know, it's not just the British Empire as was then, you know, it really is a collaboration of nations, some of whom were not necessarily on very friendly terms, but they agreed to share data because they would benefit from it as well.

Britain had the biggest navy then and it had also [incomp 09:14] of free trade and was trading around the world and it wanted its ships to come home safely…

It did indeed.

Both merchant ships and navy ships. So that was the push. And 1854, 1st August is Department of Trade launched the Meteorological Department, is that right?

That's correct, yes.

In numbers 1 and 2, Parliament Street, Westminster, right close to the Houses of Commons.

Absolutely, yes. The building's still there, of course.

[00:09:43]

And they appointed who?

So they appointed Robert FitzRoy to be Meteorological Statist to the Board of Trade, and his job was to basically set up this observing network. I should stress at this point that the interest was marine. So, as you noted, it was about getting your cargo safely around the world. The Met Office was established for the protection of life and property at sea, but in the Victorian period one would suspect that the stress may more have been on property. However, yes, so his job was to start putting in place the mechanisms to collect data. So things like designing a log with obviously columns, dates, etc, elements that all Royal Naval vessels would use, and then moving this out to merchant marine as well, so that you had as many ships as possible observing. Then starting to think about where he could put occasional bits of land observation, so our very earliest anemometers, so those record windspeed and direction. So we have very early anemometers from Bermuda and also from Ascension Island, I think it is. So sort of looking at basically small points in the Atlantic where you could put a permanent fixture that would give you further information. Obviously lighthouses, light vessels later on, but lighthouses were another sort of point where at least you had a fixed point which was useful in addition to the ships moving around.

Now FitzRoy, an interesting man, a naval man. He was captain of the Beagle, was he not, with the famous voyagers to Tierra del Fuego with Darwin?

He was, and for many people that's what he's more famous for than the founding of the Met Office. Yes, he was a very accomplished surveyor and he actually came to the attention of Admiral Beaufort, he of the Beaufort Scale, because Beaufort was also a very accomplished surveyor, older than FitzRoy, and he sort of saw FitzRoy as a bit of a protégé, and that's why FitzRoy was going on these voyages and that's why he went to Tierra del Fuego. It was all about surveying the coastlines and improving the charts, but as a gentleman on board a ship he would be too senior to be able to speak to any other member of the crew, they were not in the same class and it would not be

appropriate. And he realised that if he was going around the world, or going anywhere for round about a year he'd probably go completely insane without anybody else to speak to. So he asked Beaufort to find him a gentleman companion of the right class to go on the voyage with him. And it was Beaufort that identified Charles Darwin as a young man who would be interested in such a journey, so that's how they came together, actually, to start with. And it was also Beaufort that recommended FitzRoy to become the head of the fledgling Meteorological Office. So he's sort of there all over the place, really, in the early history of the Met Office.

And the Beaufort Scale is for windspeed, is that right?

Yes, it's a scale of windspeed. So it starts at one, goes to twelve, and it's the same speed, it's the same scale that we still use today. If you look at the original, Beaufort's terminology is slightly different, but it's still 12 forces of wind. So the consistency there of course is fantastic, you know, we still refer to hurricane force winds, that is force twelve, it's the strongest force winds you can get.

FitzRoy was a rather strange man, was he not, because he became very religious later on, didn't he, and was very upset with Darwin and Darwin with him, and the two diverged, did they not?

They very much did, yes. So on the voyage, on the voyage even FitzRoy is referred to as- well, Darwin used to refer to FitzRoy as 'Hot Coffee', was his nickname for him, because he was quite reactive, I think would probably be the terminology. But yes, later on certainly FitzRoy did become, or did start to feel more about his religious convictions. You noted the Tierra del Fuego voyage, obviously one of the things that he did do there was collect a couple of Fuegians, who he brought back to the UK to be, unfortunately in the terminology of the time, would be 'civilised' and introduced to Christianity. At least, in his favour, he also returned them to their home country. But yes, he was a committed Christian and he did not deal well with the concept of, with Darwin's concepts of the origins of man, he believed that, you know, God was the creator and at the Oxford Conference where Darwin put forth his theories, FitzRoy is famously supposed to have walked around with a Bible on his head. I don't know if that's true, but that's what they all said happened anyway.

[00:15:00]

He collected as much information as he could and it was using these networks of people, communicating with them by correspondence, written correspondence, and trying to cajole them, or even order them in some cases, to collect information. And it really took a real disaster, did it not, to really push this idea forward that there should be a greater focus on what the weather was going to do. It's the disaster in late October of 1859, can you explain that to us?

Yes, absolutely. So as you say, the origins of the Met Office were in data collection, climatology as we would call it now, concept of forecasting was not there, what the weather would do was an act of God, you couldn't possibly forecast it. Interestingly, in terms of that sort of historical, that religious basis of FitzRoy and the act of God, this is something where he's actually very much putting a scientific twist on that. So I don't think, his beliefs I think possibly were not necessarily applicable across the board. But anyway, so yes, 25th and 26th of October 1859 is the night of the Royal Charter storm. The Royal Charter storm, so named for the Royal Charter vessel, ship, which sank off the coast of Anglesey during the night with the loss of over 450 souls. It was actually a Gold Rush ship returning from Australia, it was heavily laden with gold and also a number of civilians, and it hit the headlines, partly for the loss of life, also for the fact that of the forty or so survivors no women and children survived, even though it sank within sight of land, because the storm was just too strong, they could not get any vessels out to the ship. So in the end it came down to one of the crew swimming on shore with a rope and then those who were strong enough could get themselves ashore, but of course it was a very limited number. It is sort of thought that gold was washing up on the shores of Anglesey for some time afterwards. But yes, I mean it didn't just affect the Royal Charter, so 133 ships sank around the British coast, a further ninety were badly damaged. Eight hundred lives in total were lost on that one night, which is more than had been lost around the entire British coast in the last two years. It remains the single biggest loss of life on the Welsh coast in history. And of course, it hit the headlines. And this is where FitzRoy comes in, and he approached Parliament, basically, and said, we've been taking observations for years now, we have the knowledge, the understanding of how weather systems progress, we

could have foreseen this, we could have warned that this storm was coming and potentially saved at least some lives. And so he put together a report, Board of Trade Report Number 10, which went into Parliament requesting that he be allowed to start a gale warning service. There was, I think, quite a lot of doubt that this was really possible, but in light of the disaster it was a case of, well, give it a go, what have we got to lose, realistically. And so he set that up and I think possibly our first critical means of electronic communication is coming up, because we couldn't possibly have done that without the birth of weather telegraphy. You cannot give a forecast if you cannot get data from one site to another and back again in a timely fashion, and that was impossible without the telegraph network. So all of this, all of this founding of forecasting depended on the birth of the telegraph network. He founded the storm warning service, it's now known as the shipping forecast and it's, again, believed to be the longest running national forecasting service in history. Of course it's an icon of Britain now.

[00:19:13]

It is. The author called Tom Standage wrote an extremely good book on the Victorian telegraph system, called The Victorian Internet*, and it is an amazing piece of technology. Wires across the country and then eventually undersea cables as well, which were built out at Greenwich, for example, was a major manufacturer of undersea cables, one of the first being to France, and it was pulled up by a fisherman and cut in half, so they had to relay that. And then eventually, of course, quite amazingly, across the Atlantic. The first one failed, but the second one was usable and was used. So the world was being networked together and pulled together, again, by British technology, because this was a British invention, was it not?*

Very much so, yes, yes.

Although, it's slightly American in Morse code, but the actual money was coming out of London and it was being subsidised by the government because it was so vital for information transmission and for controlling and organising an empire.

Indeed.

So in only six years, from the set-up of the Met Office to this disastrous night in 1859, Fitzroy's been able to push himself forward and really make a name for himself with this weather, with this storm, not yet weather forecasting is it, really, it's a storm forecast service.

Yes.

So what would happen? I imagine he'd look at the data, they'd analyse it in Parliament Street – it was Parliament Street, yes.

Yes, it was.

They analyse it in Parliament Street and then it sent out warnings by telegraph to the various harbours, would they, in the United Kingdom?

Yes, you're exactly right. So, not by any accident, a telegraph station was located next door to numbers 1 and 2 Parliament Street. So the telegrams went in, they were then of course taken straight next door, or communicated straight next door so you had an immediate link. Yes, FitzRoy and his team of, well, basically one, two would then look at those observations, decide where they thought a storm would hit and if there was going to be a storm. If there wasn't, nothing would happen, so this is why it's not quite forecasting as we think of it today, but if there was something that needed to be warned of they would then send communication back out through the same network to the major harbours, at which point the warning – we had no ship to shore communication, it's before the days of Marconi, radio, anything like that – so it had to be a visual warning at that point. So at this point we go old scale, old style from new style and essentially they, FitzRoy again designed a system of cones and drums. So basically large canvas shapes that would look the same whichever angle you saw them from, so there was no risk of confusion, which would be hung from a mast or other tall point in sight of the harbour and the shore for coastal shipping. And if ships saw those and the order that they were in, they then had a warning of which direction the gale would be coming from and roughly, sort of within twelve hours, that kind of thing, roughly when is it coming. So it was a warning to come in, or a

warning not to go out, depending upon what their intentions were. The first warning was actually ignored on the Tyne – the first warning was in February 1861 – and it was ignored on the Tyne and there was significant loss of life as a result. So it was not ignored after that.

No, no. He's a very innovative man, isn't he?

Absolutely, yes, yes.

You mentioned the fishing forecast, yes?

The shipping forecast, yes.

*The shipping forecast – I called it fishing, sorry – the **shipping** forecast, and one of these areas, along with Iceland and so on, is FitzRoy, is it not?*

It is now, yes. So the shipping forecast areas were not designed, not officially laid out until about the 1920s and it, they sort of, they grow and they change over time. So the area is widened and the actual shipping forecast areas are made smaller and more precise, and in the 1920s a group of meteorologists from the UK and from the North Sea coasts got together and kind of decided what they thought the areas should be and named them. Most of them had geographic terms. So Forties is because it's normally forty fathoms deep. Dogger because it's Dogger Bank. A lot of it's fishing banks, for obvious reasons. And the furthest south used to be called Trafalgar, but in, during the twentieth century at least there was increasing confusion between Cape Trafalgar, which was a Spanish meteorological service forecasting point, and the shipping forecast area, Trafalgar, which are not in the same place. And so it was decided to rename Trafalgar, and the obvious name was FitzRoy, of course.

[00:24:27]

I like that story, because these archives are not just filled with information technology and stories of bits and bytes and the speed of the telegraph and so on, they're also full of human stories and that's the thing that makes them move. So, he used the

telegraph, he put out the first gale warning, and then the same year I understand, in August, the first public weather forecast. Now, he's chancing his arm here, isn't he?

[laughs] Yes, he was. So FitzRoy believed that the shipping forecast was important to mariners. He also understood that not just mariners – mariners not just at the large ports needed it – so he designed a barometer for the fishermen, that came out of his own money. And then he also thought that the British public would find it useful to have a weather forecast as well. Now that's the bit he didn't have permission for. So he went ahead anyway and he published his first forecast in *The Times* on 1st August 1851, as you say, 1861 as you say. And it's just four lines, which are almost impossible to actually see until you know where they are, and he just talks about sort of north, westerly wind fine, kind of thing. It's a very simple, very general forecast. And he didn't actually include the east on the first day and we've got a note in the books where he was sort of planning his forecasts to say, from tomorrow we will include the east. And actually, the first forecast was accurate. But yes, he was chancing his arm. Marine forecasting, some would say slightly easier. They had more data but they just had more understanding, more experience of forecasting. Anyone that's been in the navy sort of naturally becomes a forecaster by means of having been on board a ship for thirty years. It's not the same for land forecasting. They had data, that was all, they started that coming in through the telegraph network, same sort of set-up. But they didn't necessarily have the depth of scientific knowledge to understand more complex synoptic situations and the forecasts were wrong on occasion, possibly more than on occasion, and so he did receive a lot of criticism, particularly from members of the Royal Society. And yes, that is, that plus the fact that he nearly bankrupted himself doing something very, very good in putting out those barometers to the small fishing ports, is believed to be the reason why he took his life in 1856.

He was a bit of a depressive, wasn't he?

He was. That's one of the reasons why he took Darwin round the world with him to start with. He knew that he didn't have, didn't have the mindset to deal with things as well as some others might, so he needed that company. And yes, he was a bit of a depressive. I think people would refer to it now probably as manic depression, it's

one of the thoughts of what it might now be considered, we don't know. But yes, he did suffer with bouts of depression. And…

I'm sorry, Catherine.

No, I was simply going to say that we see his handwriting in the daily weather report books that we have here where the observations come in and then they kind of note what the forecast is going to be, and towards the end of his life there are longer and longer periods where he's not in the office and it's the handwriting of Babbington, who was his sort of second in command, because he's just suffering with these bouts of depression.

He was a relative of Castlereagh, was he not, the famous English politician who also committed suicide, and I understand – he was Admiral by now, wasn't he?

Yes, he was Admiral by now.

I understand the Admiral was concerned that he might indeed take his life, which unfortunately he did. Now…

Yes.

… this kicked off a bit of a brouhaha and nearly an interruption in the whole thing, because basically, as far as I understand it – you will understand this much better than I do – he didn't really have a scientific background to explain what was going on. He was making judgements about what was likely to happen in the forecast, without having a solid theory, and what the Victorians liked was a solid theory. Is that what happened?

[00:29:05]

To an extent, yes. So he did write a book in 1863 or '64, he wrote his book of weather forecasting, which is essentially the first textbook for forecasting, and in that he coins terms like 'forecasting', that's FitzrRoy's term, 'synoptic', that's FitzRoy's

term, and he talks about forecasters needing to talk in terms of likelihood rather than certainty, which you'll still very much hear to this day. And he started putting forward some theories, things like air masses. You know, there's an image in the back of his book where you can see sort of warm and cold air masses mixing, and he was starting to understand sort of circulatory theories and those sort of, you know, those concepts of meteorology. But there was a lot more that was, didn't, yes, as you say, didn't have a solid theory behind it, and that's one of the reasons why the Members of the Royal Society reacted so negatively to his approach, because it wasn't based on a sort of a solid proven theory, because that takes time, and it was, well, after FitzRoy's death there was basically a large review of the Met Office. The Royal Society argued that it should be shut down completely. In the end, that wasn't what happened, but it was, management of it was given to the Royal Society, in essence, and all forecasting was stopped with a focus on building the scientific theory instead. Very swiftly afterwards the gale warnings were restarted, both because of the increased loss of life and a significant public outcry and questions in Parliament, etc. So the gale warnings had to be restarted, because they were effective. But land forecasting and the public weather forecasts, the equivalent of what we mentioned of 1st August 1861, they didn't restart until the 1870s when they felt they had sufficient theoretical underpinning to be more accurate more of the time.

Right, right. So it did get back on track eventually?

It did, absolutely. And over that period we see the development of, you know, the understanding of isobaric theory, pressure, isobars, how winds flow along isobars, all those kind of things that are very critical. Many other things of course came much later, you know, the understanding of how the upper air affects our own meteorology, you know, the tropopause, the jet stream, that's the mid-twentieth century before any of that comes along. But yes, a lot of the basics of meteorology are developed in those kind of, those twenty, thirty years at the end of the Victorian period, really.

And there was a man from Greenwich was going up in a balloon, higher and higher and higher, was there not?

There was, yes.

Who was he?

We're talking about James Glaisher here.

Yes.

So yes, Glaisher was definitely forward thinking, or certainly upward thinking.

Yes, that's one way of putting it.

And there is of course a film about him now.

Is there?

Yes, *Aeronauts* came out, ooh, about three years ago, I think, now.

Okay.

Some of which is accurate, some of which is not. He did not have a female in the cockpit with him, he had a male, and a very good aeronaut that male was too. [laughs] But yes, James Glaisher started to go up to- he discovered, he had instruments tied all over the cockpit and he sort of, he was the first, we believe, he encountered that sort of, the tropopause point for the first time. The point where temperature decreases with height and then actually it levels off very briefly and then it decreases again, and that's a point in the atmosphere. And he, we think, encountered that for the first time, so he started to understand that, you know, there are, that things change as you go up, let's put it that way, and winds can be in different directions or can be stronger, all that sort of thing that he encountered as the balloon started to sort of veer off to the left and right. So, but the other thing that Glaisher did was establish a rainfall observing network and that involved ordinary men and women all over the country taking rainfall observations and sending them in. And that's the start of what is a very, very dense and actually very important climate network that we have still to this day, it became the British Rainfall Organisation, and then that became part of the Met Office. But that rainfall network is actually very

important. It was one of the earliest sets of data that were then, I say transcribed, put onto Hollerith cards and collected, not the first set, but it was one of the earliest sets to be sort of analysed in that way because it was so important.

And apparently these two went so high they both passed out, because they went without oxygen.

They did, yes. Another thing they learned, oxygen decreases with height. So, yes, it was actually his pilot that came round first and brought them down to safety. He climbed up through the ring of the balloon to sort out a problem and got them down again and Glaisher was unconscious for some time. But his observations kind of, because he was taking observations every five minutes, I think it was, and his observations stop and then restart again as he comes round.

[00:35:12]

So, now the calculations are being done, because you have to do some calculations, presumably with paper, pen, pencil, eraser and maybe one or two ready reckoners, is that what was used really as the technology?

Most of it's that. They had two additional things to help them. So one of them, designed by Galton, James [Francis?] Galton, was a trace calculator, otherwise known as a, well, also known as a pantograph, as far as I can tell. I don't know very much about this wonderful instrument but it was designed in the 1870s, or used in the 1870s, and essentially when meteorological instruments, particularly then, took an observation, it created a line on a piece of paper, they were known as curves. They weren't necessarily entirely curves, they were up and down and all over the place according to temperature, pressure, etc. But these needed to be turned into numbers, so he developed a trace calculator, well, yeah, trace computer which could be used to basically trace over that number and then by, basically by means of a separate contraption that it was attached to with a set of *x* and *y* axes it would then turn. You press your finger on a lever and it says, right, okay, you are now at *x* point on *y* axes. So it could turn these things into numbers. It was manual but it was a way of turning graphs to numbers. And then later on they had the first harmonic analysis. So Kelvin

harmonic analysis was brought in for statistical analysis of pressure and temperature, again, from the traces. And actually that machine is still in the Science Museum, the Science Museum collection, the first harmonic analyser. So again, we had a few analogue computers, if you like, which were helping with taking the base observations and turning them into numbers. From that, the calculations from there, absolutely pen, pencil, ready reckoner, etc.

And about this period, if we move on a little faster – sorry, a little further, not faster – to around 1900, the beginning of a new century, we've got tabulating machines by then. Is there any record yet that you've been able to find in the archives of the use of any type of tabulating machines?

I have not found any reference to tabulating machines. That doesn't mean they weren't there, but I haven't found a reference to them. They seem to be basically just, you know, pen, paper and well, to be honest, they abandoned the trace computer because it was just too complicated, but they were still using harmonic analysis. So it's those kind of things and then it's really all about, the focus for the technology becomes all about weather telegraphy, for a while, really, rather than the data analysis. That's being done very much, you know, lots of people, who were known as computers, I have managed to actually trace that from the 1860s onwards now, carrying out calculations, but it was people, not machines.

So there are people from the 1860s onwards, who are called computers, and who are doing the calculations? Is that what you're saying?

Yes. They're referred to in the annual report from at least 1869, but that's when they're referred to as having employed another nine, so it implies that there were certainly some before then.

Well done, that's a very good piece of research. That's excellent. And – C-O-M-P-U-T-E-R-S?

Yes.

Wow. There you go. And about this…

Computers computing calculations.

[00:39:10]

Yeah. And about this period as well, we've got Senor Marconi, have we not? He came to this country of course and set up in north-east London, didn't he, the Marconi company, and he is used for wireless telegraphy. No longer needing the wire itself and so this is used on ships with the Marconi Room, I believe it was called, and it was kitted out, was it not, with a receiver and transmitter. So when did this technology come in to weather data collection?

I don't know the exact date for that. What I do know is that you see a shift in the, certainly the number of marine observations collected, basically from the Titanic disaster. That marks a key step change, really. Now, obviously there were Marconi Rooms in ships before then because we know that the Titanic had a wireless room, it was sending out signals. But from that point with the loss of the Titanic, there is suddenly a huge interest in marine information, sea ice information, and so the US launched a ship to go out and research. The UK focussed on ship-to-shore wireless, and so it established basically ship-to-shore communications for sending marine observations, post 1912. So that's when we definitely see that coming into play in the Office. But it doesn't mean it wasn't around before then, but that's when it certainly has a major step change.

You previously found, according to your timeline, 1909, 10th January, first weather observation received from a vessel, the SS Caucasian, using Marconi's wireless telegraphy, you already found that yourself?

I'd just forgotten that as we're talking. I don't have the timeline in front of me, you do.

It's a magnificent piece of work, this timeline, and hopefully we'll have it online sometime. Now, we've got to move on, I think, because there's a lot here, the history,

but what I'm now going to focus much more on, on the increasing role of the idea that you can actually numerically predict what the weather is going to do. Numerical weather prediction – NWP, is that, that's what it's called, is it not?

Yes, yes.

And in 1922 there's a man who you are very interested in, Lewis Fry Richardson. And he's a pioneer in numerical weather prediction, tell us about him and why he's a pioneer.

Yes. One of my favourite people, Lewis Fry Richardson, I rather like him. So, taking us slightly back, he was, Lewis Fry Richardson was first involved in meteorology in 1913 when he was appointed the Superintendent of Eskdalemuir Observatory. He had no knowledge of meteorology at all, he was a physicist and he was brought in to bring a more theoretical approach to the understanding of meteorology. So basically to start working out some of the underlying equations that might help you to calculate the numerical weather prediction, as it would become. And so he started working on this concept and the first draft of his book, *Weather Prediction by Arithmetical Finite Differences* – there you go – was actually ready not long afterwards. And the Royal Society sort of said, publish it, and he said, no, I want to do a worked example first. Unfortunately, along came the First World War. Now Lewis Fry Richardson was a devout Quaker and he could not bring himself to have any of his work, anything that he was involved in, be used for the furtherance of war in any way. He repeatedly asked for leave to join the Red Cross or an ambulance unit, it was refused because of course the work he was doing was really useful to the Met Office. So in the end he resigned and joined a Friends' Ambulance Unit – obviously, Friends, Quakers. But he took his work with him and worked on it privately and he worked up, he did produce that worked up observation. It was actually basically, apparently to him it was quite inaccurate and he was quite disappointed, but actually – now is it- who looked at it later on? Peter Lynch, a more recent meteorologist, has gone back and looked at that and actually the only thing that Richardson didn't understand about at that point was the concept of smoothing, data smoothing. If he'd applied data smoothing, which is a concept that didn't exist at that point, so of course he couldn't apply it, he would have had an accurate forecast. So actually, his calculations, which

were carried out in a war zone, were bang on, which is incredible. After the war he returned to the Met Office and he published his book, which by this point is known as *Weather Prediction by Numerical Process*, and that was published in 1922. And that's basically, well, seventy years ahead of the concept of a computer, he is describing a computer, he's describing how a computer could work. And there's a wonderful phrase in it where he's, he's just letting his imagination run riot and thinking, how could this theory of mine that I know can't possibly happen, how could it happen. So essentially he describes, he envisages a theatre. Think of the Albert Hall but a lot bigger, all full of boxes and each box is a different grid square in the globe, with people calculating the observations for that grid square, and then there's essentially a conductor in the middle with a torch and every so often the conductor will make a move and everybody will pass their paper one to the right, essentially. And the conductor's keeping everybody in time, keeping all the motions moving in time so that, you know, your forecast is created and goes around and keeps going around. And he reckoned he'd need 64,000 people to do it. Later people reckoned it was more like a million. But if you show this to one of our IT experts, as I have in the past, they've basically said, he's describing a supercomputer, he's describing the master-slave relationship of a supercomputer with, you know, the multiple nodes or, you know, whatever they might be using at the time, obviously supercomputers have changed over time, to actually carry out these calculations. So he's got the idea in his head long before anybody had got a computer that could even get close to what he was trying to do. But his basic, his basic equations are still there at the bottom of the models today, because they're the basic equations of thermodynamics.

[00:46:28]

Did you say 64,000?

I did.

He said 64,000?

He reckoned 64,000 people, yes.

That's amazing, given our binary, the binary nature of computing and the importance of 64,000. It is quite amazing, isn't it? So it went on and the system was expanded and developed, presumably international connections were made and information was passed internationally?

Are we talking about data or are we talking about NWP?

No, the data itself.

Oh, the data itself. Yes, absolutely, and that's where Hollerith cards come in. So the Met Office started using Hollerith cards from 1821 – sorry, correction – 1921. 1920 actually – checking my notes – from 1920. And then from 1926 that's when international data sharing started. So the Met Office received observations coming in from KNMI from the Royal Meteorological Institute of the Netherlands. So that's marine data coming in. And then later on data is being shared with India or coming in from the US and, you know, Hollerith cards became the de facto means of moving data around the world.

Good, okay. Next we've got another piece of information technology coming along, because of course we've got then radio transmission in broadcasting on 2LO of a weather forecast. Yes?

Yes, absolutely. And just as this year is the hundredth anniversary of the BBC, it's also the hundredth anniversary of that first forecast. It went out two hours after the BBC first crackled into life. So yes, it went out on 2LO, as you say, didn't reach necessarily all that many people, but it was a forecast, a read forecast, a text produced by the Met Office that a presenter then read out. Yes.

Probably in a dinner jacket.

Almost certainly, yes.

And this was transmitted from Savoy Hill in London?

Yes, it was initially. Yes.

Okay, so we come through this. We've got television as well, in 1936, early use of television, but that was aborted with the outbreak of the war, was it not?

There were two factors. The war certainly didn't help, but the main one was that not just, simply not enough people had a television, so you just weren't reaching enough of an audience. The proof of concept was there, you know, you could read out or even put a chart on a screen and describe what was happening through a read text – we haven't got as far as an actual forecaster in front of a television at this point – but there simply weren't enough televisions, the network was not big enough. So they basically paused that until such times as the television network was large enough to make it worthwhile. I should also point out that there were no forecasts at all of any variety during the First or Second World War, because that data could be picked up and used by the enemy. So the only thing you had eventually was a few coded forecasts which were put out for the farmers to enable them to, let's say, get the crops in before a storm was going to come through, or warnings of frosts for the apple crops and things like that, but that's the only forecasts that you had during the wartime periods.

[00:50:04]

To put it bluntly, most of the weather comes from the west, so you don't want to tell the Germans what's going to happen.

Pretty much, yes. And you can actually see, we obviously have the D-Day charts, and one of the key things about those is that you can see from them that the British had broken the Enigma code, so they were reading all of the German data - that was all going on at Bletchley Park and the Met Office did of course have a presence there – but if you look at a German chart for the same period, there's no data for the UK, because they hadn't broken UK codes, but there's also no data for the Atlantic because they'd lost submarine, most submarine superiority, they'd lost air superiority by that point. There's virtually no knowledge, I wouldn't say none at all, I'm sure

there was some, but they had very limited vision of the Atlantic, and as you say, most of our weather comes from the west.

Tell us the story of D-Day forecasting.

[laughs] Yes. As Junes go, it was one of the most unsettled for some considerable time, which really didn't help them. But, so the chief forecaster was a gentleman, a dour Scotsman by the name of James Stagg, who was a member of Met Office staff, became obviously seconded into the RAF, as did most operational Met Office staff during that period. And his task was to work with allied meteorologists, so to work with the Americans, to work with the British navy, RAF, and to collaboratively agree forecasts. A challenge, bearing in mind that they used different systems and definitely didn't agree on very much at all. So his skill was as a forecaster, but it was largely as an administrator and I'd say possibly a peacemaker. But essentially it came down to him in the end to decide what the forecast was going to be. Ideally they would all agree it, but if they didn't, he had to decide which way he was going to go. And, as I noted, early June was extremely unsettled and so there was a very high degree of discontinuity between the forecasters. And the plan of course had been to invade on 5th June. On 4th June he then had to give a forecast saying that the forecast would not be good enough, that a front was expected to come in, basically sit across the English Channel and make it impossible for the armada of, especially the flat-bottomed ships, to actually cross in any degree of safety. The American meteorologists didn't agree with that and so it was a tough decision to call, but it was the correct decision. And so he took that to the joint chiefs, based in Southwark House, they were all based in Southwark House, near Portsmouth, by this point, and Eisenhower made the decision not to go, and then at 3 o'clock on the 5th, at 3am on 5th June he had to go with the next forecast which was, well, it's your call but we think it's, you know, we think it's marginal but we think it's good enough. And so you see in his diary, final and irrevocable decision, the invasion is on, basically. And he was, clearly he was not convinced it was going to be okay. He knew just how marginal that forecast really was, because he sort of notes that Admiral Creasy and various others of the joint chiefs congratulated him and he said they need to wait and see what happens.

And it was successful but later on a storm did come and wreck many of the Mulberry harbours.

It did, and indeed that storm did not come from the west, and it was not seen in… with accuracy. It was actually round about the same time as the second, the second period in June when the invasion could have gone ahead. So had they not gone on 6th June they'd have had to wait until round about the 20th, 21st. And at that point the Met Office forecasts appeared to be okay – well, I wouldn't say just the Met Office – the allied forecasts indicated the weather was okay. Actually, there was a very severe storm that came up, as you say, it wrecked at least one of the Mulberry harbours, and the forecasting for that was not great, because it came up from the south rather than from the west and it was just an area that they didn't have the vision on.

That was close.

Or didn't have as much vision on. Yes, absolutely. Indeed, Stagg wrote a report afterwards. It's only a brief report but it kind of notes kind of the weather on both periods. And he didn't say, you know, it would have been a disaster, but sort of clearly from that weather report, it's rough, it's windy, there's a storm. And Eisenhower sent it back, we have it in the archive, and he sent it back with a note across – or a copy back – with a note across the top saying thanks, and 'thank the Gods of war we went when we did'.

Oh, wow. You've got that in the archive?

We've got that in the archive, yes.

[00:55:20]

Magic. Now, during this period, there's a very brilliant and at that time little known mathematician working in Bletchley Park doing things on a machine called Colossus, first of all the Bomb, and then Colossus, and he moves out and he goes to the National Physical Laboratory down in Teddington, and then he goes to Manchester, and he's got various ideas that he's had since the mid-1930s about a device. In fact a Turing

device, because he's Alan Turing. And the thing is beginning to kick off on both sides of the Atlantic. So there's more and more calculation having to be done for the numerical weather prediction and in 1951 somebody, something rings a bell in somebody's head that maybe the Met Office should look at computers. Is that right?

Er, yes. So, as you say, post-war in the UK a lot of the staff from Bletchley Park scattered, essentially, to different places. So you've got Manchester, you've got Cambridge and you've got National Physical Laboratory. In the US they sort of stay together actually for a bit longer and became, they stayed as a company, kind of, called Engineering Research Associates. That sort of then split off a bit and various people were in there, including one called Seymour Cray, who founded Cray Computers, which became relevant to the Met Office later on in its lifetime. Within the UK, yes, they split up and so you then had a computer at NPL, a computer at Cambridge, a computer at Manchester. And then the Lyons catering company comes in, of all things. It's not quite where you'd expect the Met Office story to go, but it does. So Lyons catering, a very forward thinking, very large catering company, starts deciding that they want to build their own computer. They looked at the options and they decided that they were going to build a version of the Cambridge computer. So they built their own Lyons Electric Office, with, only twenty staff built it. They started in 1949, it was operable by 1951, they did a pretty decent job. So they built their computer. And that's sort of where it starts. At the same time, in May 1948 there was actually a meeting which was held jointly by the Met Office and Imperial College to discuss – and I quote – 'the possibilities of using electronic computing machines in meteorology'. And so sort of from that, after that a Forecast Research Division was established at the Met Office and then one of those members of staff went on a training course to Cambridge and looked, understood the Cambridge computer, and as a result of that of course there was a match of that Cambridge computer at Lyons, and so the Met Office, two members of Met Office staff, Fred Bushby and his assistant, Mavis Hinds, started using the Lyons LEO at Cadby Hall, at Lyons headquarters to do the very, very first experiments, explorations, if you like, into the application of computing to meteorology. We're not really sort of looking at NWP at this point, it's can we produce charts, can we put data in and get some kind of model out. The first sort of atmospheric model calculations have been put together by Sawyer and Bushby, that was also happening in sort of '51/52. So they were playing

with that in 1951. It's very, very early days, just sort of trying to get, trying to see what they could actually produce with a computer.

You mentioned Fred Bushby. Who was Mavis?

Mavis Hinds was a Met Office, well, she was basically an assistant, but she – just – you know, an important but a Met Office member of staff who was his assistant who was basically one of the first two members of Met Office staff that were really sort of involved in, I say putting numbers into a computer, putting code into a computer and seeing what would happen.

Mavis Hinds. H-Y-N-E-S?

H-I-N-D-S.

H-I-N-D-S. Hinds. We must note that word, that name, I think, and give it appropriate accolade. Well done Mavis Hinds.

[00:59:53]

So basically, the Met Office is using a bureau service, as we would later call it, with the Lyons machine, yeah?

Erm, I think so, yes, in the terms of it's a borrowed machine. I mean it came with the benefit that they got dinner in the managers' mess every night when they were working on it.

[laughs]

But yes, it's very much a collaborative exercise. So yes, they're borrowing the machine, they're getting the assistance of the Lyons staff to use it. But what's also quite amusing is that the Lyons staff also then built the forecast into, well, built Met Office forecasts – this wouldn't be what was coming out of the machine because I don't think it would have been quite as up to date as that – but they were building the

forecast into what they put… to decide what they were going to put into their fresh produce vans that were going out across the country. So you sort of get this mix of Met Office is benefitting but they're getting, they're using the forecasts too.

Because they had to supply all of these teashops, these lovely corner shops and so on?

Yes, the Lyons corner shops. And they also had, it would seem, just simply fresh produce vans that went out and people could buy from them.

And presumably the number of iced buns would go up or down depending on the weather, so that's what they wanted to know.

Yes. You know, what do you put on your van. And of course if it's going to be very hot, they won't be very well refrigerated so you don't want to put things on there that are going to spoil.

Now Lyons also made ice-creams, didn't they?

Yes.

So that was good, that was good. Okay. We should move on, should we not, to 1959 when the Met Office gets its own computer. Or have we missed some significant things there?

We've missed one in the middle, we've missed 1952 when the Met Office starts using the Manchester Computer. And we should definitely mention that because Alan Turing was also using it.

Oh, God. What was it used for?

So basically they, the Lyons computer was good but it wasn't powerful enough. It's a running theme, the computers always become not powerful enough. So they needed, they needed to move on, so they started using the Ferranti Mark 1, which was the Manchester Computer, to carry out calculations as a sort of, it's sort of a precursor to

a system of mathematical forecasting. It's testing and experimentation again, basically. But it did, it basically proved that, sort of proof of concept again, it proved that actually there might be a future for the concept of NWP. And they were working on that machine at night as well, going up to Manchester for a couple of nights every other week and frequently having to scale the gates of the university to get in to use the computer. And Mavis Hinds, again, in some of her memoirs notes that it was, some of the people that had to climb over the gates went on to take senior positions in the Met Office. But yes, so they were using Manchester and it was really from there that they could prove that the Met Office needed, you know, it was worth the Met office investing in a computer. Put it that way.

So Mavis Hinds is involved again?

Yes, she's still there at that point, working in Manchester.

Did you say she had a memoir?

Well, she wrote an article called *Computer Story*, and it's as close as you get to a memoir. She really doesn't- there isn't – there should be – but there isn't really a memoir. She doesn't publish much about herself, but she does talk about that story of computing that she was involved with, so there's a little bit of her within it.

And sorry, that has been published? Where?

So that went out in the Meteorological Magazine, amongst other things, so it's definitely out there in the world.

Oh, right.

In one of my notes I should have what it's called. Yes, *Mavis Hinds: Computer Story*, and it was published in 1981.

We'd like to have that.

I'm sure we can get hold of it for you.

That would be marvellous. 1981. So we then get to 1959…

Yes.

… and buy the first computer, which is a Ferranti again, Ferranti computer, because you're aware of the architecture as a result of the Manchester machine and it's put into Dunstable.

[01:04:32]

Yes. So the Met Office was split apart during the Second World War, various elements went to various different places. The main forecasting division went to Dunstable, which was not very far from Bletchley Park, that was no accident, and post-war Dunstable sort of stayed as the main headquarters of the Met Office, the nerve centre, if you like. And that's where the computer goes, ordered in 1955, delivered in 1959. But staff had actually attended their first actual programming course – before that they just had to sort of work it out – but the first programming course was in 1956, so by the time it's delivered in 1959 you have staff – I don't know how many, I haven't been able to find a number – but you have staff who are capable of actually using the machine. What I also thought was rather fun was they had, they'd identified who was going to have to be the maintenance engineer for it, and in order for him to learn, he actually went to the Ferranti factory and helped to build a Mercury computer so that he knew how it would work.

[laughs] That's really looking after your customers isn't it? Close interconnection of the supplier and the customer. So in the use of computing, as I understand it, there are basically three ways in which the Met Office will use a computer, or computing power, let's put it like that. One is, standard things like payroll. You may or may not do that yourself, but payroll will be a classic. You've not got a lot of, you've not got a lot of process management to do, you've not got a lot of stuff to order, but you might have bills of material and things like that. So the classic back order type of stuff. Then we've got the operational, it's actually generating forecasts, yeah?

Yeah.

Weather prediction. And that depends on a series of things that I discussed in detail with Chris Little yesterday, the grid size, the type of capture, the grid size is now down to, well, ten kilometres. It used to be 260 kilometres, so it's getting finer and finer and finer, which means you need more and more processing power to actually process it in time, because you don't want today's weather forecast tomorrow, you want it yesterday, basically.

Yes.

And so it's got to be done in time. Now, you're always therefore pushing the limits of power and coming over what I call the Turing horizon. If it doesn't give it to you in time, then it's no good. If it's somewhere over the Turing horizon and it can't be computed in time, it doesn't matter. I don't want to know in five days' time that there is a nuclear attack coming from Russia, I want to know now or not, and I can have four minutes to pray or do whatever I want to do. So we got that. Then we've got then the capture of data, vast, more and more of it. But then we've got a third layer as well, I presume, and that is basic research. What is actually going on in the atmosphere in weather and how can we then take that scientific knowledge and apply it to the actual forecasts themselves. Is that, am I right in categorising those three layers? Back office stuff, NWP for forecasting, and research?

Yes. The research would probably be more, might well be sort of referred to more as climatology, so that's the data processing and, yeah, and then associated research. So essentially, yes, you've got general computer requirements, you've got forecasting and you've got climatology which is, you know, dealing with the data, quality control, research, testing out new models, you know, and then new equations and all that sort of thing. And yes, all three are going on and that's why, so the first machine was called Meteor. Why they went with the space theme, I don't know, but every machine got, at least for the first few, sort of got a nickname that had a space theme. So Meteor very quickly basically runs out of power to be able to deal with all of these things going on at the same time.

And you get a new English Electric machine, KDF9.

Yes. So the Met Office moved to Bracknell, if they hadn't done the KDF9 wouldn't have fitted in, so the two do rather go hand in hand. They took the Ferranti with them initially and then they built, you know, built the KDF9, that was called Comet. So we've gone from Meteor to Comet. And that was, speaking of your Turing horizon, yes, that's where the operational element really starts to come in. The decision is made that the forecasts are good enough, they are useful, they are at least as useful as a synoptic forecaster, if not more so, they're dealing with the data fast enough, okay, we're going to go operational, we're going to start using numerical weather prediction to produce our forecasts. And at that point it's got to be fast enough, it can't fall over, it's now got to produce a forecast twice a day on a timetable forever more. So from 2nd November 1965, you know, that's when the Met Office started the operational use of numerical weather prediction, with great fanfare and many reporters, and all the meteorologists wanted it much more low key in case it went wrong. Thankfully it didn't and the forecast was accurate.

[01:10:00]

I've skipped over two things that I wanted to mention to you and see if you have any comments on. The first was in the early sixties computing was getting miniaturised and we have mobile units for the RAF, is that right?

I think so, yes.

Your timeline says so.

Yes, I don't know a great deal about them. Yes, they're using them, but I don't know a great deal about them.

Okay. And on 1st April 1960 we got the first satellite launch for weather.

Yes.

So a crucial, again, piece of information technology that we should acknowledge. So we're now into 2nd November 1965, the first numerical weather prediction is done by the computer, is seen by the public, is seen by the press and people are relatively happy.

Yes.

Then in 1971 you get a big new computer, do you not? An IBM 360 195?

Yes. So that was a, that was sort of an exciting leap, I think, in a way. So during the sixties the – you were talking about research - so quite a lot of research had been done at home, but equally the Met Office was using the Science Research Council's Ferranti Atlas machine, a huge machine, off site, completely different place, to develop the ten-level model that they wanted. So the Met Office launched with a, operational forecasting launched with a three-level model – levels being levels in the atmosphere – and then they decided that, you're always looking to increase, to increase your levels, to decrease your grid size, as you said, so, you know, they wanted to move up to a ten-level model. To do that they needed, one, a computer to actually build it on, which is why they started it on Atlas completely off site, and then a computer it could run on, which is why they bought the IBM 360 195, which was powerful enough to actually run that ten-level model. That one, by the way, was called Cosmos, so another space theme. And so, yes, that came in 1971 and on 1st August that was when the three-level model was replaced by the ten-level model operationally. So that's a big step change, really, in forecasting.

Oh yeah, yeah. And Chris Little told me yesterday that IBM was desperate to get that business and they piled in a lot of free stuff for you, or they discounted stuff. One of them was that they built tape machines that could read KDF code straight into the IBM computer…

Yes.

… and they also gave you, or discounted graph plotters.

I don't know about the discounts and what was for free, but certainly, yes, a lot, they did a lot of work to help, because a lot of data had been moved, for the KDF it had been moved from Hollerith to tape, but the tape needed reformatting, so yes, they sort of built that facility, I believe on site with the actual computer so that a lot of this could start to become automated, if you like. And of course, Fortran makes its first appearance in Met Office coding language.

When?

By the end of 1971 we had over 160 staff trained in Fortran. Fortran IV, that is. I don't know if they were using it before then, but as far as I can tell Fortran sort of makes an appearance then.

Okay, good. Now, we've got to move on to the national weather radar network. What's this? This is 1978.

Yes. So the weather radar, another form of data, essentially. So I mean radar, they were playing around with radar as early as the Second World War, when they were looking for planes and found thunderstorms. So this was realised that actually, ah, radar can be used to look, particularly I suppose, for rainfall. And so, yes, the radar network was established, as you say, has continued to grow, but that was at the start of a significant amount of additional data starting to come in into the Office and the need to be processed and fed into the models.

[01:14:45]

Okay. The, I think the next major thing that happens, isn't it, that you're beginning to run out of computing again, and you have to buy your first supercomputer in 1982.

Yes, I mean we added another IBM to the original IBM in 1975, so we stuck an extra IBM on the mainframe in order to, so that they could do some research at the same time as the ten-level model because we were running out of power, as ever. And actually what that also gave us was an onsite back-up for the first time, because prior to that we'd had to rely on Rutherford Appleton, or even the Admiralty, for our back-

up if the main machine went down, which it did, particularly in 1973, and caused an awful lot of trouble. So it was kind of, right, we do definitely need to have our own onsite back-up. So yes, so they added an IBM 370 158 in 1975 and then, yes, really the big step, as you say, is the arrival of the first supercomputer, which came along in, yeah, well, post-1978, as you say, 1982. And the reason for that was it came out of, essentially growing international concern or interest in climatology, the start of the concept of climate change has arrived by now, the earliest papers on climate change are there. And it was agreed that the UK would play a significant role in what was known as the World Climate Programme. And obviously that required basically going back to that huge resource of data that they'd built up by this time, our database known as Midas, still known as Midas, it sort of had come into being and they needed to be able to process all of that data, so they needed a machine that was an order of magnitude more powerful than the IBM. So that's when they moved up to supercomputers and the Cyber 205, which the Cray – sorry, no – the Cyber, not a Cray. Which was, again, actually the intention was it would be attached to the IBM, to the mainframe, but the mainframe started to sort of creak because it couldn't quite keep up with what was required, so there was continuous progress, if you like, from then.

That's Control Data Corporation, is it not, the Cyber? I think.

I believe so, yes.

Yeah, CDC.

You're getting into the realms of computers I'm less familiar with.

And you soon, you ran out again 1991 and you got yourself a Cray?

Yes, that's when the first, that's when the Cray came along, yes.

And there's a change there of model. You've now introduced the Unified Model. Now what is the Unified Model?

Well, I'm sure others have talked to you about the Unified Model and in far more depth and understanding than I ever could. But my understanding of the Unified Model is that rather than having different models running so that one is giving you today's forecast, one is giving you the medium, you know, looking a week out, and another one is looking at your climate model, you build them all into one so that your Unified Model is running everything from what's going to happen in twenty-four hours to what might happen in fifty years, all at the same time. So that mesh is not only getting finer, it's also stretching out, so all of your models run together, which requires an awful lot of computing power.

Nobody could explain it better than you could, that's a brilliant explanation. Thank you, that's very, very clear. And of course you soon ran out of computing power because you buy your second Cray two years afterwards.

Yes. Yes, that as far as I know was very much around the research, increasing that research.

[01:19:14]

Right. And then you've got a massive change that occurs. You're down on the M4 corridor where there's a lot of computing and presumably also a lot of poaching of technical staff, for instance, because you generate some very, very capable people, and it's decided to move to Exeter.

Yes. So the move to Exeter took place for a number of reasons. The key one was the building at Bracknell had concrete cancer and so they had to move somewhere. It wasn't going to be possible to stay in the building. The Met Office was also not really in one building, it was spread across three or four, you know, training was down the road, they were spread across parts of an industrial site for other elements, so they really wanted to try and bring the Met Office sort of back together as a unit. And, in addition, it was around the time of a concept known as 'government in the regions', and so there was a pressure, a preference at least, for government bodies to move out from the London area and to base themselves elsewhere in the UK. And so the Met Office looked at a number of options. They did look at staying in Reading but going

somewhere else. They looked at East Anglia, they looked at Devon, those are the ones I know of. There were a number of options. And in the end, basically the staff were given a vote, between, between I think the final two, the staff were given a vote, and they voted for Devon. So there was then obviously a huge relocation project, which was actually very successful if you consider that about eighty per cent of the staff did actually move with the Met Office. That's a fairly significant uptake, to move your life, your children, your spouse, whatever else it might be, to the other side of the country.

Well, you're within half an hour of London, aren't you, in Reading, where you were, Bracknell. Now you're moving out, you're several hours from London, and not that London is the centre of the world…

Yes. Three hours-ish.

Yeah. Not that London is the centre of the world, but it just happens to be the centre of the world, that's all. As well you know. So you've got that massive move, and it is a success, without breaking operations.

Yes, absolutely. So the machines were moved down individually. One came down, obviously you've always got to have your back-up, so they were moved down on the backs of low loaders with armed – well, I'm not sure if it was armed guard – they were certainly guarded. Moved down on the M4 and then yes, the first one came down, was set up, went operational with virtually, virtually seamless between Bracknell being, if you like, switched off, and Exeter being switched on, and then the second computer was moved down into the- they had two computer halls, so one in each computer hall. And so the second machine came down so that the onsite back-up was again in place.

Wow. Towards the end then, in fact in the new century you began to move into social media quite a bit.

Yes, yes. As did much of the world, so the Met Office kept up.

Yeah. What was the purpose?

So the purpose almost goes back to actually FitzRoy's original concept of reach. So it's not about research, it's about reaching audiences. So of course FitzRoy, you know, first reached out with the telegraph network, then the newspapers, then of course there was the radio, then there was television. So it's about reaching your audience wherever your audience are. And so it started off with, I think, if I'm correct, I think it started off with YouTube. So in 2007 they started with a YouTube presence and then moved onto other social media. So the first social media channel was actually on Twitter in 2009, and then Facebook in 2010, Instagram 2013, SnapChat 2017, TikTok 2019. And it's just about keeping up with where your audience is.

[01:23:45]

Okay, yeah, yeah. And you've carried on with more supercomputers. 2015 you have a new Cray, the CX40 is installed, and also you build a supercomputer building. What's that then? For the supercomputers?

So when we brought in the new Cray, part of the concept was around having capacity not only to do our own forecasting and research, but to be able to make supercomputing facilities available for other organisations involved in, particularly I suppose, climate research.

Okay.

So the Met Office maintained its two computer halls within its HQ, but then basically just across the M5 it built a second building where, if you like, a third supercomputer was located. It's not quite as simple as that, but the general idea was that was additional capacity that could be used really very much for the research angle. I mean they're all connected up so the data can flow wherever it needs to flow, but it was focussing on enabling research, not just for the Met Office, but for other organisations involved in climate research. So options would perhaps be Reading University, who do a lot of weather and climate research, for example.

[01:25:15]

Okay. And by this time of course you've thrown in the leased line from BT and others and you've gone to extensive use of the internet for your data transmission?

Yes, so there's a lot of data transmission by the internet. But there are also, you know, there are still sort of hard cables in locations to transfer data, obviously between those computers, for example, that's not going to be going quick enough, or not enough of it is going to be carried by internet.

Now, you're not a department store that just closed its shops because of Covid, you are an internationally renowned operation which is absolutely vital to so many different things that it cannot stop. So come Covid you have to keep working and you have to turn yourself into a virtual organisation almost overnight, don't you?

Yes. So that's, yes, basically the Met Office sort of became operational remotely, or virtually overnight. So, as with everybody else, when the decree came, you must go home, the Office looked at its options, for the safety of the staff and for the ongoing operation of the organisation. And initially everybody went home. That meant that technologies which were in existence but hadn't necessarily been sort of fully tested, you know, really just had to be, had to be got going. We all had to learn to use Teams, we all had to learn to, you know, to use all of our remote capabilities, because that's what we had. And so you had forecasters working from their, you know, doing the night-time forecasting from their conservatory, so that they weren't going to wake up people in the house, for example. But I know one of the things that was a challenge was around aviation forecasting, because that requires onsite staff, so there very quickly had to be permissions and agreements put in place for those staff to work from home, because they were not allowed to work on site. And so, yes, everybody worked from home. As soon as people could start to return, obviously some of the first people back were those operational staff. And with the second lockdown, obviously people went back home again, so there was a sort of yoyo process, but yes, the Office essentially became remote overnight, because it just had to keep

functioning, as you say, you can't switch off the forecasts, particularly for aviation. And defence, obviously.

And have you remained a remote organisation?

No. So obviously hybrid working is now the norm, and you find that across the Met Office as well. But I'm talking to you today from the archive. Most staff have returned to an extent, many staff have returned, certainly the operational side, have returned as per norm, if you like. It's now very much a hybrid working organisation, but it is definitely not remote working.

People have a vision of an archive with a lot of dust, a lot of old people staggering around with old books and ledgers and things in folders. Instead it's an absolutely fascinating story and it has been a fascinating story, a story as well expertly told. Thank you very, very much for your contributions to the Archive, Catherine Ross of the Met Office.

You're most welcome.

[01:29:06 recording ends]