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AN ORAL HISTORY OF BRITISH SCIENCE

Professor G. Russell Coope

Interviewed by Dr Paul Merchant

C1379/63

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**Interviewee's surname:** Coope **Title:** Professor

**Interviewee's forename:** Geoffrey Russell **Sex:** Male

**Occupation:** geologist/  
**Quaternary** palaeoentomologist **Date and place of birth:** 1/9/1930,  
Bollington, East  
Cheshire

**Mother's occupation:** GP **Father's occupation:** GP

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**Interviewer's comments:**

## Track 1

*Could you start off by telling me when and where you were born please?*

I was born in East Cheshire at a place called Bollington, north of Macclesfield, where the Cheshire hills give way to the Cheshire plains.

*And what was your date of birth?*

Oh, 1<sup>st</sup> of September 1930.

*And could you tell me anything you know about your father's life, either things that he told you or things you've found out?*

Yes. He was a general practitioner, a medical practitioner, all his life, and my mother was too, also in East Cheshire. And it was a practice that extended from the hill farms down onto the rather lush Cheshire plains. And my father was – spent most of his time in medical practice but also was a fanatical, what shall I say, a sort of – a true car enthusiast, a golfing enthusiast, a fishing enthusiast. And whatever it was, as long as you tack enthusiast to the end of it, this was my father's strong points. But as soon as he got really good at something he used to find that this was in fact rather less interesting than getting there. So my mother was also a general practitioner, so we were brought up by a nanny. In those days nannies, and this was before the war, were – had proper veils on the back of their heads and they looked quite like nurses in hospitals. And we were pushed around in a pram and my first recollection is actually being in a pram. I can remember quite clearly going to farms because our nanny was a farmer's daughter and being able to look eye to eye at farm geese, which frightened me to death of course. So my earliest recollections are of being brought up in that fashion.

*You say we, brother and sisters?*

I had three brothers and three sisters, so I was in the middle. I had an older brother and an older sister.

[02:18]

*And what did your father tell you about his earlier life before becoming a GP in Cheshire?*

Not a great deal, I know very little. He grew up in Bolton, Lancashire, and apart from the fact that his father was very keen on growing things like orchids and things like this, I don't know very much about him. So ... I can say very little about him because I don't – he didn't talk much about his childhood apart from the fact that he also had two brothers and a sister and that his elder brother fought in the First World War in part of the flying corps. And one hears a little bit about that sort of thing but not much about what my father did, apart from the fact that – that his elder brother was an interminable story teller and my father – I remember my father telling me one day, 'You know, the stories were so dreadfully boring.' So when he was a child lying in bed and his elder brother was telling him the story, my father used to nod off. And then in the early morning his elder brother would say, 'As I was saying last night when you went to sleep ...?' [laughs] And he'd have to hear all the rest of the story. So I know very little about him.

[03:47]

*So you don't have any direct experience of those grandparents on his side?*

Not his side, no, no. On my mother's side, a little bit, my mother's – my mother's father was a general practitioner in Carlisle. He was an Irishman from Kerry and he had a large family, there were thirteen of them in all, and he died before really I was sentient, so I wouldn't know actually much about him. But my grandmother I knew very well, yes, and she was just, what shall I say? Not a housewife but a mother, almost a professional mother. And she had this array of children, all of whom became quite – well, very conspicuous in their own fields, particularly in medicine.

*What memories do you have of time spent with her, if you did spend time with your maternal grandmother?*

Oh, I used to go up to Carlisle for holidays. And so she and some of her children were – for instance, one of her daughters was a general practitioner also in Carlisle. And I was rather frightened of her because she was always telling me what to do. So I had – but my grandmother I always remember as a source of information. She always was telling stories about things that were going on and so she was – she used to say that she's the trunk of a very big tree and all the information funnels into this. And so – but I can't remember very much about particular things. I can remember this general feeling that in fact if you wanted to hear anything you went and heard what granny had to say.

*Did she take you out to local places?*

No, not really, not very much, no. She was getting on by then, so I – I had a bicycle and I could travel around from Carlisle to visit all sorts of friends.

[05:54]

*And did your mother tell you anything of her childhood? You say that your father didn't.*

Well, she was a medical student in the days when medical students, women medical students, were few and far between. And they had to have a chaperone, for instance, in the lectures. A lady had to sit there knitting somewhere in the audience while the lecture was going on because they didn't trust women students amongst all these men. So my mother describes pretty horrendous stories about how the male students would put upon the women students with practical jokes in one form or another, which I won't really mention, because most of the medical students' practical jokes are pretty awful things, so –

*What sort of thing?*

Oh, I don't wish to go into this too much.

*Okay, thank you. And what memories do you have of time spent with your mother as a child yourself?*

Very little because, as I said, my mother was a full time general practitioner and therefore there was very little in the way of personal contact. She would come and have tea with us in the nursery as a great treat. Most of the rest of the time she was having to deal with the practice because my father and mother were sole practitioners. Well, no, there was another doctor at the top end of the village but in fact virtually they were sole practitioners, seven days a week, twenty-four hours a day. It uses up most of your time, so that's what happened to my parents that almost all the time – I remember my mother being rather removed from us because she was a professional and therefore we were brought up by our nanny.

*And your father, time spent with him similarly distanced?*

Yes, on the whole, except for his enthusiasms. We did get caught up in them for one reason or another, as I mentioned earlier on. We'd suddenly find that in fact he wanted to do gardening or something and we were roped in to do things like that.

*Oh, that's interesting. Yes, what sort of things do you remember doing with him?*

Well –

*Which enthusiasms did you take part in, in your father's –?*

Well, enthusiasms, well, I remember I went salmon fishing on the Dee with my father and I think I caught the smallest salmon that anybody's ever caught on the Dee and – but it was near Everton, on the Dee, it was really rather nice in that we – it's very difficult to actually remember precisely what one did with that. By anyhow, a day's fishing, yes. My father had, for instance, a 1935 Bentley, and driving around in that was – not me but being driven at some colossal speed around the Cheshire lanes was really rather fun. In the garden my father would – wanted to make things as he wanted them. So we had this flowerbed which he decided he wanted to make into a sunken garden and proceeded to dig out a huge pond in the middle of it, so that in fact

when – it's very, very difficult to describe other than he had a huge – an enormous pond which used to be almost like a hill in the flowerbed and it took us ages and ages to do this. And once it'd been made he lost interest in it. It was always the same problem, that whenever he was really excited by something he used to – once it'd been done he lost interest in it, so things like that. But he was – he had lovely flowers. He had a huge conservatory and it was absolutely loaded with plants that he imported from some nursery somewhere or other and it was marvellous. He had a vast, vast, oh, greenhouse full of exotic plants, exotic things like vines, nectarines, all sorts of things. And these on the whole, after a little while – I suppose the coming of the war really made it impossible to keep these things up, and the whole thing went to rack and ruin. It's a great, great shame in a way.

[10:13]

*Could you describe your family home as you remember it? It depends on the detail that you can remember of course but if you can, if you could sort of take us on a tour of it. I don't know, I'm assuming that you had the same home throughout your childhood –*

Yes.

*Though that may be wrong.*

Though we did to start with but our family home in Cheshire was built by one of these cotton magnates in 1840 something or other, I don't know what it is, it doesn't matter, it's about – but it was really grandiose. It was built in order for the servants to run it. And in 1937 when we bought it, 'cause we lived in the house next door prior to that, it was really a grand move because we just had to go next door. And it was a very, very – it had about eleven or so bedrooms, all of which were occupied because of my brothers and sisters, filled the place up pretty quickly. It had a grand garden with cedar trees and all sorts of things going down to a river at the bottom. Erm, what else can we say about it? It was built on a magnificent scale. It's now, by the way, turned into a doctors' surgery. So what was originally a grand house went through this transitional stage during which it was partly a surgery and now it's been completed

converted into a surgery, so it's a sort of Rake's progress; it's gradually deteriorated [laughs].

[11:47]

*And so did your father and mother both have their practices at home?*

Yes, yes.

*Separate practices or were they with –?*

No, I think it was actually a joint practice, in fact I'm sure it was. About 6,000 people came in.

*What do you remember then as a child? So if we're thinking of this house, you would have been seven or more. What do you remember of the – I suppose the operation of the GP surgery from home? What did you see of that?*

Oh, well the – part of the house was given over to consulting rooms and waiting rooms, and the comings and goings of people. I had a room at one stage directly over the top of this, so I could watch the comings and goings of patients coming in and out of the surgery. In the olden days people used to come in with bandages and blood and all the rest of it. It was a real hands on practice. It wasn't a matter of sending people to hospital, you did it there and then. So the – you lived in the house, part of it – well, I should say a third of the downstairs was devoted entirely to the medical practice, yes.

*Do you have any striking memories of things seen or heard, comings and goings there?*

Not that are repeatable, no [laughs].

*And you suggest that the most time that you spent with an adult would have been with your nanny then.*

Yeah.

[13:40]

*What do you remember of – apart from this very early memory of visiting farms and looking at geese in the eye, what do you remember of things that she did with you as young children?*

Well, now you're coming to a rather critical stage because in 1939 my parents bought a house in the centre of Wales because we – not unnaturally we were rather frightened of the idea that there was going to be severe bombing. And this was in the Dovey Valley at a place called Aberangell and this was then a place where our nanny was looking after us entirely. Our parents lived almost exclusively in Cheshire, we lived almost exclusively in – in this little village. And that's the time when our nanny then started to take over and looked after us entirely, so – and she was an extremely efficient person at running the house and family. Little to say about what I remember about her apart from this fact that we to start with were rather frightened of us, because not unnaturally she was a fairly reasonable disciplinarian, and discipline doesn't go down very well with small children.

*And what did she do with your Wales in this –?*

Oh, she just – she looked after the house and she went and did the shopping and everything like that. And we, when we first went there, this is September 1<sup>st</sup>, my birthday, 1939. And we arrived in central Wales and nobody had – my mother believed that somehow or other you ought to air a house first, put fires in and get it all – we got there and it was damp and shut up, and there was no sign of any fires. And it was considered to be inappropriate that we should sleep there, so my brother and I lived in – went to stay with a lady on the other side of the road. She looked exactly like the witch out of Snow White and she spoke Welsh, which compounded the problem because we couldn't understand what she was saying. And so we were rather frightened about this. And so we lived next door, on the other side of the road whilst the house was got ready for us. So that was very – and from that time onwards my

nanny looked after us as a mother would do, and my parents would visit us occasionally from Cheshire. Of course except at Christmas time when we went back to Cheshire for the Christmas celebrations, which was just the time the Germans decided to bomb Manchester which was seventeen miles away. So we had a fireworks display which made a normal fireworks display look pretty innocent.

[16:14]

*How did you feel then about this distance between you and your parents?*

I didn't know anything else. In fact when I met people later on in life where a mother actually looked after the children I was quite envious. I thought, you know, isn't it marvellous that mothers can actually look after children because it – to me it was not an experience that I'd ever had. So therefore you can't say – it's rather like the lion in the cage at the zoo, you know, it knows nothing else. I knew nothing else either, other than I thought everybody had nannies and everybody had mothers who worked. So it's not easy to answer your question really.

*If you were sort of upset and, you know, wanted someone to sort of comfort you is that something that your nanny would do?*

I suppose so, yes, but ... difficult to say really because she acted as a mother. In other words, she kept reasonable discipline but also was quite affectionate. In fact in later life I realised how affectionate she had been. Not necessarily at the time but, you know, recollected in tranquility when you get pretty much older you suddenly realise, yes, she was a very, very good mother substitute. And that goes for being, you know, what shall I say, comforting when we had problems. But I don't think I had all that many problems. Living in Wales was an idyllic existence, as you might imagine.

[17:56]

*What did you get up to with your brothers and sisters in the area?*

Oh, let's start at the very beginning because when I and my brother went across the road to live with Mrs Reece, who lived next door over the other side, erm, we were rather frightened, as I told you. And one of the things was that there she had a bedroom and we thought that something nasty was under the bed, as all children of that sort of age thinks, a hairy hand with claws, if you follow. And I remember wondering what we were going to do about this, saying to my brother, 'How are we going to get into bed without actually having to go too near to the bed because something nasty might appear from underneath it?' So I decided to leap into the bed from about ten feet away. It was a feather bed and I disappeared, it's like going down at sea, and this was fairly spectacular. So we had a really very bizarre first night, and in the morning when we got up Mrs Reece said, 'Go out and play.' Now I'd never met this situation before and I said to her – it sounds barmy doesn't it? You're living in the mountains of central Wales. I said, 'Where?' And we had miles and miles of hills and open country in front of us. And she opened the gates at the bottom of the garden and she says, anywhere. And that was the emancipation as far as I was concerned. From a childhood where I had to hold onto the pram, to a childhood where I could do anything. And so I started a life that was very free, very exciting and very different from anything I'd experienced before.

*Why did you have to hold on to the pram?*

Well, because that's the way we did it. It was rather like holding mother's hands except holding onto the pram was a proper way of keeping control. So we all walked along, holding onto the pram. That's the way people did it in those days, they walked along with nanny pushing the pram and me holding onto the pram.

*And so then when you realised that you had this freedom to explore the hills and the landscape, what did you do with that freedom?*

Well, I had various friends at school. We went to the village school. This was the little school in the village which had – must have been thirty or so children and three teachers. Most of the class was conducted in Welsh, including mathematics or shall I say arithmetic. And I won't go into that because that's one of the reasons why my mathematics ain't too good because when it's conducted in Welsh it wasn't terribly

intelligible to me. So I got friendly with various of those little boys, and one of the great activities of course was poaching. And I don't know about making recordings of this but in fact we lifted fish out of the river, big sea trout, salmon, you name it, catching them with all sorts of strange devices like three pronged forks, straightened forks, that were made by the local blacksmith and – or catching them with rabbit snares on the end of sticks and all this sort of thing. So in other words, I learnt as you might say country crafts which are not all together the sort of conventional sort of country crafts, so I had a great time either in the river, under the river, on the river, in every conceivable way. And so this was the most exciting time of my life by a long, long way, the most formative time too. I haven't really recovered I don't think, even now.

*Could you describe in as much detail as you can some of these outdoor improvised crafts or activities? It just seems very interesting in terms of understanding you, particularly as what you've just, that you think this was a very influential time. But also of a kind of childhood that perhaps wouldn't be possible now, so –*

And what is – I think what is different now is that people are now frightened of giving children complete freedom, and we were given complete freedom. The limitations on what we could do was imposed by geography, how far could you walk, how far could you –? Well, you didn't have a bicycle and so I – I explored. We explored because it was a joint effort and we went and did all sorts of things. You know, what happens if we go up this valley or that valley? And so it was genuinely exploration. And natural history rubbed off on you in all directions, and I think this is where I started to be really excited by natural history in every way. So that this where – what I mean by a very informative time. After all, I was only ten – or nine, ten, eleven, and that's a very important time in a child's life and it was very, very exciting. And of course we had the huge winters then. I mean you could climb waterfalls which are in fact entirely made of ice, which made life really rather exciting, especially 'cause every now and then the thing collapsed, yes. But I tell you what, there was no worry about security. We didn't have a policeman in the village. There was one policeman who lived, I think, down [inaud] and he used to come up on Thursdays or something, I've forgotten what the day was now exactly. And he used to nip round to the old – to the schoolmaster and then get on his bike and bike home, and that's all that there was for

security. The local water bailiff was also the local poacher but nobody worried about things 'cause this was – this was the sort of natural way in which people operated in the country. So nobody had this sort of fear of molestation and all the dreadful things that people imagine today. So that's the way it was different. Total freedom to do anything we liked, anywhere. And with nobody ever saying to us thou shalt not. This was a – this was a notion that never came into our heads, we could go anywhere, we could do anything, in and out of people's houses. I mean I don't think houses were often locked or ever locked. And so we were always free to go into anybody's house and do anything, and nobody came to any trouble. Nobody hurt themselves, it was much less dangerous climbing an icy waterfall in the centre of Wales than it is crossing the street in London.

[24:59]

*In what ways did natural history impress itself on you or to –?*

Oh, everything. Yeah, for – I'll give you a little example, in – at the beginning of the war nanny used to get a newspaper and it was full of, you know, the warring factions, people fighting one another. And then in the spring even our front started to fight one another. And I went down to the pond below the house and damn it, the frogs were gripping one another and croaking away and making a terrible noise. And I spent a whole morning separating them 'cause I thought they were up to no good in a sort of military sense of the word and, you know, little things like that. You start to ask questions as a child, you know. Why have the frogs all started to fight one another? So – or you get – you go to the cabbage patch and you find caterpillars. And the first thing you do is you keep them, and you keep them as pets, you know. And then unfortunately they grow up. And the book said, and here because I could just begin to read natural history books, that they would turn into butterflies, and mine didn't, they didn't into little wasps instead. And I was horrified, I thought that the books had got it all wrong. And so that all the time I was up against seeing things, finding things, which told me – I mean going birds' nesting and all – all added up to a natural history experience because I kept asking questions about what I was looking at, finding things which prompted other questions which prompted other questions, etc. So I think that it was – it was very hands on experience in that I learnt a lot by practicality.

*What was involved in birds' nesting for people who may not even be familiar with that phrase? What did you –?*

Well, birds lay eggs, and eggs are collectible. And I – and all the boys in school used to go round collecting birds' eggs. And we used to poke a little hole in it, and a little hole in the other end, and blow the contents out. Sometimes it was a rather smelly egg because it had gone bad or something but I had a collection of birds' eggs, everybody had a collection of birds' eggs, and this is the way in which people started being interested in it. Because then you started to get more and more exotic birds' eggs and you'd climb up – the old slate quarries in the valleys, I used to climb up them, look down the chimneys and there'd be jackdaws' eggs in there. But getting the jackdaws' eggs out from six or eight feet down a chimney, involved all sorts of ingenuity, like trying to bend a teaspoon, put a teaspoon on the end of a long stick and lower them. All of this sort of thing was how we behaved, and then of course later on I started to find there were baby jackdaws. And what could you do with baby jackdaws? You could rear them and bring them up as pets. So everything led to something else.

*You looked after little baby jackdaws?*

Oh, yes, all the time. Looked after the little animals right up into adult life.

*Where did you look after the animals? I mean in terms of your home.*

Well, when I went away to school – 'cause eventually I went to school and went off to boarding school, and then I kept small animals all the time.

[28:44]

*And we'll wait till you've got there then to discover. Where were you getting the natural history books from that you were able to follow?*

I got a natural history book of great thickness, which I still have upstairs, which I still delve into every now and again, which just is a comprehensive account of everything about natural history that you want to see. I've forgotten even the name of it because the back isn't – or the front has fallen off now, so I have no way of knowing. But, yes, my mother bought that in I think 1940 or maybe '39 for my birthday, something like that, and that started off the – if you like, the reading about what I was experiencing. But it meant that everything I found and everything I saw had – could be checked up on this book. And prior to that I don't think I read anything. After all, what was I expected to read but a stupid story about Milly Molly Mandy and all the other things which to me was excruciatingly dull. But give me a book in which there was a description of a beetle or a bird or something and it's much more exciting because you can go out and see whether it's true or not.

*And to what extent were your brothers and sisters involved in this outdoor exploring? You've mentioned friends from school you see joining in with you and –*

Well, my eldest sister didn't stay very long with us because she went off to school. And my elder brother was far more, what shall I say, aesthetic in his views of things. He liked – or the arts side of things rather than the science side of things. I mean, you know, with all families the difference between the children is amplified by the fact that – by proximity. In other words, because my brother, elder brother, would be interested in music or art or something like this, therefore I was interested in something else, and so it went on. And so he was not interested in natural history at all. And I don't think any of my brothers or sisters, both sisters, quite different, were interested in natural history. It was just me because once you become interested in that then your brothers and sisters have got to go and find some other territory to be interested in, so that we didn't overlap. In fact we off lapped if that's a proper word for this, so that we were interested in different things as far as we could possibly do.

*What did your sisters do in this environment then?*

Well, you see my eldest sister –

*She was born, yes.*

So ... difficult to say, I can't actually remember. My sister immediately younger than me – yeah, I can't – I can't remember enough about it to say anything useful about it.

*And what do you remember of teaching at the village school?*

Apart from the fact that it was in Welsh or a lot of it was in Welsh. And I learnt all sorts of Welsh rhymes, Welsh times tables, and it was – it was interesting in this sort of way because I never learnt the language. My elder brother learnt much less than I did but I could understand it and my younger brothers could speak it as – now their recollection is quite different from mine. They've – the ones who learnt to speak it have now forgotten it. My elder brother and elder sister never learnt it but my younger sister and myself remember words but we don't know what they mean, so that it's extraordinary how you can acquire a language extremely quickly and you can also lose it very, very quickly as well. This was clearly in, you know, what we experienced when we were in the village school, yes.

*Was there any teaching of science or nature study at this –?*

Tons of nature study. I was – must have been a great irritation to the headmaster, who was Jim Morris because I had what I called my museum, and my museum consisted of everything that I could get in the way of natural history even including bones that were buried – were beyond decomposition. So I had a window ledge which was my museum, this was in the village school when I was ten, which had every conceivable thing from plants, bits of animals. Now some of them were rather smelly, nearly always rather unpopular with everybody else. At least the headmaster was sensible enough to encourage this. I think – I think in retrospect he was probably very, very tolerant of my idiosyncrasies, yes.

[33:56]

*Thank you. And you mentioned that you went home for Christmas to Cheshire.*

Yeah.

*And – well, near to Manchester. I wondered whether you could describe in more detail any sights and sounds of war?*

Oh, well, first of all it – we were seventeen miles from Manchester and the – the whole of the cellar underneath the house was propped up with pieces of wood to protect it if the house got bombed. And we had to live down there, and we lived down there during the night time anyhow. And it was pretty uncomfortable and rather damp but really rather exciting. In fact my experience of the war was one of suitable excitement. You could hear the bombers going over and you could always tell German bombers from friendly aeroplanes ‘cause German bombers went whoo, whoo, whoo, whoo, whoo and there was this sort of rhythm to them. And we heard them going over to bomb Manchester, and then lots of bangs, most of which by the way were ack ack shells, anti-aircraft shells going up there. And the whole of the sky was lit up, the whole of Manchester. This was just about Christmas time and I think it was 1940, in fact I’m sure – it may have been ‘41, difficult to tell, but ‘41 I think. And they dropped a whole lot of bombs around and curiously enough it set off incendiary bombs. And of course in those days everybody collected souvenirs, so we collected vast amounts of souvenirs, including one unexploded incendiary bomb which myself and a friend tried to undo it in the sort of potting shed in the garden but that’s a different story. What happened was that the – the war, if you like, became a sort of toy, it became the sort of experience that we were enjoying simply because it was so different from everything else. The idea that people could be hurt or killed never entered our heads at all. Until we saw it in the papers late – much, much later on in the war when we saw things like the concentration camp pictures, things like that suddenly struck you. Prior to that the war was entirely a matter of fun and competition, it was no more serious than a game of football. Very similar in many ways because there was a we and a they, and we were supporting our team and so you were supposed to be supporting theirs.

*What else did you collect, objects that you collected, shrapnel?*

Shrapnel in particular, pieces of bomb. I had a piece of bomb that landed up near Pott Shrigley and until very recently I had that as a sort of paperweight, it was a great

chunk of stuff. Erm, also it's the stuff that the aeroplanes dropped to confuse, I think it's called chaff or something, which was used – it's like silver paper. And the trouble is we collected vast quantities of this because it was – it could be dropped by aeroplanes at some stage or other. And this was also a souvenir but it was a souvenir you could trade. You could trade a chunk of chaff for a piece of German aeroplane or a piece of unbreakable glass. Notice it was a piece of unbreakable glass, it had all been broken up, but it was to us known as unbreakable glass in spite of the fact that it was in chards. So, yes, I – it was a sort of trade. After a German aeroplane was shot down in central Wales we had all sorts of bits of this, and so before the military police actually arrived to guard this aeroplane, and – and when the military police arrived at the village school, we're back to Wales now, who gave us a harangue about how irresponsible it was for us to have all these pieces of information 'cause it was vital for the war effort. And after that, she said, we must bring all our souvenirs back. And of course nobody did because nobody understood what she was talking about because if you're Welsh speaking you don't address them in English. Of course that was the sort of problem. So souvenirs became currency and so you could swap, you know, a piece of – oh, canvass from the body of a Junkers 88 was quite valuable stuff, so that you'd get a big piece of silver and green canvass which you could swap for a hinge or something. And so this sort of trade went on all the time.

*Between your friends at school?*

Mostly in Wales, yes.

*Were your brothers involved in this again or –?*

You know, I can't remember that, I can't remember it. It's a long time ago [laughs].

[39:21]

*Yes. And to what extent was religious instruction a part of your childhood?*

Well, we were brought up as Catholics. And that meant that in the village in Wales there were two chapels, a top chapel and a bottom chapel, and these were large. Each

of these could have accommodated the whole of the village but come Sunday the village divided into the people who went to the top chapel and the people who went to the bottom chapel. Since these were both variations on non-conformist church we never went to either. Therefore on Sundays we were considered heathens because we didn't – and when my mother was about we used to go mass at Machynlleth and so there was a small amount of religion but an awful lot of time between my mother's visits, we had almost none at all. But we did have the usual mantras of saying The Lord's Prayer in Welsh of course, which I can still do in Welsh. And I'll tell you why, because my Welsh has drifted off badly since – in the time that's elapsed. And so that I think that we were looked at – looked on as being rather irreligious because we wouldn't go to either the top or bottom chapel, which were the two options that were available to us.

*And what was the extent of your faith as a child?*

Wow, that's difficult. I believed what I was told, no matter – it was much later that I thought to question that sort of thing.

[42:10]

*And do you have any recollection of any political discussion at home? I realise your experience of your parents is limited, but I mean that's associated with the war, but did you gain any sense as a younger child of their views on things worldly or things international then?*

No. In fact it's very interesting that throughout the war itself it was looked at as a competition, a conflict, that we supported us and other people must have supported – in a sort of sense the right and wrongs of this never entered our heads. I mean it was too early. You don't start to think about politics really until you get into your middle teens. You don't question, just as I didn't question about religion until later, I didn't question about the rights and or the wrongs of warfare. And so I can't very easily answer that question because it's too early in the story if you like.

[42:10]

*Okay, thank you. Could you then describe your boarding school?*

I went to Stonyhurst, it's in what's rural Lancashire. The people think of Lancashire as being largely built on, well, large areas of it were rather beautiful. To start with my prep school was a place called Hodder, which is on the banks of the Hodder river and once again I started my natural history over – all over again in the river, on the river, under the river, in every way. And I had some very, very sympathetic masters at school who really supported my interest in natural history, so that's my prep school.

[42:58]

Then I went to bigger school and gradually became more and more inclined to break bounds in a way, in that I always wanted to be away from the playground into the surrounding countryside. I rather suspect I must have been a dreadful nuisance to the school authorities because I didn't want to stay within the confines of the normal traditional place, I wanted to go and look at things. And it had a magnificent country round about us full of absolutely everything in the way of plants, animals, you name it.

*And so Hodder, was that a boarding prep school?*

Yes, it was, yes.

[43:39]

*Okay. Could we start there then, and if you could give me any memories you have of the sort of content of the teaching there? Perhaps mentioning individual teachers as far as you can remember.*

I find it difficult to do that simply because, you know, you have classes and I don't separate them up very well. Thinking a little bit about it, I think I probably, it's – you know, the well known statement people learn more at conferences between the lectures than during them? I think I learnt more between classes than actually in

them. In other words, I don't remember much in the way of teaching but I remember people who had influence outside, people who took me down to the river, who showed me things, going and looking for things like dippers' nests along the edge of the river or sandpipers' nests. And looking at fish in the river, big sea trout and salmon coming up the Hodder and just being shown them. And those were the sort of influences that I remember most clearly, and it really was an extraordinary thing. We eventually decided to go catching eels with ordinary table forks and things of this sort 'cause this tendency to go poaching seemed to be extended into my – into the life at the school.

*Who showed you these things? Who took you down to the river to –?*

One of the masters in particular. I don't know which master, I can't remember now, but I certainly was taken and shown things, yes certainly.

*And for people who haven't been there could you – in your mind's eye, in your memory, can you describe the river –*

Yes.

*This is the sort of –?*

It was – I went back a short time again and what is most evocative is the smell. I stopped at High Hodder Bridge got out of the car and said to Beryl [sniffs], 'I know where I am by the smell.' Now this is the most interesting because you can't describe it. It's not something you can say – when you just think of the inane comments that wine salesmen produce about their products and you just realise it bears no relationship to their product itself. The same is about the river. It is the smell of the river that became part and parcel of my life. So even now when I go back I can tell you which river I'm beside, but I can't describe it, I can just tell you where it is. So that one gradually soaked up this experience, not necessarily in a sort of, what shall I say as in a formal context, but in an informal context. So Hodder was a grand house sitting above a river, which was a tumbling river of rapids and pools and swirling eddies and big, big wheels where – meanders on the river. And there was everything

there, otters, fish, birds, plants, trees of considerable antiquity which we undermined by the river so that we built dens underneath the roots of these trees and shared these dens with otters and things like this. It was a magic place but it was a magic place between lessons. And I can't tell you much about the lessons apart from I had to learn lots of Latin grammar, which at the time irritated me enormously because I could be doing something more exciting outside. And I used to get chastised for looking out of the window, often enough, but just outside there was something more interesting than inside. And I can quite clearly remember getting into trouble because my mind was elsewhere. You know where my mind was, it was down by the river doing things.

*And when during the day could you get down to the river?*

During break times. I mean – and for instance, because you live on the spot all sorts of times, I mean teatime, you know, after – well, not after lunch because we had to lie down after lunch to digest our meal, but all sorts of times. We had days, we had good days, when we could go down by the river and spend pretty well the whole day down there. And there's a lovely flat below the – below the house of Hodder, we called it paradise. My God, it was a paradise too, it was a marvellous place.

*And do you remember –? You may not remember their names of course but do you remember particular fellow pupils who shared your interest in the sorts of things that you've described?*

Yes, I – I can say it without being able to go into names. Yes, we did. I mean, for instance, we mentioned fishing earlier on. Yes, I had friends who went fishing. Very difficult, you develop at that sort of age very intense relationships. My greatest friend at the time was actually killed in Korea later on, which was one of the tragedies of our age. And he and I used to go and do things, lots of things together, but it was again all river based. And most of our time, whatever we did, was somehow orientated around the River Hodder itself, which is a – and there's an enormous amount of it. It went on for miles and miles and miles, and the limitations simply on how far we could go before we had to get back for tea.

*And apart from fishing and observing, what else did you do there?*

Difficult to tell you just like that. As they say, I need notice of that question sometimes.

*And were you able to get on it, in crafts or were you –?*

Oh, yes, swimming in it, a terrific amount of swimming in it. We had several places. I learnt to swim in the river largely by washed down river willy nilly, whether I liked it or not. But again, there was this – back to what we were talking about, there was this sense of freedom, total and complete freedom. You were down there and of course we were being supervised but we were being supervised in a sufficiently subtle way that it wasn't obvious. And so I felt I was in complete freedom, I doubt very much if I was but I felt that way.

[50:37]

*Thank you. And the next school, which was Stony –*

Stonyhurst, yes.

*Stonyhurst, yes. Could you describe that as a physical place, both the building and the grounds?*

It's a vast – it's a vast building originally – well, made – it's really a Tudor building and it's really – in a huge estate and so that – and other bits have been attached to it. It has huge towers in front of it with, oh, stone eagles on the top and it looked very, very spectacular. It's well known [laughs].

*And the grounds there, could you describe those as a habitat for you?*

Yes. Well, moving on a little bit, one – I'll give you a little story that goes with this. One day after prayers in the evening the headmaster, who was known as the rector, was standing at the top of the stairs. And he when he stood at the top of the stairs he was always looking out for people who had been committing some misdemeanour or

other. And I thought, my God, I wonder who it's this time? And he said to me, come here. And just like the drowning man is said to have his life flit before him, I thought of all the things I might be arraigned for and he said, 'Well, come with me please.' And I thought, this is very strange. There are two stories, I'm eliding a bit here. And he said, 'Will you come into my room?' And he said – and I thought I was going to get into trouble. He said, 'I wonder if you could do something for me.' He said, 'There's a funny noise in my chimney.' God, it was relief, the intense feeling of relief that I wasn't get beaten or something in fact. So I put my hand up the chimney, brought it down smack on top of a jackdaw which had come down the chimney and got itself lost in the bottom of the chimney. And so I took it, emptied it out, and he was so incredibly grateful that I had in fact somehow laid this ghost that had been rumbling around in his chimney for a couple of days or so. But then a little bit later the master who was in charge of the estates round about was also standing at the top of the stairs and I thought, oh gosh, here goes, somebody's for it. And he singled me out, 'Come here. I want you to come with me please.' A similar story, go down to his room and he said, 'If I give you five pounds ...' [laughs] can you imagine this as a child? 'If I give you five pounds would you go to Clitheroe and buy rat traps?' And we're having a terrible problem with rats up at Deer House Farm or whatever it was. And I thought I was in heaven. You know what they had done? Because I think I was difficult and inclined to break bounds, they made breaking bounds official. I was made school rat catcher and I went and bought the traps and I caught the rats like this, much to the gratitude of the school authorities. So in other words here's the practical side to the natural history story in that they must have at some stage said what are we going to do with this chap. And they had made me school rat catcher. Now later on I started to read about a chap called Charles Waterton who was also a chap from our school in the early 1800s, and they'd made him rat catcher too [laughs]. I feel that I'm in good footsteps in other words.

*And for those who won't have any idea, what's involved in being a rat catcher? What did you have to actually do?*

I got on the bus and I went to Clitheroe and I went into an ironmonger's and I bought rat traps. Not the snap ones like the nipper or whatever it is but these were gin traps on a small scale, nasty things. And then, oh, and you spent a bit of time doing a

reconnaissance patrol of the area and find out where the rats were and then would subtly put these traps down in front of the holes. And lo and behold the next day you'd go back. You see you've got freedom now to do everything and you've got official sanction from a university, not from – from school authorities. So in fact I spent my time catching rats until the rats got rather clued up that I was a dangerous person, didn't catch any. So after the first two or three weeks when I caught quite a lot of rats, the rats rumbled the whole system and evaded my traps [laughs].

*And what else would you break bounds at this school to do? Breaking bounds I think means that you moved off the playground –*

Yes, that's right.

*Into the wider estate.*

There was one of the masters, the lay masters, there were both – [inaud] of the Jesuit establishment, and there were priests and there were lay masters. And some of the lay masters lived in the house outside the immediate confines of the school. And in those days food was a bit tricky and one of the masters were – everybody shall have to be nameless in this one, who came up to me after a certain class and said, 'We're having visitors next weekend. Is there anything you can do for us?' Which sounds a rather cryptic sort of request until you realise that in fact he knew that I was able to catch things. You remember me telling you about fish in the river? I knew how to catch things like hares as well, so I said, 'Right, what would you like?' He said, 'Well, what can you get?' And I said, 'Well, how about a brown hare?' Oh, he said, that'll be excellent he says. Off I nip and snare a brown hare and bring it back, and I was knocking on his door with my coat bulging. I'd got two large brown hares suspended from my braces underneath, you see. So I became not only the official rat catcher but the unofficial provider as well in a sort of sense, with – with meat that was difficult to acquire.

*How do you catch a brown hare? Or how would you do it at that age?*

I tell you what you do, you – first of all, the most important thing is reconnaissance. You go out and have a look where they are.

*How would you –? Sorry, how would you tell where they are for the –?*

You just look, you just – you surreptitiously look over a field and you see a brown hare. You clap your hands and the hares run away and they go through the hedge. And then you go and you put snare in the place where you see them go to. I'm teaching you nefarious things. Anyhow, having done this you then go away and do another field. You clap your hands, they run back again, and there you've got them haven't you? 'Cause they go through the same holes again and again and again. So with half a dozen snares you could almost certainly catch one or two hares in that sort of way.

*And what sort of snare might you have used then?*

Probably a rabbit snare, set about an inch or two higher than you would for a rabbit.

*And is this something you would have had to bought or could you make?*

No, no, no, you've got to buy these from the ironmonger, you can buy them by the fistful. I've forgotten what the price of them but they were brassware. But anyhow, that was how I managed to convert, if you like, the skills acquired in central Wales to be operative in different situations.

[58:37]

*And what do you remember of the formal teaching of, let's say – I know some of these subjects won't have been covered but let's say geology at Stonyhurst?*

None, none, no geology. First of all, science was what interested me because I started to convert what was natural history into genuine natural science. As we get older you try to make it a little more sophisticated. And I remember effectively doing things like physics, chemistry and biology, and this is the way people did things in those

days. And I remember doing an experiment in – it actually was in physics but it doesn't matter. And I – the results that I got were different from what the master expected me to get and I was told to do it, the experiment, again. Now in – I went on doing it until I got it right if you can follow because there's something odd about physics, you can get physics wrong very easily. Then doing biology, we – in those days you could dissect animals that you would find rather politically incorrect. For instance, we were dissecting frogs and I remember, I must have only about sixteen at this stage, looking at my frog and looking at the book. And this was the supply of nerves to the arm, the brachial nerves, and my frog and the book looked quite different from one another. And the biology master said, that's interesting. Now this is the approach which I treasured. I didn't get it wrong, the frog didn't get it wrong, it was interesting. If my physics master had said to me those results are different from what you expect, that's interesting, what's happened, it would have been a far, far more valuable lesson than merely having to repeat it until I got it right. In biology I discovered there was no such thing as it being right or wrong. It was interesting and every now and then different. So the most valuable lesson you learn in biology is the word usually; it is usually like this. And then the next most valuable word you learn is except; it's like this except. And you find all sorts of exceptions to – and that's what pushed me into biological science. Now ... I mean we could move on a little bit because by the time I'd done my higher school certificate, as it was called in those days, I wanted to go to university and I wanted to study zoology, as you might imagine it's the most likely thing to study with my background. And I went to Manchester and the head of department was a chap called Professor Graham Cannon. And Graham Cannon was very, very famous in many, many ways, we needn't go into that for the moment. And he, I discovered after I'd gone into the university, into upstairs, didn't like undergraduates. Now I think I should put it differently. Whether he liked them or not was irrelevant, he didn't have any. So on my way downstairs, and this is one of those strokes of fate, underneath the zoology department was the geology department. And to get downstairs I had to pass through the geological department museum. And I remember seeing, oh, bones and bison from Windy Knoll in Derbyshire and thinking, gosh, I'm in the wrong subject. Geology would be – if this is geology, this is what I want to deal with. For I'm back to that old museum that I mentioned in the centre of Wales where I had all these bones and things, absolutely cluttering up the place, and there they were in cases and people seriously working on

them; where had I been all this time. And so within less than twenty-four hours I was converted from an ambition to be a – to do zoology to an ambition to do geology instead. I didn't know what it was, all that I knew was that it included the right sort of things. And I started doing geology, in other words, by accident of architecture if you like. It was just – it just happened to be below and happened by accident. I started a bit late in the course but geology to me was a completely unknown area. And I hadn't been geology more than a few weeks before I suddenly said, this is the gap in my knowledge that I knew nothing about. And I was keen in those days to fill gaps, and I remember thinking this was marvellous. I'm doing a subject which fills a big gap. And I was just a vacuum cleaner, I just sort of soaked up any information.

*Did zoology not have similar, well different, but have its own collections of things that might –?*

Yes, ah, but you see you couldn't be an undergraduate. You couldn't take an honours course in zoology in Manchester. So it had fascinating things, yes, lots of fascinating things, but you could in those days do a course which is not an honours course in zoology. And so I ran concurrently geology and zoology as a sort of subsidiary subject, honours geology subsidiary to zoology, and botany at the same time. You can't do it now, I don't think.

*Apart from the fact that it seemed to your mirror your own collecting of specimens at primary school, what was it about this – the sight of these geological collections that really attracted you, do you think?*

Big bones, big bones were simply fascinating because this is what initially draws your attention. You know, there's no child in this world that isn't fascinated by dinosaurs but big dinosaurs, no child is interested in little dinosaurs. So size matters, bigness is what impresses you to start with. And there are all sorts of, not only the Pleistocene bones but there are also, oh, Ichthyosaurs, Plesiosaurs, you name it, everything. And these in their own right, before I understood anything about them, were exciting just because of their size I think.

[1:06:04]

*And so let's – we'll come onto this undergraduate course in a second? Do you have other descriptions of teaching of science and of other subjects at Stonyhurst? This could include, if we like, geography as a –*

Never did any geography.

*No geography.*

The fact that I'm a professor of geography now is interesting because I never took a single geography exam ever, or course.

*Any memories of the teaching of chemistry at Stonyhurst?*

Yes. We had a master who was extremely knowledgeable, a very, very charismatic and a – a chap called Dr Haddock, known to us as Hake of course, as you might imagine. And he was – he was very good indeed. And so I remembered – I remember him because of his idiosyncrasies. He could make chemistry exciting and interesting, but at one stage we had a master who clearly was a bit odd. He suddenly materialised, I won't give you his name for reasons that'll appear obvious I hope, and he was grotesquely incompetent. So I had the two ends of the spectrum, one very charismatic, very informative, very exciting, and the other who was absolutely incapable of teaching anything. And one day he actually tried to do an experiment with combustion, as he said, he got everything mixed up. And doing an experiment on combustion on a laboratory bench, in front of a crowd of adolescent students, you could just imagine what fun we had because he set the whole place on fire. And we had a marvellous little man, the lab steward called Piper, who came in and he just simply went round putting the fires out on the – on the – with such quietness and such composure that it was – it was a lesson which I have learnt. Now from that nonsensical I've learnt that yellow phosphorus would spontaneously ignite, that if you put sodium into water it will generate hydrogen or something which will – also can ignite. And if you put phosphorus – not phosphorus sorry, potassium into water it will actually spontaneous – it's terrific but you can't mix them up, 'cause if you mix them up you have the most extraordinary conflagration. And the one thing that

burning phosphorus produced was phosphorus pentoxide, which is a yellow cloud, and we all disappeared into this cloud, coughing and spluttering as you might imagine. It wasn't excessive for the amount of phosphorus pentoxide that was in the atmosphere. And I remember just as the – as I was disappearing into the cloud seeing the lab steward cleaning up the top of the bench and spoiling all the fun. So, yes, and so that you will remember things which you perhaps shouldn't remember but when I said that Dr Haddock was in fact very charismatic, I don't have that memory. I don't remember him teaching me something superb. Oh, yes I do, Mendeleev's Table. Gosh, the Periodic Table was a magic thing but the one time that I remember most is the one that was most catastrophic. It says something about teaching doesn't it?

*The lessons that you remember, yes.*

Are the ones that go wrong.

Yes.

Absolutely.

*And what sports were you involved with at school?*

Rugger only. I mean, yes, I played rugger quite regularly. I was – again because I was a bit individualistic and my position was full back, which meant I could do what I liked, so once again it's that same story of trying to regulate me because in fact I must have been difficult to cope with and therefore if you have a rugby team you put him at the full back and then he can be an extra three quarters or he can stand there. And if there's trouble he has to stop it, you know. In other words, you're the last stand, if you like, of the opposition, so it was, it fitted my personality.

*When you say that you think you must have been trouble, do you have any memories that confirm the [that] view in your mind that you were trouble? Aside from breaking bounds would you have memories of being – of being difficult or of being what we might call 'naughty' now?*

Yes, I can't recollect easily the specific examples. Yes, I must have been difficult. We had corporal punishment at school issued by a thing called a tolly which was a strip of Gutta-percha about, oh, eighteen inches long and about three inches across, and you were whacked on this hands with this. And I got – I got my fair share of this, not without good reason I feel sure. But once again I remember the punishment rather than the cause of the punishment.

[1:11:25]

*And any clubs or societies that you joined? I don't know whether they had this sort of thing.*

Yes, several. The one – we had the countryman's club to which I was co-opted I think because I could take people out on Sundays on trips. For instance, I could catch fish with snares in the river, etc, which I duly did. Other – it was entirely as a teaching tool, you know, just to show people how it was done. The fact that we could eat the proceeds was rather exciting and –

*How do you –? Again sorry, but my lack of knowledge but how do you fish with a snare as opposed to line?*

Well, oh gosh, well, if you take a rabbit snare, if you just – it depends what you're looking for. If you're looking for a big hefty fish you use a rabbit snare. If it is a salmon you snare it to the tail end. If it's a sea trout you get it halfway down because there's a slightly different tail anatomy. But when you're dealing with brown trout, as I was in school, you – a rabbit snare is far too robust, so you unravel it and you make small snares out of big snares, out of single strings of – single strands of brass wire. And then you have a stick and you attach the thing at one end and you carefully slip it over – slip it over the trout's head end, not the tail end, and when you're about halfway down you flick it out. And on one spectacular occasion I hadn't a stick so I borrowed one of the school master's canes – no, I don't mean the canes they rapped people with, with his walking stick, and he was there so it was done with his acquiescence. And I tied my snare onto the end of his walking stick, snared a whopping trout about a pound and a half, flipped it out, and as it came to the top of

the trajectory, as I flipped it out of the water, it came out of the snare and shot onto a grass field nearby as if that was intended. And of course I said it was. It was a pure accident but you've got to take the smooth with the rough occasionally.

*And where had you learnt how to do that?*

Wales, I think again we go back to the rivers in Wales.

*By experimenting or had you had some –?*

No, no, we were shown.

*By who would have shown you in –?*

Other – other colleagues in school, other boys in school. And I never enquired how they found out but I think it was rather passed on by some sort of apostolic succession. This is the way small boys have to learn to live, and poaching was one of them. And I'm sure it's still being passed on to this day, except most of us are a bit too long in the tooth to actually do it any more.

*Were there – perhaps they might have been called masters were they at Stonyhurst? Were the masters who seemed to have an interest in natural history themselves that went beyond teaching?*

Yes, yes, I think so. Again, I can't give you precise details but there were quite a lot of activities which took us out into the country all over the place. Formal natural history? Yes, a bit, a bit, for one reason or another. Er, once again the biology teacher was a very good natural historian and was a broad spectrum man, he knew his animals and plants and he knew his ecology and this is what – it became more interesting to me not just to collect individual things but to put things together into ecological ecosystems and things of this sort. This I learnt at school, to start with anyhow. And project work on, for instance, the ecology of a neighbouring wood. Fascinating when realising that everything fitted together into a sort of complicated jigsaw puzzle like situation. That's where I started it.

[1:15:42]

*And what were you reading? Apart from things you were asked to read for schoolwork and so on, what were you reading at this age?*

Erm, I have to admit very little that wasn't natural history, and this was the driving force. It was natural history was the thing that drove my enthusiasm all the time. Novels and things like that are just terribly dull. I started – Tolkien was very good when *The Hobbit* came out, you know, and I liked that sort of thing 'cause it was a total fantasy world. And the great thing about Tolkien's stories was that he also built in the natural history to them. And so I began to – I had sort of sympathy with him, you know, I could – I could live in this imaginary world. I think it's because in fact the world I live in was also partially imaginary. It became more crystallised and more scientific as time went on but the initial stage of looking at natural history was a sort of fantasy world which gradually started to become more clear as time went on. But the earlier stage – I could have had dragons just as easily down in the Gas [ph] Wood as having in fact sparrow hawk nests down there. Why distinguish between dragons and sparrow hawks, you know? They all had the same credence as far as I was concerned. Then you gradually started to – you asked me whether I believed what I was sort of taught. Yes, I mean you read about dragons, you say, yes I do, I can believe dragons just as easily as I can believe anything else. So to some extent this imaginary world, this fantasy world, gradually disappears in favour of a real world, which is the world of science, the world of natural science, as opposed to just collecting things. I could have believed that some of the bones that I found in my primary school were monsters, whatever monsters are, doesn't make any difference, quite happily. And then I grew up and I lost that fantasy to some extent.

*And when you say you were also reading non-fiction, natural history books, where were these coming from at this age?*

From the library.

*The library.*

The school library, yes.

*Are there key –? Again, this is asking a lot of detail and you simply not remember enough but were there key texts? In the same way you had this key text that your mum had given you or something –*

No, no, there weren't. There were no – I don't remember key texts like that. I wish they had been because I – but I think again most key texts were, what shall I say, fairly specialist but they had a series of books which were stories about natural history sort of things. Francis Pitt, a famous Shropshire lady who had kept all sorts of animals, and we overlapped in that she kept all sorts of wild animals. And she wrote very, very well and I remember enjoying her writings very much. I remember also a series of books called *At Home in the Woods*, *At Home in the Fields*, this sort of thing which were anecdotes. And at that stage this was a means of learning and you'd feel you could share people's experience when they were describing something to you, so that narrative had – as opposed to dry – just keys to identification, narrative about how they go about doing their whatever it is, you know, how they live was so important. Then I started to pick up a chap called Grey Owl. Do you remember Grey Owl?

*No.*

Well, Grey Owl was a chap who wrote from Canada about beavers in particular but the whole of the wild world, and this also impressed me enormously. And therefore to discover that he was an impostor, he was not a purebred Indian but a man from Hastings, really was like Father Christmas being found out to be dad dressed up. But I suddenly lost heart but when I believed in Grey Owl as a human being, as an Indian, I remember being enormously impressed by this chap. In other words, there has to be a – if you like, a sort of natural historical sort of component in what I read. And those are examples of the sort of things that I read because they were like my experience of things.

*Yes, they're all a sort of – a human interacting with the environment –*

Oh, yes.

*Personal descriptions of that.*

And I think I've been doing that ever since. I have found great satisfaction in making narratives out of my data. And so I tend to draw pictures or build pictures now as I did then, only now they're a little more scientific and a little more, if you like, er ... difficult to quite – to put it – er ... relevant in a sort of way. It's all very well reading about somebody's personal experience of doing this or doing that but now my pictures I'm hoping are conveying information which is of value to other people and not simply a description of me.

[1:21:58]

*Now I said I'd come back to this. Could you describe more fully your keeping and rearing of animals? I think it was at Stonyhurst that you said that you were doing this.*

Everything. I mean first of all any small animal was – from insects upwards, I would collect slugs and keep them in jam jars. Now I always remember we had one of those great Arion, you know, the big black slugs, and I had it in a jam jar and it was – we fed it. Unfortunately I went away to school for thirteen weeks and came back and there was something very strange about it. The slug was all right but it was half as big as it was. It somehow seemed to have de-grown, you know. Actually it was dehydrated but that's a different story. But it's an interesting thing there was that I would keep everything, snails, fascinating, insects as pets. I've already mentioned I'd keep caterpillars as pets. I kept every conceivable thing as a pet. We had at home dogs and things, and cats, but I found these things rather dull. The really interesting thing was wild animals like foxes. And subsequently I kept almost every conceivable British mammal and birds, quite a lot of them, simply because I enjoyed particularly if they were totally free flying. I had at school jays, for instance, that we reared from tiny, tiny chicks out of a nest at the top of the drive. And these used to fly around completely free and come to my call. I just put my arm up, call out and these things

would come and land on my arm, which was really rather – it's very, very attractive to go around and live with these animals. I had foxes that would come when they were called. And later on we had badgers and all sorts of things, and deer that would do exactly the same thing. Totally free living, so that initially jackdaws started the story as far as birds are concerned, then jays and magpies, you name it we kept them. And people, they would start to bring things, little things, to me, and this was the way I acquired most things, people would – and it went right up to – as you noticed earlier on today, in modern times people still bring things to me.

*So whereabouts were the jackdaws in your – in school, where?*

In a shed, not very far away. It's a bit embarrassing actually because in the gardens at Stonyhurst were two summer houses, designed I'm told by Christopher Wren. And one of these I commandeered as my jackdaw sort of aviary, much to the consternation of various of the school authorities because they did their droppings all over everything. And this – these summer houses were used for storing deckchairs and things like this, which was suitable when the parents came in the summer. And various people were recruited to clean off the jackdaw droppings off the – off the chairs because I'd used the summer – one of these summer houses as my jackdaw-iam or whatever you call the thing, yes. So those – they were very tolerant. And you asked a short while ago why was I difficult and now you're beginning to see that I – I was difficult.

*Did you need permission to use these, one of these, as your place for keeping jackdaws?*

I think technically, yes. I only say this because I don't think I got it. I think that I should have done but I think that I'd found this sort of rather elaborate and beautiful summer house and I thought, right, ideal for keeping jackdaws in. It never dawned on me at all that it was actually inconvenient to everybody.

*What other animals did you keep at Stonyhurst?*

Oh, mostly birds of one sort or another. Everything from kestrels down to little birds. Most of the little birds flew away, yes.

*So a kestrel. Where would you keep a kestrel at school?*

We had sheds you see and my – during my reconnaissance there I can still take you to various places, I did, I took Beryl a short while ago. And you can see my old sheds down there. There are still buildings that have been used once upon a time and then when I was there, empty. They had been standing empty for quite a while so they needed a certain amount of repair. I remember one of them was about – oh, absolutely ideal for a muse to keep things in.

[1:27:01]

*Thank you. So the decision then at the end of Stonyhurst to go to university so that you decided you wanted to do zoology –*

Yeah.

*What A levels had you taken to get to that?*

Chemistry, physics and biology. They weren't called A levels, Higher School Certificate.

*Higher School Certificate, yeah. And then you applied to Manchester to do zoology.*

Hmm-hmm. The reason for studying at Manchester was it was fairly nearby, so I could stay at home you see. And this was my first effort at applying. There wasn't any UCAS and all the rest of it, so you just went along and saw the head of department and said can I join your department and he said yes, just like that.

*And so we've got to the point where you've gone down the stairs and you've seen the geology museum, decided that ought to be the subject.*

Yeah.

*What happened next?*

I went to see the head of department. Oh, yes, there was a chap called Don Griffiths who turned out to be a complete geophysicist later on and he, me and my sister – and I remember saying within the same day, ‘How do I join the geology department?’ And my sister said, ‘I’ll ask Don Griffiths.’ And Don Griffiths said, ‘Come and see the head of department.’ And the head of department was Professor Pugh, William Pugh, who became head of the geological survey later on. And it turned out by some stroke of luck that Professor Pugh had done his field work in the same area as I’d lived in, central Wales. And we fell to reminiscing about it all, and it went on and on. The interview consisted entirely of, and do you know and do you remember type of things, you know. So that I chatted away, chatted, and then he suddenly said, ‘Well, you can start tomorrow.’ And it was a week after term started [laughs].

*And what year was this, just as a marker?*

Oh, about ‘39, about. Once again give or take a year or two because I’m not quite sure but that’s about it

*So you were at university during World War Two?*

No, no, ‘40.

*Oh, ‘49.*

‘49, beg your pardon.

*Sorry, sorry, I thought you said ‘39. It might have been ‘49.*

I might have done but I didn’t mean it. But I meant ‘49 is what I meant.

*Oh, okay, thank you.*

If it had been during World War Two I would have been a child in arms.

*Yes, quite yes, so '49. Where did you live during your time at Manchester?*

At home because we – in those days there was a railway station at home and you could get the train into Manchester every day.

*So you lived at your old Cheshire home?*

Yes, that's right.

*At this time were your parents still operating their surgeries?*

Yes.

*And what was the view of your parents of your choice of – your remedied choice of your –?*

Oh, my mother didn't know what geology was either and said, oh, good dear, how nice. My father said, why can't you do a proper subject? He was convinced that geology was a waste of time. And then I discovered that the only worthwhile job was medicine, he thought, and I can understand subsequently what he meant but – so that really they were very supportive but they'd no idea what I was doing. All my father thought was that there could have been a better choice and my mother would agree if I enjoyed it. So this was the approach, rather different in both cases.

[1:30:41]

*Thank you. I don't know whether you can remember the course in terms of first, second and third year. Are you able to break it up like that?*

Remember that what I did was a rather strange course that was available in those days. I did an honours geology course plus, in the first year, a zoology and botany

course, which was pretty elaborate. And then in the second year I dropped my botany, the third year I took a zoology course as well as geology but wasn't examined in it. Now the geology course started off with the head of department, Professor Pugh, giving us the usual lecture of geomorphology and all that but with the – Arthur Holmes' *Principles of Physical Geography*, which I'm sure you know of, which was in fact the sort of, if you like, the text book of the course. We also did simple things like elementary palaeontology, elementary stratigraphy, just the order of the strata, and very British orientated. And, identifying rocks, this is a granite, this a granodiorite, this is a dolerite, etc. So there's an awful lot of factual information and we did things called problem maps. Now a problem map was really a three dimensional problem – better thought of as a four dimensional puzzle. You have a geological map and you had to work out what the structure was. And it was usually a contrived map of sort of an imaginary world in which geology in increasing complexity was gradually shown to us. That was fascinating because when I used to travel by train I used to do my problem map sitting in the compartment with other people and it nearly always happened that I was sitting in the same compartment with the same people every day. And then I used to have to take three or four problem, extra problem maps, because the other people in the compartment wanted to do them as well. So we used to have impromptu problem map classes with businessmen and accountants and people who were always struggling away, and they'd come back and say – talk to you days later, you know, those flight lines don't quite fit you know, and this sort of thing. And where has the fold axis gone, you know. And it became rather an interesting sort of – it was rather like Sudoku but written in geology.

*So you had these presumably – though you'd been set these for undergraduate coursework –*

Yeah.

*And you were doing them on the train between home and –*

Yes, but I was taking a whole fistful of other ones so that I could issue them round the compartment so that the compartment could also do it.

*And these were people just on the way to work then?*

It's just – it was just the same sort of excitement as doing a Sudoku or a crossword because the rules are very simple but the results are complicated. And this became a fascinating sort of activity on the train going in. And when the journey was three quarters of an hour it passed the time excellently. Other people did take card games or something like this or crosswords and we did problem maps.

*And once you'd decided what the geology, the three or four dimensional geology was in relation to this flat map, how did you record that? By sketching or just by written description of what you thought was there?*

Well, first of all you've got the problem map, this is just like a Sudoku game, was incomplete. And you could sketch onto that map the pattern of outcrops, where the rocks would occur if they happened to be exposed. So you could draw all over them and where they were. And some people did brilliantly and some people made an absolute bog of them, but the interesting thing was that it was a puzzle and you drew it onto the map, filling in the places where the geological evidence wasn't available.

*I see, yes, thank you. And any other aspects of first year geology? Problem maps –*

Field –

*Identification –*

And then we went to the field and we did what was I think a sort of cook's tour, starting off in Manchester and travelling northwards, right up into the highlands here, and stopping off and looking at rocks. And it was – it was my first real experience of the fact that rocks, instead of just appearing there, actually made sense, geometric sense, and little logic sense, so that this is the way in which geology should be introduced. It is a field subject to a very, very large extent. And it was only when you got out into the field that all those bits of information, bits of palaeontology, bits of petrology, bits of stratigraphy start to come together. So we spent a fortnight

travelling all the way across here in the highlands and, well, north of England into the highlands and everywhere.

*And do you remember what sorts of things happened in the, I suppose, non-focused working parts of the trips? So I wonder whether you could describe, you know, the social aspect of this first experience of organised geological fieldwork?*

Well, it was the usual things that undergraduates get up to, drinking rather too much in the evening, etc. One of the nicest was when we went up to Loch Lomond, and at Loch Lomond there is a youth hostel, a sort of Scottish baronial mansion that had been taken over by the Youth Hostel Association. And we stayed there and it was my first induction into Scottish dancing, which turned out to be extremely vigorous and just the sort of thing, great fun. And, erm, I'll be doing it until I run out of puff, I've been doing it ever since to the tune of doing demonstrating Scottish dancing. So that all started out on a field trip. So once again, between the formality and all sorts of important things happened and I learnt a lot then all of a sudden. But to discover that there was a whole area of dancing which didn't involve close personal contact in the way that ballroom dancing did – I was instructed as a child that ballroom dancing was something one ought to learn. And my dancing teacher used to say more hip contact, more hip contact, and I thought that's the last thing in the world an adolescent young laddie wants to do with his rather buxom lady who was trying to swing me around all over the place. But highland dancing, Scottish dancing, was completely different. Yes, you had personal contact but it was on a more formal basis with much, much less hip contact.

*Where were ballroom dancing lessons happening then? Where and when was this?*

Oh, next door to our house in Cheshire was a lady who ran ballroom dancing classes. And it was considered a social asset, just as I was trying – somebody tried to teach me to smoke because that was considered also a social asset. Well, fortunately I managed to relinquish the smoking bit but I never took to ballroom dancing, and fortunately neither does Beryl, so between us we're quite happy. But oh, yes, it's – I mean things like the quick step and foxtrot and all these things that everybody had to do, and this was considered to be essential. I went to one or two balls because my mother thought

it was very good for my social development and I was utterly bored. And to be expected to actually dance with strange girls, in those days there was nothing more abhorrent to a young man than actually be expected to do this. And so I fell out of love very, very quickly with ballroom dancing.

*At what age would your mother been encouraging you to go both to lessons and to balls?*

Oh, there's – oh, on and on. Er ... I mean it starts with children's parties where do you do Roger de Coverly things like this. And these were okay but when I was expected to go to balls I had to – there were one or two, not many because I didn't like them very much, so – but I remember going to one or two balls where [coughs] – excuse me – girls had to dress up in appropriately skirts, voluminous skirts, and things like this. I can't remember whether I had to dress like a penguin, I can't remember down to this life, but I do remember going to them. And I do remember finding that this was not my scene, put it that way.

[1:40:12]

*Thank you. So that's first year geology. And the zoology component of the first year?*

Yes, yes.

*What did that consist of?*

Well, a series of lectures by a Professor Graham Cannon, who I mentioned earlier on, which were brilliant in many, many ways because in those days the – it was chalk and board and some of his drawings on the board I could have photographed if I'd had the gear because they were so beautifully done. But everything fell into place. It was the old end endoderm, mesoderm, ectoderm, and everything had to be coloured. Ectoderm was green, mesoderm was yellow, endoderm was brown. I may have got those two colours upside down but it doesn't make a difference. And you had to stick to the right colour, so you went in and you – and I mean what amazed me was that no matter what sort of embryology or whatever it is you were dealing with, there was this

underlying conformity. The fact that it probably is excessively simplified was something which I – at the time I found the fact that there's a uniformity there. It was a wee bit like Mendeleev's table, to discover that chemistry makes sense in an orderly fashion, to discover that embryology and zoology makes sense. Comparative anatomy, for instance, makes nice sense, was quite a nice discovery, it was quite a satisfying feeling that it isn't just a whole lot of chaotic bits but there's a whole lot of interlaced bits. Well, Cannon's lectures were interesting in that way. He also taught that this was a group of people in various departments taking zoology as what we used to call a subsidiary subject. And all the medics had to take the same subject, take the zoology. And Graham Cannon rather liked the medical, female medical students more than the male medical students. All the females used to sit at the front, so all the girls were sitting down there and all the chaps in the back, and we were kept in the back. And that's how I met Beryl, you see, 'cause my wife happened to be one of the girls who comes and sits at the front you see. So we met to some extent in Cannon's lectures but then it took me ages and ages to find out who she was and where she was coming – you know, where we could meet again and other – so you couldn't do that now, it'd be called sexist or something, and it's terribly inappropriate.

*Why did they sit only at the front and not spread around?*

Because Graham Cannon thought they were prettier than we were.

*So he told them to sit on the front?*

Because he liked them. He used to go to the medical students, the medical graduation ceremonies, because the medical – the girl medical students were much prettier than the others. He used to tell us this. Even in lectures they had to be down nearer the front where he could keep his eye on them, put an eye on them anyhow.

*Any other evidence of his preference, apart from the seating of them?*

Apart from the fact that of course that he didn't want undergraduates because it would sort of clutter up his department.

*How many – as a sort of ratio, how many female geology undergraduates were there in [both talking at once] –*

Oh, we had about five or six men to women, as in a couple of women usually. It was of that order anyhow, certainly not more than about five. In our final graduation there was five or six, five yes.

[1:44:03]

*Erm, yes, sorry yes, and in terms of taking undergraduate geology, I asked earlier about your faith and you said that this was something that you questioned later on in life, certainly not as a younger child. I wonder whether you could tell me now about your questioning of something which you'd tended to accept as a younger child.*

Well, at school we were taught very little about evolution. And I was really taught - and by the way I could do all the religious doctrine perfectly well, I'd get prizes for them too funnily enough, but I had my tongue in my cheek after a little while for two reasons. One of them was that we were not taught about evolution and sort of some form of special creation which was the only way in which - well, this interrelationship, comparative anatomy and everything else, started to suggest to me that this is not just a series of isolated things but they were all from the point of view, anatomical point of view, very, very similar or very closely related. And therefore to some extent I saw this as different from what I had been - I had been taught. And if this was - and if therefore my education in biology had been partial, as it was, then in fact I began to worry about the fact that what else was partial. To what extent had I only been fed a certain part of the acceptable area of science? And to this day I feel fairly sure that this is what happened, so that evolution to start with said, look, you don't need a divine interpreter or a divine engineer or what have you to produce - the idea that evolution happens and then Darwinian selection is a mechanism whereby, if you couple this with a knowledge of genetics, that this is the driving mechanism of origin of species, origin of all the diversity. Then this is very much at variance with what I'd been told. So that's where the under - it's rather eroded away at my faith. The other one becomes a rather simpler one. That is remember there was a hymn called *All Things Bright and Beautiful*? But any biologist knows that all things bright

and beautiful does not describe the situation as it really is, that once you start to look at biology as it really is then a benevolent designer, a benevolent deity, doesn't really feel the bill. Geology – I'm sorry, biology is horrendous at times in no way can it be seen as benevolent. And when I realised this very, very early on, that was the beginning of my sense that it wasn't really – that the religious story didn't quite fit the bill. So I got two strings, once is the evolution and the mechanism of evolution, and the other is actually a descriptive thing, that just a minute, anybody who can look at ichneumon flies and see how they operate realises there's a real problem with *All things Bright and Beautiful*. Real nature is horrendous.

[End of Track 1]

## Track 2

*Could you continue to tell the story of reasons for losing a kind of what you call a naïve faith, including a sort of timing of that? When were you getting the kind of information that was sort of growing on –?*

I mentioned timing to begin with. It's very difficult because there's not a sort of eureka moment, it's a moment that – it gradually creeps up on you. The inadequacies of what I was taught. For instance, Adam and Eve, this is all very well as this is talked about as our first parents, but it doesn't require much in the way of arithmetic to realise that you've got more grandparents than parents, or great grandparents, etc. In other words, the pyramid goes up and gets bigger and bigger. And I thought that the idea of a single, you know, primordial human being was very unsatisfactory arithmetically amongst anything else, and nobody managed to talk to me about this in a sensible sort of way. And when adults don't explain things you start to invent your own explanations, and I felt quite unhappy with that sort of notion. I told you that in fact I felt that once I realised that evolution happened, not only that it happened but that there was a mechanism for it which made absolute sense without the necessity of having to have a designer, a creator or – this again began to start to undermine things. Then personal things start to step in, that if you are attached to a formal religious group then you're expected to confirm in all sorts of ways which I found rather unnecessary. Not only that but trivially – trivial and stupid. And why should the religious authorities intervene in almost every aspect of human life? And I felt this was an intrusion. In other words, if you start with the simple story it's unsatisfactory, then a slightly more complicated story, that's even more unsatisfactory. But when it started to intrude upon my own private life I began to feel that this was a little bit more than I could accept. And I'm in that position now. I'm not an atheist in the sense that I am certain there isn't a god, I just think that I can see no reason why there has to be. So my Rake's progress, if you like, is in fact a continuous downward slide from confidence at one end to total lack of confidence at the other.

[02:49]

*Thank you. And second year at university –*

Second year.

*Yes. Geology and zoology only?*

Yes.

*And are you able to give us a sense of the content of the second year including the field component?*

Yes, I would rather think it's not very easy to remember the precise details of the second year component other than, do you remember me mentioning Mendeleev's table? That Mendeleev's table suddenly made chemistry into a pattern that seemed to work. One of the great things about second year was what we called petrogenesis, this is how igneous rocks are formed by the gradual crystallisation of a silica melt so that it becomes – gradually changing in its composition. And suddenly to realise that there was experimental evidence that you could do by melting rocks and crystallising them into patterns, so that all the igneous rocks, for instance, and the minerals that they composed were again all interrelated. And that interrelationship is rather like – the eureka moment of the Mendeleev's table is the eureka moment of igneous petrology. It suddenly started to make sense. Okay but it was complicated sense but from then you've got all the rest of the rocks. You got rocks which are sedimentary, and they derived from the other. In other words, there was interrelationship or you got metamorphic rocks which was the – either igneous rocks metamorphosed or sedimentary rocks metamorphosed, and there was a chemical sense in all of this. That was to be very exciting but it was overshadowed by real studies of palaeontology, not simply how to identify fossils but how they might be related. For instance, there were studies of things like ammonites and the belief in those days, which was very prevalent, that if you go back in embryology you somehow or other recapitulate your phylogenetic genetic history. Your history – your – by that I mean that somebody once described it as during the development an organism climbs to the family tree, that it goes through stages which represent earlier stages. And if you take an ammonite and break it down you can find in fact earlier stages. And so fascinating to

me, it happens I think to be wrong but that's not the point. It's said there are laws and patterns in evolution which people look for. I think that an awful lot of what I was taught probably hasn't borne any sort of – it hasn't been acceptable subsequently but at the time it mattered, at the time it was exciting. So palaeontology and the – and petrogenesis came together as producing patterns. And then something happened which I thought was very interesting, and that is a professor at Birmingham, a chap called L J Wilson, Leonard Wilson, produced what he called his sort of geographical atlas in which strategically the sequences of rocks in various places suddenly became part of an ancient geography and another of these unifying appearances. I thought that book was marvellous, I still do. The fact that it hasn't stood the test of time is also no criticism of it. The idea that we're now seeing the interrelationship of things, we're once again going back to, you remember talking about biology being lots of little things like animals. And then you often get gradually more complicated relationships to ecosystems, the same web as geology. You start off in the first year, you look at rocks and you look at fossils, you look at bits of stratigraphy. In the second year you start to put it together, and putting it together was to me most fascinating. So in a sort of way that's the general picture of second year. And then more fascinating, we were taken out and given a patch of ground to map geologically. And we were just wound up and let go and you – you knew approximately what you were looking for. And it was as if you were discovering for the first time how the geology fitted onto a landscape. And it was another of these occasions when I suddenly found that all I'd learnt suddenly started to fit together into a coherent whole.

*How did you go about mapping? Or first, where was the area then how in practice, step by step, did you map it?*

Well, all right. The area was east of Hereford, a place called Woolhope. Now the Woolhope Hills represent a sort of enclave of ancient sedimentary rocks which had been pushed up by tectonic activity, earthquakes and the like, surrounded to a large extent by old red sandstone. And this island of ancient sedimentary rocks was what I was mapping, and that's where we started. You're issued with Ordnance Survey maps and a pencil, and you go out and you find an outcrop of rock. You locate it on the map and you make a quick description. Now you've got a notebook as well, so

you write down what you're looking at and you gradually build up a pattern bit by bit by bit. And you haven't been there very long before you – a pattern starts to emerge in your mind, and then you're constantly testing this pattern against reality, and that's what science is all about. You make observations, you have an idea, then you test the idea. And within – within a week maybe you're looking at a map and seeing bits of data. You can't help but try to put them together into a mosaic picture. And then you find some more data and the mosaic picture has to be changed. And it's this business of having to have an idea of how you think it goes together, then finding more data and rejecting the old one, inserting a new one, which is the whole fun. And I'd describe it exactly like this, enjoyable – an enjoyable exercise of making a geological map. All the time new pictures keep turning up in your own mind and old ones have been rejected and new ones put there, so it's all a matter of taking field slips. When you get them back at night time you sit there with an oil lamp and worry about how you – how this will fit onto that bit, and to fit onto that bit. And the more data you have the more sure you are of where these little bits go. So that was the fun of it, and we were there for three or four weeks, maybe more.

*And what data would you collect about these – the domes or hills?*

[Coughs] – Excuse me. First of all, if you found an outcrop of rock then you could describe it because it's part of the training. We'd describe it as sandstone or shale or a limestone. And then you'd give as precise a description as you possibly can but there's more information. You've got your fossils and things of that sort. And you put these all down in your notebook. Then because there's sedimentary rocks, and more of these salverian rocks [ph] are sediments, there's a layering. And the layering gives you more information, because this shows that the rocks originally were horizontal 'cause they're at the bottom of the sea, and now they're tipped up at any angle you like, forty-five degrees or something of that sort. And you have a little machine called a clinometer which is a method of measuring the angle of the rock, and it looks like a little compass but you just put it on the rock. And that information you plot in your notebook and on the map, and this starts to give you a pattern or structure. For then by looking at an area gradually getting bigger and bigger these little angles of dip, as we call them, start to make sort of structural sense. And then you go to a farmer and he says what are you doing? You always ask, you have to ask

permission. And you go to a farmer and he'll say, 'Well, what's that little machine?' Now all farmers are suspicious of little machines. And I remember saying, 'Ah, it's a measure. It's a machine for measuring the slope of the rock.' And I remember one farmer saying, 'I don't believe you.' He says, 'Any fool can see which way that's sloping. What's it really for?' So it – we had great fun going around trying to explain something which must have been totally mysterious to the farmers. They were only interested in the top few centimetres where they grow their crops, and we were talking about something underneath. And a farmer once said, 'Oh, what's the point of it?' And I remember trying – struggling as an undergraduate to explain to a farmer who was highly sceptical of what I was doing that there was some reason behind this. Not very successfully I may tell you.

*To any extent were the farmers useful in identifying places to look, if you like, in the area or –?*

Sometimes, but sometimes they were actually obstructive and some farmers didn't want to know because they thought we might be going to dig up their farm or whatever. So there was always this constant resentment we might be doing something they didn't want, others were very helpful, 'Ah, you should have been here when I was a child. There was a quarry over there, you know.' And you learn little bits about farms or, 'We never plough that field, it's always boggy,' says that underneath it is probably clay. And even when you've not got any precise information about the geology you can have indirect information such as that's a ridge and therefore it must be resisting erosion, so it may be limestone. That's a hollow, it may be clay, and the farmer will then fill you in with the data. Up there is where we get our lime for the fields, down there we never bother to plough. So that this indirect information, yes, is very valuable.

[13:41]

*Thank you. Any other fieldwork in the second year?*

That was enough, good Good.

*Four weeks, yes.*

I mean yes, field trips, field trips of rather greater sophistication. For instance, it's very difficult because they all tend to merge into one another, but instead of just looking at rocks and saying this is a sandstone, we were given much more information about what that sandstone might mean in terms of its texture, its internal structure, its total context and so on. In other words, fieldwork became more sophisticated in the second year, yes. But I can't remember precisely which because I went to teach fieldwork later on and I wonder too – I wonder sometimes whether an experience that I had as an undergraduate I've now transferred to what I taught for undergraduates myself.

[14:48]

*Could we then consider –? I assume it's a three year course here?*

Of course.

*Could we then cover the content of the third year?*

Erm, I think that it's – it sounds ridiculous but that is in fact not difficult to talk about. It was the quality of the answers that you gave to – to questions. The simple thing that to begin with in the first year was identifying things, then putting things together into a pattern, and then subsequently things that we didn't know the answer to at all. And I always remember we had little animals called graptolites, little fossils, and these fossils were very interesting but nobody knew what on earth they were and therefore an enormous amount of speculation of what they could be. And then comes a chap called, God I've forgotten now his name, a Pole, who really identified what they were 'cause he found small cephalochordates, not cephalochordates, I'm not sure which, protochordate animals anyhow that looked exactly like them in the present, living in the present time. And I was a bit disappointed to discover a solution to a problem because the fun of trying to find out what they might be was so much greater than the discovery of what they actually were. So there's an awful lot of this sort of thing. Statistics looking at – instead of just looking and saying this is a so and so,

looking at assemblages. Statistical analysis came fairly late on, and always very interesting because if you look at collecting data in order to do – to mix the statistical analysis of things then you’ve got to start looking at the collection of the data to discover whether this is biased. And I had great fun with this and enjoyed enormously the idea of statistics. Well, that came in my third year. And a great guy, who sadly is not with us any more called Fred Broadhurst, taught me an awful lot of this, looking at what we call non-remalariates [ph], these are things like mussels that are occurring in the cold measures. And we were measuring these things and then one day he said, ‘Well, let’s put them away and come back to them later. And then we’ll come back to the ones you’ve already measured and you measure them again, and then you see whether your measurements before resemble those that have come later.’ And you’d be surprised, the same specimen measured twice comes out with two measurements. And some things are hard to measure, some things are easier to measure. Those which are hard to measure may have all their variation due to difficulty of measurement and not due to any interior volatility of the thing itself. And to me this was the sort of thinking that I thought was marvellous, put it away and try again another time. To what extent are your measurements repeatable? Now that type of thinking is what I found in the third year but I specialised by this time in palaeontology, and then sadly abandoned things like petrology that I would have liked to keep going. I still do hanker after it, I like specimens of igneous rocks, they look lovely. But I had to do something, everybody had to pick to do something, and I specialised in fossils, not unnaturally.

*What did specialising in fossils entail? How were you marked out as a specialist in that on the course?*

Just as I was describing, you looked at things rather differently. I was looking at fossils not simply as individuals but to what extent is there variation within fossil groups etc, how are fossils related to one another, to what extent can you reconstruct paleoecology from fossils, this type of this. This is what we did when we started to specialise. And sometimes we specialised in – in, what shall I say, sophisticated measurement of things. And I’ll talk a bit more about this in a second or two but, er, we looked at also monographs of things, and trying to identify things in monograph, and trying to discover to what extent the information of the monograph was really

reliable. And to me this is a fascinating thing, you look at something, and the training here was important because you have a fossil which is incomplete and you look at that – pictures in the monograph to try to find a match of something which is incomplete, which is completely different from all your biological training. You don't look at things which are incomplete, you look at type specimens. No, no, we used to go up and down the pages, trying to find out our nearest match. And what this taught us, there was no such thing as a nearest match. Well, there's such a thing as a nearest match but it wasn't fairly close. And where do you draw the line between saying this is the same as that, and this is different from that? It depends entirely on your mood. You say that is nearly the same as that, but is that nearly enough? And that's a very subjective thing. I learnt therefore a lot about the way in which you go about identifying things if you're dealing with incomplete data. And the one thing I've found subsequently is incomplete data is what we deal with. I was once – a student once got terribly cross with me some few years ago about me saying you have to make your assessments in geology on inadequate information. And he got terribly cross because he said, 'Well, you can't do that. If it's inadequate, it's inadequate, and you can't do it.' And I rather crossly said, 'I got married on inadequate information but it's perfectly successful.' In other words, you don't have to have adequate – total information to make a perfectly good valid judgement. And do you know some people didn't like this but when it's the – this is the sort of third year type of question, is this really the same, is this not really the same? And you haven't got enough information to be absolutely sure yet you're not allowed to say you don't know 'cause that's not an option.

[21:32]

*Any clubs or societies at university that you joined?*

Gosh, I'm trying to think now. Clubs and societies? Not really. I joined the local Catholic society, primarily because Beryl was a member of it [laughs]. And so we've had nice social activities like carol singing and the usual thing that undergraduates do, and taking children from the local orphanage to the zoo, which was a very alarming experience, and that sort of thing. I also was quite a keen rock climber, so we – we did all sorts of rock climbing. And I can't remember whether I was actually a

member of – I think I was a member of the local climbing group. We did – we climbed together whether we were members or not, it made no difference. I gave up my sort of rigger and things like this. I just – at the level at which I was expected to play it was getting pretty dangerous. I got serious concussion twice and I thought that's plenty, I don't want to be killed the next time.

[22:54]

*And could you talk about significant friends and relationships? And I think we've already – you've already hinted at the relationship that is the significant one but friends, yes, friends and your relationship with Beryl over this –*

Because the intake was extremely small it would force you – your friends were the people who were in it. Oh, yes, we were on the whole a good crowd. Yes, once again, if you go climbing with somebody it's a pretty intimate relationship. When you've got somebody either on the top end or the bottom end of the same rope it makes – it makes things really rather personal. Erm ... and of course since I became attached to Beryl there wasn't a lot of room for – for [inaud] but –

*And how did the relationship with Beryl develop?*

No, she was a medic, and of course it takes an awful long time to get a medic qualified. And so in those days one was really abstemious and very – not platonic at all but we got on and we went and did things together. We did healthy things like going for hiking in Derbyshire, up and down the Manifold Valley, and Cave Dale and places like this. Great fun, erm, but quite different I think from the way people behave nowadays.

*What were your shared interests, if you had shared interests besides presumably walking?*

Well one another is the most important [laughs] – is the answer to that question. It's difficult to tell. I think that what's happened as far as our marriage is concerned, we've gradually accumulated shared interests that we didn't have beforehand. No, it

was a pretty intense affection for one another that meant that shared interests were gradually developed as we went along. So I can't remember actually in those days whether we, apart from going for walks together and saying, cor, look at this, type of thing, I don't remember anything in the way of actual shared interests at all.

[25:12]

*And to what extent at university were you politically engaged or involved?*

Not at all. In fact very fed up with politics because when we were undergraduates there was a very intense group of people, and I mean intense, absolute loopy, fanatically keen on communism. And they in fact were very keen on recruiting people and one of my main reasons for keeping away from politics is I didn't want to be involved with that sort of thing. And there were quite a lot of these. One never knows whether this was spontaneous or organised from outside, I wouldn't no. But no, I avoided politics fairly seriously. I did rather worry about the fact that some extreme left wingers seemed to have an alternate agenda, yes, quite frightening at times.

*In what way? It's hard for me to imagine.*

Because I think that in fact they were looking for converts. In fact if you talk to Beryl she'll tell you the same. There were people who would come up to her, lecturers come up to her, and gradually introduce politics into almost any discussion. So it was really a matter of I think – of a fear and subsequently I think it's a justifiable fear that these people were looking for converts.

*Were you –? Did you feel that you were being approached at any point?*

I did, yes.

*By lecturers in geology?*

Not in geology. In particular physics was a hotbed of communism. Again, without highlighting any particular names it's well known. But, yes, it seemed to me as if somehow or other this was an ulterior motive that was being introduced occasionally into conversations. For instance, Beryl would be approached by somebody who'd say, it's a great day for you to [inaud] or something like this, and you'd suddenly realise that this was not what he was saying it all, it's really rubbish isn't it, type of thing. In other words, the introductory comments seemed perfectly innocent and then you suddenly realised that in fact there's more to it than meets the eye. Now I personally was not really involved at all. In fact I can say exactly the reverse.

*Yes, I think Tom Kaiser has been a name mentioned to me in relation to the physics department –*

Yes.

*At Manchester at the time.*

Oh, there were others.

[28:01]

*Thank you. Could you tell the story now then of the transition from university work to what happens next in your –?*

Well, yeah. After my degree I did an MSc at Manchester. And one of the things that fascinated me was [coughs] excuse me, was the rugose corals. These are beautiful things, they make sections of them and they look like paper doilies, they're beautifully elaborate things. And as an undergraduate I had looked at some of these and realised that in fact they were a bit like stratigraphy. They accumulated – they were built up gradually so that you not only had a three dimensional structure but it was a four dimensional structure, there was a time component in this. And from this, using ordinary stratigraphical principles, this cuts that, therefore this must post date that etc. You could do the same with corals. And I was interested in trying to reconstruct the sort of four dimensional pattern in coral structures. I spent my MSc ostensibly

studying septal insertion in carboniferous rugose corals. But what I was interested in is trying to reconstruct the whole pattern through thin sections, and I made lots and lots of sections, lots of serial sections, and came across some interesting things about the way in which the septa, different parts of the animal, are responsible for secreting different sorts of septa. Fascinating.

*Different sorts of?*

Vertical partitions inside – the septa are these vertical partitions inside. Well – and this had never been commented on by anybody in any of the literature and I felt as if I'd discovered something. Mind you, nobody's commented on it since so maybe it's a little more trivial than I gave it credit for at the time, but I did think that, you know, the whole idea of trying to use stratigraphy to understand the structure, the gradual build up of the structure of a coral, was itself quite interesting. And this is the reason why I did it, so I did my MSc and finished that.

*Could you describe for – in as much detail as you can for the listener who won't have done it themselves, but the sort of practical processes that you were involved in in this MSc? You say cut a section but –*

All right –

*And then what you did with the sections –*

Yes, all right, I can do that. There were several sorts of techniques. First of all, find your coral. And I got a lot of corals from, for instance, Salton and Ribblesdale up in the – up on the Yorkshire, Lancashire border. And these were little things that are more or less like cylinders and you will often find them on marble slabs where they have been polished, and you can see these things look like sunbursts radiating – like paper – well, I describe them like paper doilies. Now these – you then cut with a diamond saw these straight across and then if you grind them down thin enough you could actually get them transparent. And then you start to investigate the detailed structure of this, and the detailed structure will tell you which pieces of the corals, of the coral, were formed before other bits. Now this bit is – comes after that bit because

this bit abuts against that, etc, etc. You're working up through a series of these. So therefore we had a means of getting serial sections through corals but you lose a chunk of coral each time because each time you make a section it's a millimetre thick, and you lost that because you have to grind it away to make it transparent. So I started by polishing surfaces, photographing them, and then going through minute increments with a succession of photographs. Each photograph – because if you polished it up it would be nice but you can't afford to polish it up because you'd lose some more information, so I put a thin film of ordinary machine oil on the surface and you got a polished surface you can wipe off. And so you get a stack of photographs and then you can study the intimate details into which things are touching which, etc. So that's the way it was done. Mostly actually through photographs but backed up by thin sections, so two methods ostensibly trying to do the same job; one giving you beautiful detail but keeping – but losing slices all the way through, and the other getting detail, good detail, but not as precise. And yet you can do it in milli – oh, hundredths of a millimetre all the way through, so I can reconstruct the whole thing. Is that fair?

[34:38]

*Very good, yes. And then I wonder who supervised your MSc in geology.*

Now, officially Dr Straw, and Straw was – well, he was just – I was virtually wound up and let go, I mean because I didn't get much in the way of supervision. Again, being too bloody minded and independent I didn't want people meddling with my ideas very much, I wanted to have – to do this job. So although he was technically my supervisor the person who I got most out of was the chap called Fred Broadhurst, as I told you, because he was the sort of chap who looked at it and said that can't be so. And you'd go back and think about and see if you're right or not right, or whatever it is. So my official supervisor was different from my practical supervisor. Officially it was Dr Straw and Fred Broadhurst was the chap I went to if I had more problems.

*While you were at Manchester University doing the degree and then the MSc, to what extent had you left these sort of rural countryside pursuits behind?*

Quite a lot actually because when you're doing something like that, a project of that sort, it takes up most of – not only time but most of your intellectual energy as well. And I also found them fascinating in their own right. I found that – I must have dozens of photographs that I could happily hang on the wall. So my enthusiasm shifted over a little bit till it had become an official goal. They sound excruciatingly dull but they were not.

*And so having finished the MSc, did you try and go back to the sorts of decisions you were making about what you wanted to do?*

No, I can't, and I'll tell you why I can't, because I didn't know. I was playing by ear at that stage and all that I knew was that I wanted to get a job so as to get some money because living on one's parental largesse is not a satisfactory lifestyle, so I wanted to move. I didn't want to move very far because of Beryl, so I applied for a job at Keele University. And Keele University at this time was a dynamo of ideas and really a most exciting place, so I spent a year at Keele as a demonstrator and continued my coral studies there as a species, other groups of corals, and so on. And there because Keele University was devised on a rather different basis than most universities in that the course was a four year course and it was very generalist, you had a foundation year which was taking lots and lots of subjects. I lived in the village pub and spent most of my time in various people's sort of ex-Army huts with intense discussions where you could find somebody who takes a degree in philosophy, theology, chemistry and history or something. And you never knew who you were talking to because people had expertise on almost every conceivable sphere, all mixed up together. The most dynamic intellectually – the most dynamic experience intellectually that I think I've ever had. So there you have the thrust and development of ideas and counter ideas, and it was like a very elaborate debating society only because of the fact that I had to go to several huts in an evening sometimes, three or four in an evening – no, usually less than that, two or three I would have thought, one was – one never managed to follow anything right through. So you'd suddenly look at your watch and say, oh my God, I've got to go to visit hut number so and so. And off you'd go and then you'd start all over again, very exhausting. I used to come back to the pub in the evening feeling absolutely dead tired. It was always after pub

closing time and the atmosphere in the pub was solid stale beer and tobacco smoke, and it was almost possible to get in sometimes. You'd feel you wanted a machete to carve your way through the atmosphere. And every time in the evenings I used to come back absolutely exhausted but it's certainly what the Americans call a steep learning curve, and I learnt all sorts of things that I never thought I'd ever learn simply because the undergraduates, so broad spectrum in their – the courses they took and in the interests they had.

*To what extent could you prepare to go into each of these huts then?*

Almost – almost nothing for – because it was very, very much like a west Hebridean ceilidh, it was spontaneous. Now a ceilidh is a party we have out in the west, and in the olden day when I used to go up to the west ceilidhs were entirely spontaneous. They weren't like concerts nowadays, ceilidhs tend to be the Gaelic for a sort of concert but in those days people would sit round and ideas would sort of crop up. So you couldn't prepare something unless you'd got some idea of where it was going to be. And since you had no idea what was going to – how it was going to develop it was almost impossible to prepare.

*What then was your role in it?*

Usually the *advocatus diaboli*, actually whatever you say I'll contradict you, which is one way of doing things. As you've probably realised by now I do like talking and so I couldn't simply sit down and listen. I used to sit down and intervene, and intervention was rather like a game. It was very much like a university debating society in that I don't necessarily have to believe what I say, I just have to say it and see what you say. So there was – it was a bit of a game. And quite a lot of these discussions which were very, very like a game, erm ... except that there was not a vote at the end to see who had won.

*And you seemed to suggest there'd be perhaps four students in each hut –*

More, sometimes more.

*Oh, more.*

Yes, yes. They were just ordinary – ordinary huts, you know, just like ex-Army huts.

*And were there lectures as well that you had to give or was the teaching –?*

Yes, I'd give some lectures, yes, and – it was officially called a demonstrator but actually it was lecturer. I had to just go and lecture on palaeontology.

*Okay, so –*

That's Keele.

*And your relations with Beryl were kept up –*

Oh, yes, yes, yes.

[40:51]

*In the – and then after, why did you not stay on at Keele, what –?*

Well, for a very good reason. First of all, my job was not permanent and one day I went to Manchester University, I probably went to the library, I can't exactly remember now, and I called in at the geology department, this is when I'd been at Keele for about a year, and Jim Lawson who had been an old lecturer, had lectured to me when I was an undergraduate, said – I'd met him and he'd been at Birmingham and he said 'Do you want a job?' And I said, 'What do you mean?' And he said, 'Well, I'm resigning' he said, 'and there'll be this vacancy in Birmingham.' And just because of accidents of space and time I happened to be there at the time when he said do you want a job. So I said yes please and contacted Birmingham immediately, and that's how I shifted ground from Keele to Birmingham.

*So you contacted them. What happened?*

I had an interview, and the interview, erm – it was a little bit difficult because my recollection of this is that in fact I tripped up on the carpet as I came into the room. Now each tiny move that you make determines the next move, if you follow, and I came into the room, tripped up on the carpet, very, very nearly fell on my face, and saw a chair in front of me. Sat in the chair and it was an easy chair. And I thought, that's funny. And then I looked up and there was this table with, oh, about four members of the faculty, five members of the faculty, sitting around and a spare hard chair. And there was I sitting in a comfy chair and all the interviews were sitting in hard chairs. And I thought this was – my face was – and I had my back to the light and they had their faces to the light. And Fred Shotton disarmed me completely. He said, 'There's something very strange about this interview,' this is how he began, He said, 'The best conducted interviews, the candidate sits with his face to the light and the committee sits with their backs to the light. In this case, for some reason or other, it's the other way round,' [laughs]. And I thought, you know, I was so convinced that I'd fluffed my interview that I just relaxed totally. I had a terrible ding dong battle with Kenneth Mather, who was professor of genetics, over whether or not each character in the six was adaptive or not [ph]. And it just continued round and round, and eventually when they ushered me out, presumably while they were going to discuss whether or not I was a suitable candidate, Kenneth Mather came out and continued the argument out in the museum. So it was not all together a conventional sort of interview. But anyhow I was told I'd got a research fellowship for three years, and that's as near as I got to getting a contract, and nobody made a contract in those days. In fact the only bit of ritual that went with the appointment was that the chief steward gave me the key to the gents' toilet. This was the only thing that indicated to me that somehow my appointment was official. I think nowadays you probably have to sign numerous documents and things like this but in those days these things were very much more informal than they are now.

*And did Fred Shotton ask you anything at the interview or –?*

Very little, very little. Most of my association with Fred came after the interview but anyhow I was appointed because of my work on the rugose corals you see. So subsequently things changed rather dramatically when my interest shifted also rather dramatically.

*At the time of being appointed then with this three year research fellowship what initially was the – I don't know, the brief or the instructions that you were given or –?*

Well, that – that's fascinating. I asked Fred Shotton this when I got my appointment and when I met him in the corridor afterwards. I said, 'What research programme do you want me to adopt or ...?' And he looked at me as though I was saying something totally stupid. He said, 'We have just given you money for three years to do research. It's up to you to decide what to do.' And I suddenly felt very, very small. And what an opportunity; can you imagine nowadays being given three years' money to do what I liked? I mean I'm sure that this exactly what was so important to me because it meant that I had complete freedom in my choice of subject.

[46:07]

*And having been told that, what initially would you have thought then that you wanted to do given three years standing –?*

You've asked me this question before. I mean in other words could I predict where I was going, and the answer is no because I didn't know then what might happen. And therefore this is – we're back to this whole role of accident in determining what you do. I met Jim Lawson, he said do you want a job. If I'd been five minutes early or five minutes late I wouldn't have met him because he was just passing through. In the – my research project, I had worked on carboniferous rugose corals, fascinating though they be, felt a little bit as if, well, I've done that, and therefore I was a bit free in my search. In the department there were – there was a museum, and in this museum were some bones of mammoths. And these bones came from a place called Upton Warren, and this was day two in the department. And I said to the steward at the department, Vaughan, I said, you know, where do they come from? He said, oh, this place called Upton Warren down near Droitwich, and we had a little chat about this. And he said they've stopped coming up now. And because I knew they came from a gravel pit and because gravel pits were great places for migratory birds, I went down to the – up on the bus and went to Upton Warren. And I asked the manager if I could go and look for birds and he said yes, and I nearly fell over a mammoth tusk, it

was very long. My memory says about eleven feet long but it was rather broken up into bits, and there were bones sticking out all over the place. Now I knew enough about bones to know that there were varieties of things. I knew that there were mammoth tusks, reindeer antlers, woolly rhinoceros teeth and jaws, all lying around on the bottom of the pit. They reason why the bones had stopped coming up so to speak was that the manager had lost interest in selling them, not because the source had dried up. And I was so fascinated by these that I spent – forgot birds all together. Now don't forget this was within days of arriving in Birmingham. I suddenly thought my goodness me, what I want to do is to study big ice age mammals. And then one of the quarry men said to, he says, 'You know where those bones come from?' And I said, 'No.' He said, 'You see that black seam with the layer of black in the middle of the gravel?' He said, 'They all fall out of that' and says, 'it's full of seashells.' Well, if you know anything about geography you'll know that Droitwich ain't very near the sea, so this became unlikely. And I got a biscuit tin and I put some of this black mud in to wash the shells out. And amongst the seashells, they weren't 'cause they were fresh water molluscs, were bits of beetle. And within one day I shifted from being an expert in carboniferous rugose corals to an enthusiastic beetle collector, because my mind was free to wander about. But each one's a succession of unlikely events, especially as the beetle bits were clearly contemporary with the mammoth, of the woolly rhinoceros. And I knew enough about beetles, which I'd acquired in my natural time, natural history time, to think I know what some of these look like. I knew not what they were but what sort of things they were. And that started getting me interested because some of them were total strangers, and because I was looking at something which was contemporary with the mammoth and the woolly rhinoceros, I thought these are going to be extinct things. So I started within days thinking of them as extinct animals.

[50:44]

And then the next sort of serendipitous – well, that was to discover that Fred Shotton was a keen beetle man, my boss was keen on beetles, modern beetles. And so he and I got very excited by what we could see. And I think it was his enthusiasm to start with which kept me going when I thought, well, I've got as far as I'm every going to go with these things. And he – we went to the Birmingham City Museum, borrowed

cabinets of beetles, looked at them, and together I think that he – he really did sort of kick off the – my interest in this. So that was how the beetles began. I subsequently found them elsewhere but what I want to emphasise is the role of accidents in all this, you know. You asked me whether or not I planned anything, and the answer's no, all I did was kept an open mind. Do you remember Pasteur's aphorism, fortune favours the prepared mind? I think it also – fortune favours the mind that's receptive. That's not necessarily prepared but receptive. And I think when Fred said to me you've now got three years' money, go and do something with it, that's what triggered off this flood of information. And as Shakespeare said, the rest is history, you know.

[52:20]

*Are you able to say a little more about previous experience of beetles, of interest in beetles? You saw them in this pit and you realised that you knew something about beetles already because of something in the past.*

Yes. Well, I don't know whether you know any of the little poems by AA Milne, you know, Pooh and all the rest, but *Alexander Beetle* was one of my favourite poems as a child, you see. You know, what's it – 'Daddy let my beetle out and the beetle ran away' you know, and I felt terribly sympathetic to the beetle, I don't have – the point is that I kept all sorts of things as little animals like slugs and beetles and all those things. And therefore you start off by getting a book which has got beetles in them or insects in them, or whatever it is, and I got that book that my mother gave me right in about 1940s, pages and pages of pictures of beetles. And therefore not unnaturally you try to match who you've got, and that's how I became fairly well conversant with at least beetle groups, maybe not species but beetle groups. So that told me that some of the things I was looking at at Upton Warren were familiar but some of them that weren't. And it's the ones that weren't that I thought must be extinct animals, that I being a palaeontologist drove my interest there.

[53:59]

*What was the –? Of the ones that weren't familiar, to someone outside who wouldn't recognise one type of beetle from another, how unusual were the ones that you didn't*

*recognise look? I mean are we talking about beetles that are – have got a slightly different shape to them that you weren't familiar with or are those very exotic looking?*

Well, some of them were exotic and ... you're quite right. The ones that really stuck in my mind were the ones that can't – don't resemble anything that I've ever seen. Now there is a group of beetles, dung beetles, they're related to the scarabs of ancient Egypt familiarity, and they, erm ... this group of beetles is known as Aphodius and amongst my bits were lots and lots of them with a big horn in the middle of its head which split into two at the top. Well, it was so exotic that it meant you could rule out almost every species of Aphodius certainly from Britain and then in Europe, nobody had got anything like it. And so it was so unusual that it started to suggest to me that if it is unusual there may be others as well, I'm sure there were. They don't resemble anything in Europe. And to skip ahead of you, that the interesting thing was eventually with a lot of help from other people, I have to say, we found that this was in fact living but not in Europe but living in Asia. And it was a species now confined to high altitude in Tibet, but living in Britain during the Ice Age? It shows you how wide you've got to cast your net doesn't it in looking? It's no good simply thinking, well it may be British, it may be European, because this one is an endemic species known only from Tibet. It lives only above 10,000 feet and heaven knows what that is in metres because I don't. But the point is that here we have something which is so outlandishly unexpected that once you've seen one thing like that you start looking for others.

[56:29]

And some of the things were sufficiently peculiar that I went to visit a specialist in the group that I was interested in, the Scarabaeidae, the ground makers, who lived in southern Sweden. A man called Carl Lindroth at the University of Lund. And I showed him my stuff and he just looked at one thing and he said, 'Do you know what that is?' And I said, 'Well, I know the sort of thing but it doesn't look quite right.' He says, 'You're dead right it doesn't. It's an East Siberian species. Where did you get it from?' I said, 'Worcestershire' [laughs]. You can imagine we had a rather – a confrontation and the reason was that most people in those days believed that the

present day distribution of an animal was somehow an indication of its evolutionary history. But now I was looking at present day distributions which had no relationship to a past distribution, and once Carl Lindroth started to point me in the right direction it was just unbelievable what we found; all sorts of extraordinary exotic things which have gone on in the same way, by the way, ever since. But again, it's just the accident of hitting the right person at the right time. And I keep emphasising accident, fortunate accident is what drives me. So in answer to your question, did I know? Even when I went to see him I didn't know what I was going to get. You can't predict the outcome of this sort of research. And so to discover things that are living either exclusively in Tibet or exclusively in Eastern Asia, extreme Eastern Asia, all sorts of extraordinary things started to appear out of the woodwork. And with them the consequences that I'm sure you're aware of now, that they are trying to tell us something by the way they've changed their distributions about past environments. Notice they're still living species but they live in a different place, and that is rather vital because they haven't evolved to fit their new conditions, they've simply moved. And that was a discovery that started off in Upton Warren so long ago.

[End of Track 2]

### Track 3

*You mentioned that you visited the gravel pit which became an important site because of an interest in ornithology –*

That's right.

*But hadn't mentioned ornithology specifically before so I wonder whether you could –*

It's only part of the general sphere of being interested in natural history, birds being part of the natural history. By that time I was getting a bit more sophisticated in my interests. In other words, rare migratory birds often come home in onto gravel pits and places like this, and therefore it was from my point of view an opportunity of finding something different because in different areas, different parts of this country, you get different species of migratory birds. And I can't for the life of me think now each particular ones but subsequently it has been a nature reserve, absolutely stuffed with all sorts of exotic things. And therefore I was a bit justified in my selection of the site.

[01:04]

*And Fred Shotton's own interest in entomology –*

Yes.

*I wonder whether you could say a bit about that. In other words, his interest in it before you discovered the site and so on.*

Yes, his first interest in entomology was butterflies. The way in which many, many people have become interested in insects is via butterflies. They're so beautiful and so self advertising, you know, the – so he went – he was considered to be of delicate health as they used to say in those days and he was shipped off to, I've forgotten now, Switzerland or somewhere, and there he found a whole lot of butterflies which were rather different from the ones he'd experienced at home. So he collected butterflies

and much to the consternation of the immigration people who wondered what these little packets were, and discovered in fact that they were in fact just butterflies were very, very disappointed. So there's a general feeling that in fact he started off with butterflies but he became very interested also in beetles and obviously this was long before I appeared on the horizon. So he – his interest in entomology, not unnaturally, gravitated to the important bits, and that is the beetle world. So Fred was almost accidentally interested in beetles, so once again it was one of these fortuitous links. I think if Fred hadn't been we might well have not – the subject would not have developed in the way it did, so ...

[02:46]

*Having then discovered this site could you say, sort of step by step in practice, what you did at this site in order to sort of –?*

Well, first of all I was interested in big bones, as I think I mentioned to you. Then the matrix of the bones became rather more interesting than the bones themselves simply because it had so many fossils, fossil shells or fresh water shells. It had a beautifully preserved, I mean absolutely amazing, even to the organic coating to the outside, the periostrum, which was absolutely beautiful, and the little parasitic worms attached to the outside. But some of the little bivalve shells have still got babies inside, so that the preservation was what intrigued me. But more than that, because there were other things, insects, I was also fascinated. But then you start to look at – to look for, I should say, the other work that has already been done around this. So you start to explore the literature and find there's almost none. And there's nothing like a scientist finding a hole in the knowledge to want to fill it up, and that's the way I felt to some extent. I wanted to look at these things and it was the discovery that some of them were familiar but some of them were unfamiliar that made it even more exciting. And the unfamiliar were very, very strange.

*And so what did you do in terms of let's say collection in the field? I mean precisely, how exactly, did you go about –?*

There was one – there was one layer which was in fact half a meter thick at most, which was loaded with molluscs, insects, plants remains, bits of vertebrates, fish, for instance, and another one much thinner which had a rather different format. And it was quite clear from looking at the molluscs in particular that these were deposits that were accumulated in the bottom of a pond. So that much was obvious and therefore we looked at it from the point of view of the ecology of a pond. And very, very quickly it started to take off in the most diverse and well – best preserved of the fossil remains were insects, oh, particularly beetles. They're very robust, you know, they make very, very good fossils because they're so sound and strong and they resist decomposition in a big way. So they were the most spectacular. Also the colours, some of them were absolutely stunningly beautiful coloured. So I was tempted in gradually by the attractiveness, not I hasten to say by the science. What attracted me initially was the appearance, the unusualness, the sort of other things other than the scientific sort of aspect. But at no time did I ever think in those early days this might come in handy one day to unravel climatic change or environmental change. It was all because it was so exciting because it was something beautiful.

*Did you in that case take any photographs, make any drawings or collect any specimens for a kind of ascetic reason, almost like a kind of souvenir or something attractive to display?*

Very much so, very – initially very much so. We even got so far as making Christmas cards out of those because they were so beautiful. So, yes absolutely. That's the reason for doing it. In fact the justification for doing it comes later than the reason for doing it in the first place. The justification is saying, what can we do with this other than saying, wow, isn't that beautiful. The reason for doing it is wow, isn't it beautiful kind of thing [laughs], okay.

[06:48]

*And so how did you collect? And this might seem very obvious to you but how did you collect the sample in the field? Is there a particular way in which you –?*

Well, to start with in the most primitive fashion imaginable, in a biscuit tin and a shovel. And I shovelled the black mud into a biscuit tin, stuck it in my rucksack in the biscuit tin, and took it back home by bus because I couldn't drive at the time. So things started in a very primitive way. I then washed the stuff through a sieve of, oh, about 300 microns simply to get rid of the mud, primarily of course to look at the molluscs and then finding that the more exciting things were the bits of beetle and other insects as well.

*Having done that then, having collected your first lot of stuff in a biscuit tin and –*

Then I had a fight with Fred Shotton because Fred Shotton thought they were so beautifully preserved there must be contaminants, they must be modern specimens, and so we had a good tussle. I mean we all need somebody like this, this *advocatus diaboli* you know, the devil's advocate, which surely you can't be right otherwise somebody would have known or somebody would have done it. So it was a marvellous site and Fred came down to the site and started to wield a heavy shovel and shovelled much of my stuff away. I felt very indignant about the fact that he was destroying the evidence but at least he became convinced after a hard day's digging that these things were actually interbedded with the gravels and were contemporary with the mammoths and the woolly rhinos. And then it was a wee bit of a Doubting Thomas situation, go on, prove it to me. And that was necessary because I got so enthusiastic about it that I would have believed almost anything, and Fred insisted that I actually established for certain that I was not dealing with contamination.

*How did you do that?*

Just by – he just convinced himself by – we dug furiously pits and holes and things all over the place to make sure that it wasn't just a modern pond bottom.

*So you had to sort of dig further back into something –*

Yes.

*To make sure this wasn't just a localised –*

No, that's exactly. You had to dig so that there was no doubt about its stratigraphical position.

*And then once you'd then convinced Fred that this wasn't local, this wasn't recent contamination but was a feature of the actual historical –*

He was very supportive, he was enormously supportive. Because his experience was almost entirely confined to British things, it wasn't until I went to visit Carl Lindroth in Lund in southern Sweden that I began to get really sure of what I was looking at, that I was looking at something which wasn't just not British, it was non-European, and that was an eye opener. But without these people I would never have been able to unravel such a complicated story.

[10:00]

*Why had you decided to go to Sweden to see this particular scientist? How had you picked him as someone –?*

I was advised. I went down to the Natural History Museum and somebody said – it was Jack Balfour Brown of the Natural History Museum who said to me one day, I think probably over the proverbial coffee, I think you ought to talk to Carl Lindroth about this. Carl Lindroth turned out to be a great, great friend of mine and a very, very wise man and I treasured his company enormously over time. He knew so much about what I was missing and filling in the gaps that I could say I think this is what I would be able to see. Yes but – and the yes but was always the interesting bit, have you considered? No. And he knew the North American ground beetle fauna marvellously, that in the Arctic, Canadian, Alaskan, all the way across, and was fairly conversant with the Siberian. And in about ten days I learnt more than ever in years from listening to somebody who was absolutely on the top of his subject and to me that was one again one of these eye opening moments when I suddenly realised I was looking at something that was, oh, so unexpected it was unbelievable.

[11:30]

*And what did he have in terms of collections that –?*

The huge collections in the University of Lund, in the Zoological Institute. It was stupendous, it was beautifully arranged, superbly diagnosed. I mean the curation was out of this world and the range of species which he'd got. But not only had he got a range of species identified, that he had acquaintances, he had colleagues in Helsinki, in Munich, the world over, that recognised his ability, recognised his expertise, and he could draw on their collections to compare with my stuff. So in a way it became – it was because in fact he was immensely respected in the entomological world that he could draw on other people's expertise as well.

[12:35]

*And so then following this visit what was the next sort of course of action for you on this site?*

Write up the story, write up the papers, and there were two seminal papers, one was the Upton Warren paper, which was published by the Royal Society in their *Philosophical Transactions*. It was absolutely a beautifully produced journal, I only wish we could do it now, in which there were beautiful pictures, lovely photographs, and very well discussed. And also the sort of site at Chelford, which was actually published earlier and that was, I've forgotten the exact date of it now but it doesn't matter much. That was also something of 100,000 years ago, the date, and this was when I suddenly started to realise that I wasn't looking at evolution, I was looking at movement. And so the species were exactly the same only the geography was – their present day location was completely different from anything you might have expected at one time.

[13:40]

*How did you find the Chelford site? You've described the finding of the Upton Warren.*

Well, I'm a Cheshire man and it was just around the corner from me, just down the road. I could reach it by bicycle if I wanted. But I heard this through – again by meeting people and saying I've found this site at Upton Warren, it's got a lot of beetles in it, has anybody found similar situations? And what was very interesting there was talking to one of the workers on the Chelford site I said, 'Are there beetles in the deposit?' And he said no. And I went there with him and within two minutes found sheets of compressed, what looked all for the world like cardboard, covered in beetles. He must have seen them but not seen them, if you follow. It's just what you see is determined to a large extent by what you want to see. And he suddenly said, 'Good gracious' you know, 'how could I have missed them?'

*Sheets of what looked like cardboard?*

Well, this was compressed organic matter but finished up that looked like natural cardboard. And the only way in which you could get the beetles was to open it up with the leaves, the sedimentary leaves rather like a huge book, and squashed on these were the animals that had lived at the time. Bodies sometimes with associated heads, thoraxes, elytra, you name it. Sometimes isolated bits, sometimes predator prey relationships with a carnivore halfway through eating its breakfast on some other beetle before it got squashed.

*And what was this site? The Upton Warren was a gravel pit, as [both talking at once]*

–

And the other one was a sandpit. These are areas – this is exploited for minerals from one week to another. The one at Chelford was exploited entirely for silica sand. All right?

*Right.*

Yes. A rather rare or intensely siliceous sandpit. In other words the sand grains were pure quartz and therefore the pit was of great economic value. And the sort of side story to this, is when I first went there and I wanted some samples of the peat, they thought they'd found a commercial outlet for the one thing that was destroying the

value of their commodity. So they were so delighted to show me they said how much would I like. I said, well, about five kilograms. You should have seen their faces fall [laughs]. No, they wanted to sell me tons and tons of it, literally.

*And what was the extent of their interest in what you were doing?*

Just to begin with they were only interested in the material that I was interested was a nuisance to them. They wanted the pure sand that they could use for refractory sand, and I was in the peat – and I was interested in the peaty base interbedded with the sand which was interesting to me. But to them a nuisance because it contaminated their sand with masses and masses and masses of sticks and leaves and bits of peat and all sort of rubbish.

[16:58]

*And so for both sites could you take us through the procedure for identifying and listing the frequency of occurrence of the different beetle species? We know that you've in one case taken some stuff home in a beetle tin. Now we know that you're taking sand or peat from this sandpit. But having – well, we don't actually know where you take this to but we'll assume it's a room in the Birmingham department.*

Yes. I had my own office in the Birmingham department which gradually became dirtier and dirtier as more accumulations of peat, mud, sand and God knows what. But essentially what we did was, particularly with the Upton Warren site is, to get sieves and wash the silts, the fine material, through the sieve and look at the stuff that stayed on the mesh. And these sieves had an aperture of about 300 microns, and this stopped most things that we were interested in, or I was interested in at the time. So the process starts with a bowl, a simple bowl, just a plastic bowl, and you wash the material, the silt, sand, raw sediment, over a sieve, collect the stuff that floats on the top and then we discovered that if you mix this floating slurry with paraffin, that's kerosene, the kerosene absorbs onto the insects preferentially compared with the plants. You then add water and the mixture of kerosene and insects and plants and everything floats, but the beetles float on the surface and the plants sink to the bottom. So we have a system of segregating the insect fossils from the plant fossils, and in this

way you could concentrate. Otherwise you'd be there all day trying to sort this stuff [laughs]. And then this material was then washed in detergent to clean it and sorted under a microscope. And very, very quickly we found the best way of sorting it under a microscope was put it in Petri dishes in alcohol. So that's the basic technique, very, very quickly that developed.

*Why Petri dishes in alcohol to opposed to any other?*

Well, they're a convenient size and - alcohol because in fact the bits – the bits of insects sunk in alcohol, which they floated in water, and it's much easier to pick out using forceps the fossils from the stuff that has sunk rather than chasing it round on the surface where surface tension makes catching them so much more difficult.

[20:01]

*And so then you've got a Petri dish with bits of the fossilised remains –*

Yeah.

*Of insects under alcohol. You can look through the microscope, you can pick certain bits out. What are you –? What and how are you recording what you're seeing or you think you're seeing?*

Now comes the difficult bit. Now it's something that you had – with all taxonomic exercises hard work is involved actually to match the fossils bits against the modern, to see first of all whether they were different. And in some cases they were different from modern but that's just because I hadn't cast my net wide enough. And I suddenly found I was looking – first of all I thought I was looking at the difference because I was – I was obsessed with the notion that woolly rhinoceros and mammoths were extinct, therefore my beetles were extinct. And it came as a shock one day to discover that they're not really different, they were the same. So we started to put names on things simply by matching them against modern. And this gradually has – well, it has taken fifty years because we're always acquiring more experience in recognising what that little bit really means. And so by direct matching, by

superimposition, you put one on top of the other, if you have a fossil and you sit it directly above the modern you can compare every tiny detail of shape and ornament without having to move your eye. And so we used the – as sophisticated a comparison as it's possible to make. And sometimes we've even used things like scanning electron microscopy to look at the details and they come out absolutely the same all the time. So what – after having got the things as fossils then the – the search for matches has taken a very, very long time. That's not something you can do in a year or two years, it takes a long, long time. It's only then that you started to discover things that are very strange that you don't expect. But to begin with I did see funny things. I saw lots of things that were very similar but not identical. And then I found things that were not only identical but absolutely ludicrously different, and these I thought must be extinct forms only to discover later that they weren't extinct after all.

[22:41]

*But just for the, for example, the 1961 Upton Warren paper –*

Yes.

*What were you doing in terms of matching in order to publish that paper? I mean what were you comparing your fossils with at this stage?*

I spent a lot of time down at the Natural History Museum looking at their collections. I also – we had our own small collection which is not as comprehensive as we'd like, so it was just a matter of slogging through the comparisons saying – first of all, if you know approximately what you're looking at, for instance, this is a carnivorous water beetle, one of the Dytiscus, well you know. Then you say how much further can I go? Well, you can probably identify the genus, and that's reduced the problem to handleable proportions, but to identify your bit may take you days. So it's very difficult to answer your question simply because this sort of stage took a very, very long time, i.e. the identification of the bits and the recognising of the exotica.

[23:49]

*And could you describe the process for the same work but on a different site on the Chelford site, because you were there removing the samples from a different material?*

Yes.

*I don't know whether that's –*

I talked about this at the Upton Warren site or – and subsequent ones really, which is – was organic silt. It was a pond bottom, accumulation in the pond bottom, of silt, wee bits of plant remains and so on. And the Chelford site was much, much more organic and had been compressed under enormous weight of sediment and a glacier that had come over the top of it of indeterminate height, and the whole lot had been compacted down until it had the consistency of hardboard. The only way of getting at the beetles there was to split the layers of hardboard and look upon the – on the bedding planes, i.e. on the sort of original deposition thing. So this was a different technique and you just have to split and split and split. The result was an enormous quantity of debris. My office at the University of Birmingham looked like a donkey's stable, there was so much in the way of peat everywhere. So it's a different technique all together. One of them you wash and sieve, and the other one you split. And I found there was a complete difference in the sort of sediment you got because the sort where the – the assemblage that you got from sieving it included tiny things, but when you're peeling sheets and sheets of what look like sort of natural hardboard you tend to overemphasise the conspicuous, so we got slightly different sort of formal assemblages from the two techniques.

[25:51]

*And at this time, while working on this material in the department in Birmingham, what was going on outside of work? I don't know whether by this point you'd moved out of living at home –*

Oh, well yes, by this time I'd got married and –

*Well, let's go back to discovering the Upton Warren site in 1955 then. In 1955 you were still living at home at that point with your parents?*

No, I was living in digs in that –

*Of course.*

Actually one of the halls of residence, the halls of residence at Birmingham. After all Cheshire is an awful long way from Birmingham.

*Yes, of course. Yes 'cause I was thinking of the Keele, yes, yes. Okay, and so can you talk about sort of life outside of work over this period then, from starting as a research fellow in Birmingham?*

Well, yes I had other strings to my bow. I mean I have always been fascinated by birds of prey and I took up falconry, for instance, as a recreation. It's hardly recreation, it's a time – occupies an enormous amount of time, so I was training birds of prey as hunting birds. And as my pastime there was very, very – it went on for a couple of decades of training falcons, hawks, everything as hunting birds. So that's what occupied a lot of my spare time.

*Why that as a hobby at this time?*

Well, to start with I rather liked birds of prey and I had this fond illusion that in fact falconry had died out in Britain but it would be awfully nice to resurrect it, only to discover that there was an active British Falconers' Club that had been going all the time that I had been unaware of. So I joined the British Falconers' Club and we had a great time together.

*I mean as this seems to be a substantial part of your life could you describe what it involved? Well, what –?*

What it involves?

*Yes, what's involved in training hawks?*

[Laughs] it's difficult to do this. I mean to train – first of all, there were two sorts of birds that we were training. One was the falcon, which is the long winged hawk, long winged bird of prey, which really is a very, very fast flyer, such things as a peregrine falcon and its friends of – the Asiatic falcons, for instance, Linnaeus in particular, Sakers. But I didn't do a Saker I did – I flew Linnaeus falcons which we could import in those days without any great trouble. And this was a very, very, what can I say, time consuming business in that you had to feed them, gradually get their confidence, then through a series of encouragements getting them to fly to you on a thin line so that they would come for their food. And they never do anything other than come to your food, and you gradually creep into their life. They creep into mine in a big way. And then one day you take that thin line off and cast it up to the wind. But you have a thing called a lure which is a dummy of some sort. It doesn't have to look like a bird but it's fun to make one look like a bird, on the end of a string. And you whirl it round like this which is – if you whirl it round your head the bird sees it and thinks it's a bird and it'll attack it. And just as it's about to strike you tip it out of the way and the falcon will go right up, it'll turn over and it'll come hurtling down again. And this – in this way it exercises its flying muscles. Now this is all for long winged falcons. And eventually you take it out and hope that it might catch something, and you do catch things but that's a different story. The other sort of bird of prey were the hawks, things like the goshawk and the sparrow hawk. The sparrow hawk was far, far too delicate, it's very, very – a small bird. The goshawk is five times as big as the sparrow hawk. And that was what in the olden days the falconers referred to as the crooks' bird because it was so efficient at catching things but this time it was quite different. You fly – instead of flying it to lower and getting it to dive on you and do all the usual sort of acrobatics in the air, it goes straight from your fist after something or goes up into a tree and then attacks something. And I could catch enough rabbits to carry with no trouble. And then once it got me which was a different story, it hit my head on top. Just because it had missed a rabbit it took it out on me instead. And these are big birds, I don't – they're not very heavy but if you imagine, I don't know what it is in kilograms but four and a half pounds of hurtling bird with spiky feet and a big beak, it can be quite an impressive sight.

[31:00]

*And where were these –? Where were the hawks that you were training? At the club or at home?*

No, no, at home.

*So where was home by this stage?*

On the Clent Hills in Birmingham, south of Birmingham. We got loads of rabbits in those days. Myxomatosis came out in about 1955 but rabbits survived remarkably well. So these are my two; the long wing falcons and the goshawks were the ones I was training.

*And this house, on the Clinth?*

C-l-e-n-t.

*Clent Hill. Is this where you had moved to with –*

Yes, with Beryl.

*Following –*

And the children, yes. Hmm-hmm.

*Yeah. Could you describe then the sort of landscape there or the grounds?*

Well it's a – a series of rather small subdued hills, a bit like the Downs. In other words they were low rounded hills which – mostly with a flat top, on the sides gulleys, deep hollows where rabbits lived in quantity near our house. It was rather the open country but nearby was woodland and all sorts of – rather more, what shall I say, gorse sort of country, ideal for rabbits and things like this. So a very beautiful bit of

the world. We were about a mile and a half from the nearest shop, considering we were only about seven miles from the university that was pretty rural.

[32:35]

*And what else? What other animals did you have at this home at this early stage?*

Well [laughs], all sorts. You see we got the reputation very quickly of people bringing little animals to us, everything from hedgehogs upwards, so we had foxes, fox cubs. People brought fox cubs quite frequently, so we had several fox cubs, but perhaps the most exotic of them all was a couple of badger cubs which we had, which lived in the house most of the time and sometimes – we built a great pen for them up in the garden where they could live but the local badger population took exception to their presence and so we had to bring them down to the house. So eventually one of the cubs killed the other cub but the surviving cub had the most appropriate name of Humbug. Humbug lived in the house, at least in the garage that was adjacent to the house, and we kept for about two and a bit years and she was very – enormously happy. Would go for walks with me up on the hill, up on the flat tops of the Clent Hills where all the local dogs were being exercised, and the dogs were very excited by the presence of a badger in their midst and the dog owners looked the other way. They were not – they couldn't, you know – we don't own things like that. So they're a snooty bunch of people, the dog owners in our area [laughs].

*And how did the badger sort of behave in the home? I know you say in the garage but I know that it came into –*

Well it used to come in and lie in front of the fire, put it that way, it would spread itself out like a house rug. It had a marvellous way of flattening itself out, but it was very, very happy to be in our company but fairly robust. If you went to touch it on the side it would bite, always. As long as you didn't touch it you didn't get bitten and so – and in many ways it was just rather a nice animal to have around, but very destructive. It used to smash up the for furniture, for instance, in order to – we had woodlice and things like this under the skirting boards and we'd get up in the morning and the skirting board had been removed as it used to go round. It was like having

burglars in the house permanently rummaging around. And we had other things, we had polecats, pine martens, deer, even little deer in the bedroom, little muntjac deer. My wife was very fond of looking after baby animals, you see. Her maternal instinct came to the fore when anything small and vulnerable came into the house.

*Yes, how did it start? Because obviously you didn't have animals at home when you were living in a pub.*

But I did at school, remember.

*Yes, okay.*

And so that this habit of looking anything was deeply ingrained into my personality and it was obviously infectious in that Beryl caught it as well.

*It must have been quite frustrating to have to live in a pub and then in halls –*

Oh, it was after – it was not during the pub time.

*[Inaud].*

I only went to Birmingham before – I was in a hall for a year or so and then I went to – we had a house of our own. But it was only when we had a house of our end we could indulge in these sort of frivolities.

*And so many people won't be able to – only because perhaps they're set in their ways they wouldn't be able to imagine how a deer can live in a house. So can you explain about that?*

We had particularly muntjac. These are Chinese muntjac, these are tiny little deer with big dagger like teeth and they've spread much over the southern part of England. They were introduced whether deliberately or accidentally I'll never know, but they're now quite common. Well, one of the things was that sometimes, I suppose dogs is the usual answer, would run them down and people would find their little

forms that had been clearly chased or apparently deserted by their mums. And therefore they would bring them to us, and this is the way we got – we acquired them. As people wondered, well, what shall we do with it now approach, you know. Answer, take it round to the Coopes, they'll look after it. And we've had tiny babies, they were like very, very diminutive versions of Bambi, huge ears, big eyes, legs as thick as pencils, totally tame and friendly. A couple of them lived under our bed and were totally housetrained, so they had a tray with soil on it and they never, ever messed the house up, they always went to the tray. So – and then subsequently we had a huge pen in the garden because they get too big for the house. And they're as big as Labrador dogs, or nearly as big as Labrador, as big as small Labrador dogs, and they lived in this pen up in the garden. And we bred them, they reproduced, and then wherever possible we wanted to put these things back into the wild again, you see.

[37:47]

*And could you give me the sort of timing of having children? So you moved into this house together a year or so after you came to Birmingham?*

It started off by a little mill down – a little house next door, a lean-to to a mill down, and that's where we had our daughter. And then the three boys came when we were up at Woodland Cottage, which is on the side of Walton Hill, on the side of the Clent Hills.

[38:19]

*And how was having young children? How did that work alongside having animals at home I wonder?*

Oh, they liked it. I mean, Robert, our eldest son was very good with animals and loved them. Our second son not unnaturally was not, on the principle that you have to be as different from your brother as it's possible to be. We did have a few scuffles because some animals are rather robust in their playing and the badgers – I tried to play with a baby one day in a rather robust fashion to which my wife took exception, but it was only fooling around. It was just like playing with a doll or something like

that. So, no, on the whole we had no trouble at all. The only people who got into trouble was a lady who came to visit us who didn't approve of foxes in the house and she – the moment she came in through the front door the fox appeared out from the kitchen and she said, 'I don't approve of foxes in the house,' so it walked up to her and bit her. It must have sensed the vibes or something that in fact it – that she didn't approve, so it didn't approve either. And they came to a *modus operandi* between them, neither of them approved of one another.

[39:42]

*Thank you. And how did having children alter or affect your working life?*

It concentrates the mind something, as you probably know. Er ... it becomes all embracing. Children occupy all your time and – or a lot of it anyhow, so that they all had to be fitted in. Well, we used to come up to the highlands up here with the family and the animals, all in the same car, and the au pair girl as well, so that one small car used to be absolutely bulging. It was – it was a novel experience put it that way, not one that you should repeat because little animals would get under the pedals of the car or in the back and then would get into trouble. So with the four children, an au pair girl, Beryl and myself, and then half a dozen spare animals running around in the car or sitting on the back seat being troublesome, it was quite a traumatic journey. So, yes, we had – we had a difficult time of it but you can't leave them at home. Oh, I forgot to mention there was a dog as well, two dogs sometimes, so that the car was pretty bulging by the time we got up here.

*So this is somewhere you visited on family holidays?*

Yes, all the time, yes.

*To where we are now or to other ...?*

Well, actually mostly further west than this, the Isle of Mull and places like that.

*I was wondering whether having – as well now as having animals to look after, falcons to look after, having children to look after, whether it changed when and how you could do your work, whether it made it more difficult to –*

Well, this is what my wife refers to as multitasking. I mean this is what you get used to. Anybody who's got a family realises that you can't just do one thing at a time, you have to do three things at a time. I always remember my nanny, who I told you about, could both knit and read to us, and keep us in order, all simultaneously. One develops this habit of this is the way things were, and if I hadn't got a wife who was actually a full time medic also keeping not only a job down but keeping the household down and keeping the children in order, I suddenly realised that nanny was only doing one thing that everybody else had – that all mothers had been doing for a very long time.

*Yes, how did you manage with both of you? 'Cause both of you were working full time, your wife –*

Yes.

*A doctor.*

Well, as one of the parents in school, at a meeting in school, once said to Beryl, 'How can you possibly run a general practice and keep the children,' you know, 'the children at the same time?' And Beryl said, 'It's quite easy, I just neglect the children.' So the only thing to do is just answer a silly question with a silly answer.

*Were you able to work in a flexible way?*

Oh entirely. The beauty about academic work is, yes, I used to work all night sometimes and all day at other times, and it just – and it's very difficult to – I sometimes have to declare on tax forms how much time I spent on something and the answer is don't be silly. Oh, twenty-four hours a day sometimes. Sometimes nothing for a week, you know. It depends very, very much how the spirit moves me because you can't be a fanatic all the time, you just have to be a fanatic occasionally. And

that's the way I think that my work has been driven. It drives other people barmy but it's the only way I can operate.

[43:40]

*And what memories do you have of time spent, aside from holidays, of time spent at home with the children when they were young, the sorts of things –?*

Great fun, great fun –

*Yes.*

Yes, marvellous, yes. And they were ... they were terrific fun to have around. I mean they always have been, and now grandchildren are doing the same thing. They occupy an essential sort of component in my life. Yes, the answer always is fun, and getting into trouble. I mean building treehouses out in the garden and then setting them on fire, you know, thing like this that health and safety would have a terribly sort of alarmed response over. Or a tunnel in the garden was just like one of these escape tunnels in the prisoner of war camps, you know. It was a very elaborate and deep thing, and why it didn't fall in I will never know. So I had to be very responsible and tell the children not to do it so deep next time.

*How would you compare sort of your relationship with your children and your own father's with you? Because you could imagine that it might be similar. Your dad was a busy GP, you were a busy academic, you can imagine that the relationship might be similar but how would you compare it?*

Very, very different., we were – Beryl and I were much more hands on as far as the children are concerned. In other words, whereas my parents worked and we were looked after by a nanny, at no stage did that happen really with us. We wanted to be hands on with the children and therefore we were with them all the time. Of course when Beryl was doing the surgery I was looking after them and, er, at all times we were in contact with them. We didn't – we did – my mother once thought that I was incapable of looking after children, and therefore when one of our children was being

born she sent a stand in nanny who ... from home, to look after them. And it's interesting that I – I resented this enormously. And since the stand in nanny was highly unpopular with me as a child, she was also unpopular as we would have been when my mother sent her to look after the children. So that other people thought we were incompetent but we thought we were perfectly competent to cope with them.

[46:14]

*Thank you.*

But very different is the answer to that.

*Could you say where your work took you next after the work on the Upton Warren site and the Chelford site?*

Well, the sites came pouring in then, because once you publish something like the Upton Warren site, other people say have a look at ours and see. And so I have a huge list of sites that I've been working on, not only here but on the continent. I've done a lot of work in Switzerland, places like this, so – and teaching postgrad students, who have then gone all over the world, all over the place. So really once the snowball starts to roll it starts to accumulate all sorts of other sites, some of which are very important, some of which are very trivial. But the basic sort of thing is that once you have got these insect faunas and once you realise that they are made up of species that are still living today, the next stage is and so what? What can you do with them? And I've spent now the last forty odd years, forty odd years, using the insects from various sites to try to understand climatic change because what is happening is that the beetles change their distributions, i.e. their geographical ranges, in response to climatic change so that sometimes we have in Britain species which are exclusively high Arctic or Russian or Asiatic, and at other times exclusively European or even southern European. And these come and go as the climate comes and goes. And so the question really was not only was the insect population, if you like, made up of species still living today, but since their geographical range has changed, to what extent would those changes in geographical range be construed as changes in climate?

So the development of the subject has gone in that direction, towards interpreting the beetle faunas in terms of environmental change.

[48:30]

*I think what we need to do is kind of carefully trace that development through your career if we can so that –*

It doesn't follow any logical sequence.

*That's okay but – and I realise we won't be able to talk about every site and every piece of fieldwork but what would you identify as the next significant site or other form of breakthrough after the Chelford site and the papers on the –?*

I think you'd put Chelford and Upton Warren more or less into the same sort of category, and both occur during some phase of the early part of the last glaciation. And then several things happened. The development in the scientific world of radiocarbon dating became sufficiently sophisticated to be a sort of commercial enterprise. You could know that you'd get dates done. In which case, when, what age? And the answer is it has to be really younger than 40,000 years. Upton Warren is probably younger than 40,000 years, slightly older, and Chelford much older. And what I was interested in is in fact not only the climatic conditions but when they occurred. For that you need a date. So I started to get more recent than that, I started to look at what we call the late glacial period, i.e. the terminal phase of the last glaciation, because then I could get good radiocarbon dates, good samples. And I went to places like in North Wales, at a place called Glanllynau which is on the North Wales coast near to Criccieth. And the reason for going there was that I had a long sequence of sediments deposited in the last – well, between about 13 and 14,000 years ago, and about 10,000 years ago. And that was the time when the last Ice Age was coming to an end, and that was a period during which there was an enormous amount of knowledge based on palynology, or pollen analysis, which suggests that there was a climatic oscillation. And I was interested to know to what extent the beetles, as they came and went, mirrored the changes in the pollen. And of course they didn't in all respects, they did but in some respects not at all. And so I got very

interested there in the site up near Criccieth and the beetle story there showed extraordinary differences between pollen, reconstructions of climate, and the beetle layer. At about 13,000 years ago it may have been 12,800 but let's use a round figure, and say about that the climate went from high Arctic to at least as warm as present time, in an instant of geologic time. That's the first time I found something that's looked as if it was like a square wave. Instead of being a gentle curve it was a sudden step. And it's a huge step, it means that we've tried because we've got datable deposits to put a timing on this; it looks as if it's about 13,000 years ago, if pressed, if you tell me it was 12,800 I wouldn't worry, it's that sort of order. When you change from glacial to inter – to modern conditions in what seemed to be about one human lifetime, and that was very unpopular because people normally thought things happened gradually. That's the first time I've seen a sudden change because we now have beetles giving a measure of intensity and radiocarbon giving the timing, and therefore you could work out rate of change.

*Where were the dates coming from for this?*

From North Wales mostly, from this Criccieth site.

*I mean which radiocarbon dating?*

Now some of those were our own because by that time Birmingham University had established its own radiocarbon dating laboratory but some of them from the Netherlands. But as soon as we got our own dating system we found we only trusted our own, you know, in the way that things are, and we got a fairly consistent pattern of dates for this period. And then we looked at other what we call late glacial sites and found the same sort of picture turning up again and again and again and again. That is a very, very, rapid change followed by a gradual diminution of the temperature reaching a horrendous cold period at about between 10 and 11,000 years ago, which we call the Younger Dryas time. And at that we have a real Arctic fauna that returns to Britain after that initial warming, and then suddenly you get a sudden climatic warming again. So you get two sudden events, a climatic warming at about 13,000 and a climatic warming about 10,000, and between them a gradual deterioration. That pattern looked very unlike that produced by the palynological curves.

[54:06]

*And you said that this was unpopular, this suggestion of rapid change?*

Well, I'll tell you why, because the indicators of the climate, the thermal environment, the two indicators, pollen in particular and beetles, responded at a different rate. The pollen picture of climatic warming was largely dependent upon the appearance of trees gradually coming in. And the beetle story wasn't quite like this because the beetle story had two factors. One was the extermination of the Arctic ones and the colonisation by the more temperate ones. Whereas the pollen showed the appearance of trees, the beetles showed actually a disappearance of Arctic and appearance of temperate, two very different things. And it did seem, because you can compare the two perfectly accurately, that the beetles were extremely quick in responding to the thermal environment, whilst the trees not unnaturally took a little bit more time over it. We were both looking at the same thing but looking at two completely different indicators; one very rapid in its response and the other taking a little more time over it.

*Are you suggesting then that any resistance to your claims about rapid change and response, any resistance to that was coming from those people who were studying past climate through pollen?*

Mostly because they've not got any other alternative, they – I mean if people got – the only indicator you've got suggests that in fact change is gradual, and somebody comes along and says change is sudden, then not unnaturally there's going to be disagreements in there. And subsequently the ice core, ice cores, suggest that in fact the suddenness is in fact what actually happened to the climate, and the beetles were responding to a sudden climatic change recorded also in the Greenland ice cores and it's amazingly similar, the view that I've had, or had, and still have probably, and the green vertical record.

*So when were you first noticing in this Welsh work, this very rapid change, roughly what sort of dates are you –?*

I mean – do you mean in working?

*Mmm.*

In the '60s. It took a long time because of – in order to establish that suddenness I had to do a lot of work twice. It's no good doing work once, you've got to repeat it to make sure that what you're looking at is not just noise in some sort of fashion, so I did most of the work twice, and with research students and other colleagues, 'cause it's not done on your own, it means a lot of work. It took five years or more to really decide that what we were looking at was suddenness and not gradualness.

*And then roughly when was the ice core work confirming what you –*

Oh, gosh.

*Identified in the '60s?*

I'll have to look that up. It's not on the tip of my tongue. I knew once upon a time but I've forgotten.

[57:48]

*Yes, okay. And so who else was involved then in this work?*

Well, there was a research student who's now in Canada called Ann Morgan. And Ann did quite a lot of work on this. There was a research student called Margaret Joachim who did the same period in the Isle of Man, you know, because you've got the same sequence in the Isle of Man. And both of these produced results which were very important. And a chap who was professor of geology at the North Dakota University at Fargo called Jack Brophy, and all these people helped in various ways, some people with their own sites, some people – oh, and Allan Ashworth working at Penkrige [ph] found exactly the same sort of picture. So we were – there was a great deal of coordination here and argument, and justification. It's difficult if you try to – you find something which goes in contra to what you expect you've got to be damn

sure of your results before you publish them, and you've got to find colleagues who can find the same results elsewhere, because one of the ingredients of good scientific research is repeatability, and that's what we had to do. You had to repeat and repeat until we knew that we were right.

[59:36]

*And were you able to employ technical assistants to help with some of the –?*

No, the NERC was the Natural Environmental Research Council that funded postgrads, yes, post – sorry, postgrads yes, mostly for PhD students, yes.

*And I wonder whether you could talk about the relations with the rest of the geology department at Birmingham. And perhaps we could start with how this work was viewed by the rest of the department.*

Well, we've got to go back to the original head of department, Fred Shotton, who I said was in fact a very keen amateur coleopterist, I suppose, beetle men. I got a lot of sensitivity and understanding from him. Also a great deal of argument which I could have done without, because when you're in the throes of doing something, for somebody to come along and yes but do it all again and see what happens now, you know, 'cause – we had quite a lot of vigorous discussion, I think we should describe it. And amongst the rest of the department there was very little overlap 'cause they were respectable geologists, 'cause the insignia of office is a hammer. My insignia of office was a bucket and a spade, you know, I mean it was quite different, so that our sort of geology was so – you notice now it has shifted from respectable geology to unrespectable geology in a sort of way. It was viewed as rather peculiar by most of them with the exception I think of Al Strong [ph] who, although was a graptolite man also was a good botanist, and one needs a good botanist to identify the seeds and bits of plant remains. But it was mostly Fred and then we took a research assistant, Peter Osborne, and Peter Osborne was in fact a tower of strength. He came from Oxford University, he was one of those extremely efficient technical men who every department needs; things that he looked at were done property. And a very amiable and delightful chap he was too, and really he's the people you want in the lab. You

don't want some bloody minded bolshie chap who's self opinionated. He was a competent, amiable research assistant, and you couldn't want for better.

*And I think he – I think he came in, oh we don't have the date for that, but it's before – it was in the early '60s by the look of it.*

He was fairly early, yes.

*Yeah. What did he do, what was his role? In the sort of process that you've described of taking sample, washing or splitting, what's –?*

His interest very rapidly developed into looking at the more recent material, i.e. the postglacial stuff. And he was very, very much involved with that, looking at alluvial deposits, looking at archaeological situations. And Peter's development was more or less towards archaeology and postglacial, er ... Quaternary entomology, than mine, which tended to be more on the remote side, something – mine was over 10,000 years ago, his was younger than 10,000 years ago. This was not a deliberate split, it's just the way things happened to go.

*I wonder whether he took on any of the actual processing and so on.*

Yes, yes, oh yes. And his – he did a magnificent job of curating the samples. Oh, it was beautifully done.

*What is involved in curating this sort of sample? How are they preserved, how are they –?*

Oh, on slides quite a lot of them. And quite a lot of the best slide material is done by him, or by one or two other postdocs. There's a degree of meticulousness when you're handling a vast amount of data which is essential if you're to keep the data in order. And he and, for instance, Chris Sands, Allan Ashworth, managed to also keep the collections in fine fettle. Where I was inclined to rush past and get things done but somebody has to come up and make sure that everything is kept properly, is catalogued properly, is in order so we can find things later. And Peter Osborne in

particular, and Chris Sands, who recently died unfortunately, is – these people were very, very valuable. What I'm trying to say is that you develop a team after a little while. Not all necessarily at the same time but each tends to develop its own niche or speciality, and you need them all. You can't get away with saying, oh, we can do without him. This is my present day view of what politicians have, you can always dismantle a team and reassemble it when you need it; it takes a long time to assemble a team and expertise is not something you can buy off the shelf, so that these were people who took a long time to acquire their expertise but nonetheless once they'd got it were a vital component in the team as a whole.

*How did the team identify itself at Birmingham? Did you form a group that had a title?*

We didn't have a title, no, I think we were too individualistic ever to have a title. If we had decided this would be a good idea none of us could have agreed. Erm, no, we didn't.

*And how did you know that you were perceived by the rest of the department as being unusual? I mean the way –*

Well not seriously because I taught – I taught courses which were respectable courses, like palaeontology and evolutionary biology, evolutionary palaeontology and ordinary standard palaeontology and things of this sort, which was part and parcel of a respectable geological course. The only way in which I could tell you that I found things a bit odd, that I could not easily discuss research with some of my other colleagues; in other words, there wasn't much input in spite of the fact that I tried to talk. Oh, they were very sympathetic and understanding but I was a wee bit outside the normal range of people's experience. So we didn't get much – didn't get much input from my colleagues. Lots of pleasantries and lots of being nice to Coope, but not a great deal of scientific [inaud].

[1:06:23]

*And could you talk about your relationship with entomology and entomologists?*

*You've mentioned, for example, going down to the Natural History Museum, visiting entomologists to use collections, but I suppose more widely the relationship between what you were doing and British entomology at the time.*

Yes, the Natural History Museum were a tower of strength, some of them. Some of them were not. It depended a bit on outlook. I think that the most valuable man we had was Jack Balfour Brown. Right at the very beginning he recognised that we could actually identify fossils off fragments. Others literally criticised me saying, I don't see how you can do this because you have not got the character which we use in keys to identification. Er, this gives you quite a false impression of what a key is for. A key is a means of identification, not the description of the differences. And I felt that in fact therefore I had quite a lot of antipathy from people who said, but you can't do this and you – these people were people who were trained to look at the whole animal whilst a palaeontologist is accustomed to looking at bits. Whatever the fossil is, whether it be a dinosaur or it would be a mammoth or a beetle or what have you, we are accustomed to looking at bits. And therefore we don't even think in terms of the whole animal, and therefore there was a discrepancy between the way I did things, or we did things I should really say, and the way they did things. And there were times when I think there was total incomprehension between us. Whether this – subsequently I think in recent times people have gradually come round to think that this in fact isn't as barmy as they originally thought but people did really think that this was impossible. In fact it was not only impossible but it was ridiculous to try, with as I say certain clear exceptions, erm, and who else apart from –? Well, I've mentioned Carl Lindroth in Sweden. He was an enormous help in that when I really felt that perhaps they've got a point and I should pack it in, Carl really took me by the collar and said don't be silly. He had already started looking at fossil because – not systematically but just as a by product and he was – he was enormously supportive. Other people not quite so supportive but you don't – you only want one or two enthusiasts to back you up to make you really feel that it's going somewhere.

*And where and how people tell you that it couldn't be done? In public lectures or in private conversation?*

Oh, no, no, no, private conversation. You don't air your dirty washing in public, you just simply say just a minute. Just as somebody once said to me in the Natural History Museum, 'You can't possibly expect my entomological colleagues to believe in your identifications of beetles unless you find the male genitalia.' Now the problem about the male genitalia is they're very elaborate and very complicated in beetles. But I got them 'cause I fossil – I had fossil male genitalia. Sounds ridiculous but you find compressed abdomens in the deposits and with a couple of needles, mounting needles, you can dissect them out and there you have the very thing that the entomologists were looking for. I think that's what made quite a lot of difference, to find that the genitalia of beetles are the same in the past as they are today. Made many people sit up and think perhaps the whole species is the same.

*And when was that? Do you remember when that revelation was, whether it was at a particular meeting or –?*

Oh, no, I think now it would have been the '60s probably but I can't tell you precisely because I can't remember. I can remember it being said because I also remember the triumph that I felt when they said, well, there you are, there it is, there's the male genitalia of various beetles. And I had a whole plate of them, but Robert Angus, who I must mention as being another entomologist who was very, very sympathetic, he is a specialist in water beetles and he came and joined the department and he was an enormous help. That's Sir Robert Angus who's now at the Royal Holloway, he's just retired, but again you only want a few of these people to keep – if you like, to keep the enthusiasm, keep the impetus going, and they were enormously useful people. And occasional ones even on the continent. And then I have other people working on – in France. There's a chap called Philip Parnell who's very keen, and a chap in Sweden called Geoffrey Lemdahl put in a lot of hard work on the fossils. And in the case of Philip Parnell, he also has a magnificent collection and he is now using the collection to identify fossil assemblages from southern Europe, which again is very vital because we're finding all sorts of species there that you might find difficult to expect to occur.

*And why is it that the male genitalia was particularly convincing for those who thought that you couldn't identify –?*

It's often difficult to see why. What we're looking at is the fact that sometimes some species are so nearly similar to one another in every respect that it's only when you look at the male genitalia you realise they are very different. Because I suppose in a sort of sense the male genitalia look like a lock and key device, the genitalia have to be complicated. I presume it's one of the means which stops them interbreeding with other groups, but it is a fact that in many cases the male genitalia happened to be more diagnostic than the overall animal. If you ask me why I would go into all sorts of metaphysical nonsense because I don't actually know for sure.

[1:13:18]

*But it's just that these – showing these you think convinced some entomologists that this –*

Some sceptics, yes.

*To what extent were your family involved in fieldwork, in other words your wife and children in coming with you?*

Oh, yes, they were very useful because they'd act as labourers, you know. In particular children can – if you're collecting samples, and one of the snags about collecting my sediment samples is they're heavy, and if you've got several small children they're delighted in carrying heavy bags off site. So, yes, they were used that way. Well, anyhow if you try to stop them, you know, when they were that small they wanted to come and see what Dad was doing, you know. And they loved getting dirty, which is another thing which was an almost essential ingredient in family enjoyment.

*This is very interesting because for my scientists that I've spoken to, work and family are kept very separate. And so I'd be very interested if you could remember is there a particular field site where because your children were of a certain age or it was a sort of child friendly site where you can very clearly remember them there and*

*remembering what they did there, even what you – even what they said about what they were doing there.*

No, but I can tell you that sometimes the children got a very weird impression of what we were meant to be doing. When one of the teachers in the primary school when the children were small did one of these exercises in espionage, that teachers would ask children to write a composition of what they did during the holidays or over the weekend, one of them asked, I think it was Robert, ‘And what does your daddy do?’ And he said he washes mud, which is his impression of what I spent my life doing, and it gave a very weird view from the teacher’s point of view of what I did for a living [laughs].

*And so at field sites they could carry samples.*

They could.

*Is there anything else that they could do to –?*

It’s very difficult, I mean we didn’t keep them away very often, when there was something interesting to do. I’ve got pictures of them, for instance, you know, when we were laying drainpipes the children enjoyed themselves living inside the drainpipes and all – we didn’t believe that somehow or other that work and play should necessarily be segregated from one another, so yes they had a great time, I hope.

*And as they grew up what was the extent of their interest in what you were doing and their understanding of what you were doing? You talked about this school report at an age when they’re young, and of course that’s how they see it. But as they grew up and became older what was their interest in –?*

I’m going backwards and forwards at the moment. Fiona, our daughter, is not necessarily interested in that because she’s interested in other sorts of things. She liked birds of prey and things of this sort. Robert, our eldest son, is an extremely efficient – a natural scientist and is now professionally involved in that, and has

always been interested in what we do. James, being the next one down, not unnaturally wanted to be as different as he possibly can from his elder sibling, so he was not the slightest bit interested in what I do. And if you ask our youngest, I don't know that he is actually very interested in – technically in what I do. So the answer to your question is some have, some haven't. But there is always this problem with all children that they want to be as different from their brothers or sisters as they possibly can be. So since Robert was the first in, he was the one that was most interested, yes.

*And to what extent was he involved in sort of work in the laboratory? I don't know at what point you started –*

Oh, yes, I remember they were quite prepared to muck in. So long as it's dirty enough they could have great fun. There's nothing like, you know, washing a sample or something for having fun. Yes, they've done that a little bit.

*At what point did you start having a laboratory at home or processing samples at home?*

Yeah, it was only when I came up to live in Scotland really because prior to that I mean I had plenty of space in the university, and what was a very, very tolerant maintenance department who didn't mind me pitching God knows how much sediment down their drains. [laughs] It made a lot of difference. I don't know what in fact my delicate drainage system in the house here to be clogged up with silt and sand.

[1:18:05]

*And could you talk about relations between your work in the University of Birmingham and amateur, I don't know if that's the right term, but local groups that had to have local expertise? So local natural history societies, the local geological association groups, that sort of thing over the – at the time that we're talking about, which is the sort of late '50s and 1960s, any relations you had with non-professional scientists.*

Very little because the geologists were nearly all interested in what I call real geology as opposed to what – my sort of geology wasn't already. In fact it looked like counterfeit geology, you know. As old Charlie Lapworth, the original professor of geology at Birmingham, thought of the Pleistocene as something that stinks of varnish, it was that – well, because of the preservative that was put on everything. Lots of people felt that this was not really geology but I had to go and give local lectures, to local groups, all the time. Nothing really came out of it, it was just entertainment as far as they was concerned. So I gave lots of lectures to WEA classes, you know, Workers' Education Classes. There wasn't a worker in the audience anywhere that I could see, and there were people that Birmingham – oh, I've forgotten the name of the institute. Anyhow, something institute, and I gave courses and lectures there too, so – and my work came into these things but there was nothing in the way of much contribution. They absorbed a lot of effort on my part [laughs] but there was not much in the way of contribution from them to me when I was still at Birmingham. There were other departments which were interested, and particularly Glasgow when Professor Bishop was up there, he told me all sorts of sites up here in Scotland to be valuable, and were enormously valuable. So other university departments certainly contributed very extensively to the discovery of important sites, but not usually the natural history societies. There was the naturalist trust, you know, the county naturalist trusts, erm, and Fred Shotton was very much involved in the establishment of the, what he called the West Midlands Naturalist Trust, which eventually broke up into County Naturalist Trusts. And quite a few entomologists were interested in what it was but not in any extensive way at all, no.

*When you said you had to give lectures to these groups, the WEA at Birmingham Institute, what do you mean by had to? Why –?*

Oh, they asked me to do so and I wasn't in any position – you know, I enjoy – I thoroughly enjoyed teaching, so I used to go and give them talks on all sorts of things but the beetle story was very popular in many ways.

[End of Track 3]

#### Track 4

*Yes, if you could just talk about some of these plates of fossils –*

Yes.

*Specimens from Upton Warren.*

Yeah. Well, these will give you a sort of resume of some of the different sorts of things. These here are beetles and these are true bugs, there's one of the Homoptera there, Heteroptera here. This is a caddis case, and here are the adult caddises, and we have large numbers of the heads of adult caddises. And we have caddis larval fragments all over the place. This is an interesting thing. This is published here because we didn't know what it was. We knew what the genus was, at least we got close to it, but we'd seen nothing like it until Bill Steel, who was a specialist in these small staphylinid beetles, found a specimen, single specimen, from the Caucasus Mountains sent to him for identification. And so he'd managed to put a – a name on that thing. *Anotylus gibbulus* is its name but it's this extraordinary head which was one of the first species that we found from southern Europe, this time from the mountains. Now if I look at another one, I'll see what else there is. In amongst all these other things were things like – these are young peacockles inside their mother. And as the specimen dried out in the – under the microscope so the shell gradually opened, revealing the little – the youngsters inside. These are molars of various rodents, lemmings, and here are pieces of stickleback with the spine, the pelvic – the pelvic spine of a stickleback and here is the dorsal spine of a stickleback. So we had – and these are seeds as well. So we had an extraordinary range of different sorts of fossil material, all from Upton Warren. So it's not just the beetle story, it's the story of a whole ecosystem being preserved in the bottom of a pond, okay?

*Very good.*

That's that.

[02:16]

*And then there's the – could you tell the ladybird story? I rather like that.*

[laughs] Well, the Chelford deposits, they had to be peeled back sheet by sheet of very fine sediment, compressed into the sort of texture of hardboard. And the fossils were preserved on this – on the bedding plains. And what was interesting was that those fossils which were, or represented by, heavily sclerotised, in other words chitinised parts, were better preserved than those which were representative of things which were pigmented. And one of the best examples of this was the ladybird in which the spots are heavily chitinised, sclerotised, and the red part is pigmented and is very frail. And on one occasion when we – I was looking at a sheet of this deposit and saw this little pattern of spots. And this little pattern of spots looked curiously bilaterally symmetrical. And the arrangement of spots was precisely the remains of spots seen on the southern spot ladybird, only the whole of the ladybird had decomposed except for the spots. So this was a sort of Cheshire Cat version in the beetle world. The Cheshire Cat had disappeared all but its smile, this one was the ladybird had disappeared all but the spots.

[03:46]

*And to what extent did this sort of – the kind of things that you found at Upton Warren and the amount, to what extent was it an encouragement to continue? In other words, I'm thinking about what if you hadn't have found Upton Warren at the time that you did?*

I think I'd probably be doing something completely different now actually. No, it was such an eye opener because of the beauty of preservation which meant that all the structural colours were absolutely superb and the specimens themselves, as you've seen, were in fact very well preserved. Not just beetles but the whole of the natural history of this pond. And then what turned out to be exciting was, as I've shown you with that beetle, was some of the beetles turned out to be so exotic that we'd no idea what they were to start with. And then after publishing them ours was a really question mark, what is this? The specialists started coming with answers, and these

answers were really, truly exotic. One of which is here, which again I can – and this is one of the really early stages of this, if I can find it now, if I can put my glasses on first. And that – right, that's not the right one. [looking through papers] So we should have had a piece of paper stuck in this, and then I could have told you with greater precision but I'm looking for an earlier paper. You'll just have to turn it [break]. Right, this is an interesting animal because I knew that it belonged to the genus *Carabus* and it looks like rather like a *Carabus granulatus* except that it isn't because in detail it looked completely different. And I took this to Sweden, to Professor Carl Lindroth, who homed in onto this immediately and said I know that species, it's an East Siberian and north – and the high north of America. And to find things like this living in – once living in Britain rather made a big difference to our ideas about the way in which geographical distribution has shifted on this enormous scale in response to comings and goings of ice ages. That was in fact the definitive one that really started the ball rolling but I – in other words, you have to find the world's expert who's actually sympathetic to the subject and find specimens which even though it's a little bit of the elytron nonetheless is definitive enough for them to be absolutely certain that that's what that was. And that in fact was one of the beginnings of the whole of recognising that beetle species were still the same as the present time but living a very, very long way from where they are now.

[End of Track 4]

## Track 5

*Could you say something about how you avoided mistakes arising from post-mortem changes in insects?*

That's a very difficult one because, ah, yes, there are post-mortem changes and these have led previous people who have looked at fossil insects to credit them with brand new names. You see the philosophy went like this, this bit's a fossil, fossils are remains of extinct animals, and therefore this is extinct. And the reason for thinking they're extinct was because they had minor modifications in the post-mortem fashion. Now it was – first of all, the Upton Warren ones were superbly preserved and therefore to some extent there was little in the way of a problem with post-mortem. Post-mortem changes started to show themselves particularly when the specimens dried out, and there you get all sorts of spurious dimples that don't exist in reality and you get also increased punctuation and a change of colour. The structural colours change post-mortemly to an extraordinary degree. You see structural colours in beetles are formed of layers of chitin, that's their skeletal material, and the colours are due to the different ways in which light is refracted from these layers, rather like the colours on oil floating on water. And when you're looking or sorting – sorting them under water or under alcohol the colours are beautiful but if they dry out the colours disappear. So then you wet them again and the colours come back but not the same colours because the gaps between the layers change, they stick together or something. So reds and golds tend to become more greenish, and then on successive wettings it goes from gold to green to blue to black, and after a little while no matter what you do you can't regenerate the colour. This gives a very, very spurious view of colour that – in specimens that have been previously dried out. So these are the sort of post-mortems, there's spurious punctuation, spurious dimples and spurious colour as well. Then the last one is warping, they change shape. They change shape again on drying out. Beautiful specimens which are still damp, in field damp condition, turn out to be pieces that look like tealeaves once they dry out. So there are problems that way, but you learn to overcome them or you learn to recognise them as a persistent pattern of change like the colour, like the dimples.

[02:52]

*Thank you. Can you give me a sort of – at this stage a sort of potted history of your relations with the sub-department of Quaternary research in Cambridge over your career?*

Oh, well, we're rather independent because the sub-department of Quaternary research in Cambridge was dominated by palynology as you might expect, because Professor Harry Godwin being a botanist obviously emphasised the things he was familiar with. And there's very, very little in the way of looking at things other than botanical remains. So we overlapped very, very little indeed. And there was not much in the way of a consistent attack on the beetle story. There was a chap called Ron Pearson who did a PhD on beetles from Cambridge, rather we think following in our footsteps, but then he went on to other things.

*Perhaps you'd be able to give an account of the sort of your sort of relations with Richard West in particular. I notice that, for example, that you'd worked on the same sites though I gather not at the same time, and there seemed to be some sort of comparative work going on. And I know that you are – you sort of know each other at least of the level of telephoning each other.*

Oh, yes.

*So I wondered about the history of that relationship almost, how it happened, how you met up.*

I think that there is a difference between the interpretation of the botanical record and the insect record, which itself is fascinating. And Richard really was – oh, I was going to say one of the most important proponents of palynological or palaeobotanical research in this respect. He and I differed very considerably in the timing and intensity of the climatic changes that we were looking at. And I think that the most interesting thing there was that in fact we could carry on having different views yet we were to some extent complimentary. So our relationship was not one of, what shall I say, competition but symbiosis if you like, a sort of agreeing to differ on

various things. And I think if you talk to Richard now he would still agree to differ on interpretations but – so he would say the same [laughs], I would certainly say the same. So, yes, a good working relationship is the way of describing our relationship together.

*And is the difference between you because of the different materials that you're using to –?*

Yes, of course, it's the difference between two indicators of climate change. The botanical record is in my opinion often – it often shows signs of a lag behind climatic change, climatic changes, which trigger them off in the first place. And the beetle record does seem to me to have two advant – or several advantages. One is the beetles are very, very quick on the uptake, they respond very rapidly in two senses. One is they are very intolerant of some changes, so quite – local extinction is very common and local colonisation is very common. So you have two responses, one is elimination, another is recruitment. In the botanical story, if you look at the trees it goes from non-tree record to tree record, and having no trees present to sort of open country to having a sort of quasi forest. Well, no trees is a sort of negative evidence in a sort of way, so that in fact I feel that we have positive evidence on both the – of the climatic change because of extinctions and recruitment, and in the botanical record it's almost from negative to positive. And these two lag, the – each one must lag to some extent behind the climatic change, but the beetles and insects, respond extremely rapidly, and more rapidly than do the trees, okay?

*And are there occasions when you've worked together in the field?*

Very rarely, very rarely. We've been on the same sites together, yes, but very rarely we actually worked together in the field.

[07:36]

*Thank you. And this is a sort of intellectual question which stemmed from something we were talking about off the recording yesterday. And I wondered how you responded to the view that might be advanced I suppose that beetle species might*

*evolve physiologically, if you like, but not visibly. In other words, they may be evolving sort of internally in terms of their tolerances and so on but that that evolutionary change might not be visible in a fossil. I don't know if this is in any way defensible.*

This is something which of course puzzles everybody who's working on paleoecology. Whether they be beetles or anything else it's possible that underneath the morphological stability there's sort of cryptic evolution going on as you see at a physiological level. So there's nothing peculiar to beetles about that problem. But faced with it you've got to wonder whether or not it is a serious problem or whether it isn't. So what do you do? First of all, you can make an assumption that morphological constancy is linked with physiological constancy. And if you make this assumption and you use it, what happens? By making that assumption I found the ecological sense results. In other words, there's an ecologically meaningful pattern that emerged, a picture emerges, which does suggest that people – that beetles in the past kept the same company as they do today. And that's a strong suggestion that if in fact they're keeping the same company in the past as they do today then it would require an extraordinary parallelism of the cryptic evolution to see them all evolving hand in hand without actually any genetic exchange between them. So I think that on the principle that you make an assumption you see if it works. If it works you tend to leave that assumption. It's the way we operate and the way I believe that in fact morphological constancy is associated with the same degree for environmental constancy as we would have expected.

[09:55]

*Thank you. And I wonder whether you came to know anything of Fred Shotton that's not apparent from published accounts, either of his war service which appear from time to time, his involvement in planning for invasions and so on, and water supplies, and anything that doesn't appear in your biographical memoir, perhaps because you regard it as too trivial for that sort of publication. But in other words, can you tell us anything about Fred Shotton that we couldn't find out through published materials?*

Well, one of the extraordinary sort of serendipitous events was when I was looking at Upton Warren for the first time to discover that unknown to me my head of the geological department was also a very, very keen amateur entomologist. And this doesn't occur in any of his published literature that I'm aware of. For instance, when he was young, I think he was a teenager, when he was a teenager, he went off to Switzerland because they thought he was delicate, and there was nothing delicate about Fred's health as far as I could see. And he collected butterflies and this is, as I mention in his biography for the Royal Society, but then he also moved from butterflies, which there's limited number of possibilities in Britain because the spectrum of species is very limited, to beetles. And to discover in fact that our head of department was in fact a beetle enthusiast was really a very pleasant surprise. So there's that which is really – I don't think it comes over in the published literature but I think that it was a great help for me because what he did was make sure that when we were looking at particularly the Upton Warren site that we were not just looking at modern contamination but the quality of the preservation was so good that he thought this must be modern contamination. And we spent a whole day with shovels digging out the deposit just to make sure that it wasn't just something on the surface but was actually disappearing under tens of feet of gravel. And I think I convinced him by the end of the day that it was genuine and not just a modern contaminant.

*And was this enthusiasm for beetles and other insects apparent at his home?*

Yes.

*Did you visit his home?*

Oh yes, oh yes.

*Could you describe what you remember of his home?*

Erm, he had cabinets with beetles in them, in the sort of traditional way which most entomologists have cabinets with drawers. And he had a fairly small but interesting little collection, which he collected largely from a reserve at Tile Hill, not far from Coventry. And he was responsible really for making an inventory of the beetle

species in Tile Hill. That was good sound sense and something that amateurs are so important in their contribution to sort of furthering knowledge simply because first of all they have enthusiasm, and the second thing is that of course they can go on again and again and again visiting the same place. And since it was on his doorstep he has amassed – he amassed an enormous amount of beetle records in particular but also other records, lots of insects of various other sorts, bugs. I have some of his collection here of elaborate Heteroptera, beautiful things. So he wasn't just narrowly thinking of beetles or butterflies, he was also interested in general natural history. And he and his wife – his wife was very, very good on identifying fungi and things of this sort, so between them again they had a partnership in looking at the – particularly the present day flora and fauna from Tile Hill Wood.

*Was his wife a professional scientist?*

No, erm, she was a business woman originally, and don't ask me 'cause I've forgotten what the business was, but she was. I think she made the sort of frilly bits for the edges of lampshades and things like this, but she was a business woman effectively. But then of course mother, of the daughters, so I have no doubt that her interest in the general natural history was spurred by Fred's enthusiasm for going out into Tile Hill, you know, 'let's see what we can go and find' approach.

[14:44]

*And what do you think is the reason for his interest in the Quaternary at a time when it wasn't a kind of mainstream target for geology and in fact was seen as being somehow ungeological I think you said yesterday?*

Very much so. You see, erm, you were at Nottingham University and I once gave a lecture at Nottingham when – to their geological society and one of the final year students said, oh, we did the Quaternary in half a lecture, which gives you some idea of the importance attached to this subject. Well, Fred started off by – his major work was on the Cross Fell inlier, doing solid geology, respectable stuff he used a hammer for. But then near Coventry in fact the country's pretty flat and the base rock is one of the Triassic sandstones and mudstones, but overlying this was a layer, a sequence of

strata, which clearly were Quaternary. And in order to understand the local geology you had to do the Quaternary, so it's local interest in the Coventry area. And he developed, using lots of local people, a technique in the field of making a large number of auger holes, 'cause there's no exposures and make – or very few exposures. And there's a complex pattern between Warwick and Coventry of the Quaternary geology simply because it was on top of everything that he might have been interested in, and that's how it started. And his work on the area between Coventry and Leamington, Warwick area, is in fact a classic in many ways. I think his interpretation of it was unique at the time in that he saw an enormous ice dammed lake in the middle of the – in the English midlands which seems so intuitively wrong. But when you imagine that somehow you've got your Cotswold scarp at one end and an ice sheet at the other, you can imagine an impounded lake in the middle. Whether we believe it quite as a lake or whether it was a succession of small lakes doesn't really matter. That is the important thing that Fred did. The other thing he pointed out was that if you look at some of these deposits which look like deposits of the River Avon, if you go back into the remote past you discover to your surprise that whereas the Avon today runs from north east to south west, the Avon in those days went in the opposite direction, a complete reversed drainage pattern. Now this was really rather fascinating and this is what got Fred really rather excited. He was beginning to see things which were totally different from the present time in the very recent geologic time. And of course when we started finding fossils of this period and examples, samples if you like, of the natural history, it fitted in with Fred perfectly. And so in a sort of – there's a fortuitousness here that his interest in the early part of his life suddenly became even more enthusiastic, more interesting, as we began to unravel not only the geography or the geology of the Quaternary but its natural history as well.

[18:31]

*Thank you. Can you comment on the effect of sort of post-war building and civil engineering projects on the kind of opportunities for Quaternary geology?*

Well, it's often embarrassing actually because when you've just got a few bore holes that you make with an auger hole, that's all very well, but when an enormous

excavator comes along and digs it all up it lays bare all your assumptions that you've made about what – and these can be quite different. This was particularly highlighted in the University of Birmingham sort of campus development where work had been done by a PhD student, Ray Pickering, extending Fred's ideas about the lakes into the area near Birmingham. And there's nothing like having your hypotheses dug up and investigated in detail. And I have to say this; that it was rather embarrassing, because making geological inferences from little bore holes are pin pricks in what you can do with a big excavator. And the big excavator searched all sorts of things that we never suspected. So I don't want to go into this in too much detail but it was a real eye opener, put it this way. I think that Ray Pickering found that the exposures produced by the developers building libraries and new buildings at the university were rather different from his thesis but I wouldn't like to presume on anything that Ray actually said. It's just the risk that one runs of having your – the details of your interpretation exposed to the worldly gaze of everybody else.

*When was this development taking place at – roughly?*

Oh, '60s, '70s.

*So that's the sort of negative side of it.*

Yes, yes

*Is there a positive effect of this sort of – an increase in this sort of work after the war, this sort of digging up of things?*

Of course. There's another sort of thing, that's just the university one which something – so much was on our doorstep. But one of the important things is that gravel extraction increased enormously with the need for gravel for concrete making and so on. So very, very extensive gravel pits developed all along the rivers and into any area where there was – there were repositories of gravel and things like this. And this again gave an opportunity of looking at the sections through the sediments and collecting the organic sediments in which our fossil story resided. So this was a huge opportunity as a result of development. The difficulty of all that is that as gravel pits

work they destroy the evidence that we are in fact wanting to investigate, and if you see something you have to be very, very quick on the uptake because when people were – when gravel was at a high premium they worked at an extraordinary rate. I remember one occasion when collecting samples, this was in a road cutting, ‘cause getting motorways cut a great swathe through the country, I started in the morning in the bottom of a hole and finished up in the afternoon on a plinth, and having removed all the sediment from around me except the bit that I was sitting on. So you have to be very, very quick indeed to be in, to collect, to assess, to make a record of things before the developers would reveal the stuff in the first place and destroy it in the second.

*And how did developers feel when you arrive, or how do they respond to you when you arrive to collect –?*

Well, it always surprises me they were as tolerant as they were because we were trying to hold them up and saying, don’t do this. The very thing that they were doing was in fact making a profit, and the very thing that they were doing was the thing that revealed the information in the first place. So we had a lot of trouble from the point of view of people saying, yes, but you’ve got twenty-four hours to do the job, or imposing time limits which are unrealistic. But then you found the workmen on the site were enthusiastic in the extreme and it was just – I mean if you’re digging gravel all day then to find somebody coming along and saying, yes, but look how exciting is, then you add a certain *piquance* to life. And it was interesting that back to Upton Warren again the competition started to develop between the actual workers on the site, I’m not talking about management, but the workers on the site who were digging things up with their excavators competed with one another to bring me the most exciting fossils and then started to pilfer these fossils from one another’s little caches. So that competition got to a rather fierce extent, so that I was taken on one side by the quarry manager saying you must not let the workers compete like this, it’s undermining our productivity [laughs]. So, yes, different – obviously different levels of management. Most of them were extraordinarily tolerant of us, especially as when you kept thinking – you think that in fact we’re inhibiting their activities.

[24:00]

*If Upton Warren is one site where gravel workings were useful, are there other –?  
What are the other sites where you think that in particular the beginnings of a kind of  
building project were crucial in opening up something which you could then use?*

Well, motorways in particular. With the start of building motorways meant there'd be cuttings, and big cuttings showed things that we couldn't possibly expect. There was one at a place called Quinton, just south of Birmingham, and this cutting went through a deposit, a highly organic deposit, nobody suspected it was there, you could not have known anything about it. The hill was capped by the glacial deposit, underlain by a glacial deposit, in the middle there was evidence of a valley filled with ponds and things at the bottom of the valley. Now Quinton is geographically on the watershed of England. Split over one shoulder it goes into the Severn and the other it goes into the Trent system, and yet we were in a valley bottom [laughs]. So you suddenly realise that the present day geography has nothing to do with even the recent geological story, that the stuff that we had from Quinton would be only a few hundred thousand years old, which for a geologist is yesterday. And yet in that time the whole topography had been inverted, for today it's on the watershed of England, then it was in the valley bottom, so these are the sorts of surprise. And that's what the motorways can do. And of course because we knew pretty well where the motorways were we could – were going to be, we could keep a watching brief on motorway excavations. Building developments rather different because they're difficult to predict where they will be, but the best of all was in fact in Trafalgar Square. In Trafalgar Square they were digging the foundations, excavated foundations, for a new part embassy building and they found bones of hippopotamus, elephant and lion, and masses and masses of my beetles which I washed out of the deposit. But the irony of this, really the rather delightful irony, is that nature every now and then plays tricks on you, that in fact in the foundations where they got the lions, hippopotamuses and elephants, it was the Uganda government's new building they were building, so I felt that was a rather nice twist on the part of nature. So just the sort of thing, you know, we – it was very capricious. And I want to say thing, and that is in science we tend to think of a programme of research but it's almost impossible to think of a programme in which you don't know beforehand what you're going to see, where everything is brand new and all sorts of unexpected things turn up. So what you did was you did

investigations where things were available and then tried to put them together as a picture afterwards. In other words, the programme emerged after the work had been done, not before.

[27:28]

*Thank you. We'll come back to the Trafalgar Site a little bit later. Now we made need the publication that we've marked in a second but what I wanted to ask you more about today, you said quite a lot about this yesterday, but I wanted you to tell me about the response of other scientists, the initial response of other scientists, to your findings of rapid climate change based on the dated postglacial sequence in Wales. So we perhaps don't need to look at the chart yet but what was the immediate response of the sort of scientific community, the climate history community, to that argument that you were making?*

Well, I think that, er, it's not always easy to do it from my point of view because I view it from a rather biased point of view, but in general geologists were trained that change, whatever, was usually rather a gradual thing. And therefore if it appeared that, this is in sort of classical geology, an event took place suddenly the probability was that it hadn't – it was just because it was a long view that gave the impression of suddenness when in fact we were just looking at something that took place gradually. The same went for climatic change. That climates change in a more or less sinusoidal curved way, that on the whole, back to the – to looking at the palynological record, the palynological record is damped to a considerable degree, therefore it looks gradual. I think I'm probably correct in saying that many people found the idea of sudden climatic change in those days, the sort of '60s and '70s, counterintuitive. They thought climate change is more likely to be slow and gentle, and that rapid change is a figment of something, of the procedure [inaud]. This was the case until the ice core men in Greenland, and this is Dansgaard and his group in Denmark using Greenland ice, showed that when you get to the middle of the last – sorry, the last – the late glacial stage of the last glaciation, the same sort of sudden climatic changes were occurring as I had been seeing amongst the beetles. And then for reasons that are totally strange, credibility changed also. And because the ice core people were physicists, physics is a more respectable science than palaeontology in many ways, it

became more credible. And I think to this day most people now recognise the fact that climate change can be very sudden indeed and that the beetle record itself is probably slower than the actual climatic change that engendered it in the first place. And whereas in that little paper we've just been discussing, that I then imagined that summer temperatures changed by one degree centigrade per decade, the ice core people think that's far too conservative and actually it was faster than that. So I find myself now in the middle between the botanists on the one hand who say I'm far too fast, and the ice core saying much too slow.

[End of Track 5]

## Track 6

*So we're looking now at a graph that you projected in Boreas 1972.*

Yeah. And this is as a summary of the – a late glacial exposure on the foreshore, not far from Criccieth, where you could collect detailed samples of the sediment. And here is a log up at this side here of the – of the sedimentary log, of the different sorts of ethology. And this side here, what I want you to look at carefully is this graph here which is the graph of climate change temperatures, the medial high temperature, and here it suddenly changes. You see what I mean by a real square wave, that as far as I could see that change was dramatically sudden. It's sudden because the beetle fauna suddenly changed. The Arctic ones present here suddenly became exterminated in the Criccieth area and they were replaced by temperate things. And it's not a sign of sinusoidal curve, a gentle curve, it's a square wave, and that's the first time we ever saw something really as square as this. This is probably around 13,000 years ago. It's probably perhaps about 12,800 but I don't want to be too fussy about refinement of that. Here is in fact the pollen and here is in fact the alleged warm period, the Allerid, and it's already showing signs of being colder. So you can see a gradual change here in the pollen record is lagging behind what seems to be the beetle change. And at this side we have the carbon 14 records, that's about twelve and a half thousand there. So this is well before twelve and a half thousand in that area there, okay?

*Thank you.*

[End of Track 6]

## Track 7

*Could you describe firstly the origins of your work at the Trafalgar Square site? In other words, how you ended up being there.*

Yes, you see Birmingham was a long way from London and therefore it takes a long time for the man with the cleft stick to bring the message. And therefore it was rather late in the day that I discovered that in fact the excavations at Trafalgar Square were going on at all. Erm ... I think, oh, I'll remember his name eventually ... but it was the Natural History Museum people who alerted me to the fact that in Trafalgar Square there were excavations which were producing bones. And they were producing bones as ... which they were interested in, would I be interested in looking to see if there were any beetles. And that's where it began. The attraction was big bones and the matrix of the bones sand with a certain amount of organic matter in it. And so we went and collected the material whilst they were just about to fill the hole in and I was in the bottom of the hole at the time when there was a hopper of liquid concrete suspended over my head, dribbling concrete all the time, so that I finished up looking up looking like one of these monsters from outer space being totally encased in sort of semi-congealed concrete. But I collected the stuff in big bags and fished the bags out and as I came out of the excavation they pulled the chain on the hopper and the whole thing filled with liquid concrete, so it was a knife edge thing. The person who alerted me to it was Anthony Sutcliffe of the Natural History Museum. It takes time to remember some of these names but he – he was interested in the bones, and therefore the beetles in Trafalgar Square as a by product, would you be interested in some of the mud that goes with these bones? Not that I should do this primarily but just an afterthought. Oh, and opposite the British Museum – sorry, opposite the Natural History Museum, it used to be called the British Museum in those days, at the Ismaili Centre they had another excavation on the same principle, this time looking at the middle of the last glaciation. And a channel in the deposits of the Thames and the Ismaili Centre produced a fantastic array. In one channel, which was only about, oh, not quite two metres high, at the bottom you had Arctic beetle faunas and a layer like this, and at the top of the same channel an entirely temperate beetle fauna, so you were looking at a square wave again. It didn't go from gradually cold to warmer, we

go from cold to warm, snap, in one channel in the River Thames, from somewhere in the middle of the last glaciation. So London must be crawling with exciting sites but you have to be there so quickly that if you blink you miss them.

[03:33]

*And in such a site, or in this, or in the site of Trafalgar Square, how do you collect the samples in bags in such a way that you can remember precisely where you've got them from sort of horizontally and vertically? You know, how do you retain the –?*

Yeah, well, there are two sites that I mentioned, one is Trafalgar Square and the other one is the Ismaili Centre. In Trafalgar Square you had no option, you just had to take a shovel and there was a deposit with the bones in it and I just filled plastic bags with it, big fertiliser bags. In the case of the Ismaili Centre, Anthony Sutcliffe had been down there in great detail sampling the channel because he'd got more time. Where one was virtually a rescue job, the other was a carefully contrived excavation. And layer by layer there were sands and clays alternating with one another in the channel in the Ismaili Centre and these were collected at five centimetre intervals all the way through, in large bags at each – each level. So two completely contrasting field techniques, one is rush in and grab, and the other is take your time over it. And the beauty about the excavations in the Ismaili Centre was the – we were given plenty of time. And once again I must emphasise how Anthony Sutcliffe, who had a terrific eye, unfortunately he died shortly later but he was a very valuable man. Well I'll just say this much, that since his death I have had nothing from the immediate London area that I can think of. I might find something later but I can't imagine.

[05:23]

*And what were the key findings from the Trafalgar Square site from the bags of sediment that you collected?*

Firstly, it's never been – the whole flora has never been published, so it's been referred to quite often but I tell you now that the – many of the beetles were associated with large mammals. They're dung beetles, and elaborate dung beetles are

beautiful things, terrifically coloured, you remember me mentioning the colours? Brilliant colours, absolutely lovely things like little jewels. And these dung beetles are presumably living on the by product of the elephants and lions and other things of that sort, and hippopotamus in particular. These are southern European and suggesting that – and there were huge – other things too. The whole beetle fauna was very, very beautifully preserved, and so long ago that in a way that if it had been found now I think I would have treated it more efficiently than I did then. But it's said that the climate, back to the climate, the climate was at least three degrees warmer in July than it is now. And the emphasis I would like to put onto this, at least, could have been a wilderness. So the last interglacial, this is from – now we think it's about 120,000 years ago, the last interglacial was substantially warmer than the present day.

*How was this data arrived at for these Trafalgar Square sediments of 120,000? Is this dating or correlation with other –?*

It's correlation with others effectively, but they – it does seem very likely that the last interglacial was characterised in Britain by a very strange thing, and that is the commonness of the hippopotamus. The hippopotamus lived in Britain, in England, as far north as Leeds, Victoria Cave I think, and this itself implied that the climate was rather warmer than it is at the present time. But the Trafalgar Square deposit was not dated specifically but stratigraphically it is – it fits in with the last interglacial. And the occurrence of [coughs] – excuse me – hippopotamus also does suggest it was of the last interglacial. And there's another curious thing about it. In spite of the fact that it was very warm [coughs] – excuse me – so far we've not found any evidence of human occupation of England at this time, yet it was – yet it must have been absolutely beautifully balmy, like the Riviera, you know. Bags of animals to eat, a lovely climate, plenty of habitat, no people. That's another puzzle, I don't honestly know what the answer might be to that.

*And so we can imagine, how deep was the hole that you were in with the concrete poised above you?*

Oh, ten metres. No maybe – oh come on, let's – it felt like ten metres, I'll put it that way, but it was of that order, it was a long way down.

[08:53]

*Thank you. And could you tell the story of the origins of work at another key site, and that's Brandon in Warwickshire? This is a site which you published the fauna on in 1968 but, yes, so if we could just start off with how it occurred that you were at that time.*

Well, this is back to Birmingham and to the – the gravel pits at Brandon were very extensive and many of them were cutting into a low terrace of the Avon, and these every now and then hit organic deposits. And this was the – because it was fairly close to us and they were constantly being visited by students looking at the gravel, looking at the geomorphological context, we found that once again what the locals thought of as a black seam, in other words a pond bottom sediment, this time dating from let us say the middle of the last Ice Age, call it, 40,000, it's probably a little less – well, it's less than 40,000 but not much, years ago. And this was again another – just an opportunity whilst the gravel was being extracted to sample this black organic mud.

*When you say locals thought of this as a black seam, who were the locals?*

The gravel pit men. The men on the drag line are the chaps who know everything about it, the people in the office know far, far less. The chaps you wanted to talk to are the people out on the excavators. And they could see this black stuff, and quite often the black stuff was really a nuisance in that it messed up the quality of the gravel because it was clayish, muddish, dirty stuff, and quite often you left it so you can find it on the bottom of the pit after they've scraped the layers of gravel off the top. So again, it's fortuitous thing, what they didn't want we were trucking off site and making good use of.

*And can you describe in practice how you went about working at this place, including a sense of how long you're there, how many visits to it was necessary?*

It's too long ago, it – really I can't think of the – in that sort of precision. Erm, numerous visits, maybe ten visits or something like this, but some of the visits of course were totally fruitless because it was only when you get there or just happen to be that it was freshly exposed that you really could get decent sized samples. But again, the samples had to be in context, so again you could find the mud but if you find it just lying around the floor this doesn't tell you anything. You have to find it if possible in the actual section of the gravel, so usually near the bottom of the pit. I can picture it as easy as pie but I can't remember the sort of details.

*When you picture it what do you – what are you seeing for someone who hasn't been there?*

An ocean of dereliction, unbelievable piles of gravel as far as the eye could see and it looked just as if, you know, there'd been a huge tornado through it. So these gravel pits are enormous places, always with big drag lines.

*What is a drag line?*

You know, a bucket on a string, [inaud] big excavators pulling out huge quantities of gravel. And vast areas of the country that looked as if it had been totally despoiled. They do return it, much better when they flood it and turn them into nature reserves.

[12:59]

*Given that, as you say, timing is important, to what extent did you have people local to these sites alerting to you when, I don't know, a suitable section had been exposed or they've just started working on the end of it and have you had a look? Or did you have to literally arrive and have a look to see if it was a good time to be there?*

Mostly just exploratory, most of the time you could just call in and say – and have a look. We were told occasionally of exciting things but nearly always it wasn't a matter of saying, there's a good exposure of something which you might be interested in, but we've found bones. Bones were the indicators and mammoths in particular

were so spectacular that the occurrence of mammoth bones in these gravels was a frequent occurrence. Sometimes we went to pits where they'd been finding mammoth bones and woolly rhinoceros and all the rest, and never said anything to anybody, and there were stacks of them lying beside the conveyor belts. And you know why they were lying there? Because they were contaminating their gravel. They used to find the bones were a nuisance, so the man's job was to tweak the bones off the conveyor belts and leave them to rot. And on several occasions I said, well, how long has this been going on? Years and years and they'd not told anybody. So ... rather rarely were we actually informed of anything that didn't start off as being a bone. Somebody's found a tusk and we go down there and we find out other things as well.

[End of Track 7]

## Track 8

*Could you talk about the nature and extent of communication you had from religious believers while in post at Birmingham?*

It was very limited really, only – I didn't get much sense from various fundamentalist groups. As an example, I got the Creation Research Society sending me all sorts of things which really I suppose – they may well have heard that in fact my beetles didn't show much signs of evolution. And since evolution was one of the great targets of the fundamentalists they sent me literature but I still didn't quite come up to scratch because although I didn't have much evidence – we, have no evidence of evolution in the Quaternary, nonetheless the notion that the Quaternary could be over a million years old was appalling to them who thought the world was created before 4,004 BC before nine o'clock in the morning or whatever it was. So I used to get strange – these type of strange communications. Occasional telephone calls from some reason or other which people felt necessary to tell me that I was talking nonsense. And again, this is fundamentalism, so that I got odd periodicals, odd telephone calls, and odd students who took my palaeontology course but decided to tell me beforehand that although they would listen and although they would do the exams, they wanted me to realise they didn't believe a word of it. And I have to say this, that they didn't do very well in the exams either because whether or not conviction mattered in this respect, I wouldn't know. So all different sorts of ways in which religious groups impinged, most of them on evolution, most of them on the edge of the earth, I suppose because in fact that they had some idea that the bible should be interpreted absolutely literally. That's – if you like that's the sorts of people who'd contact me.

*And how did you respond, for example, to the telephone calls?*

I wish I'd got two telephone calls simultaneously and then I could have put the two speaker together and let them run because they rattled on and on. I don't have to respond, I just – you know, the conversation is going on and on and on and on with no opportunity for me to respond at all. On the whole I just said thank you very much

and put the phone down because what are you going to –? Since rationality wasn't involved you can't have a logical discussion with somebody who's already emotionally committed to a particular position. You don't want to rock their confidence in themselves, so you don't want in fact to, what shall I say, sort of contradict them. Apart from the fact that it probably won't work, it probably won't have any effect at all, so the only thing to do is to say thank you very much and put the phone down. The alternative is when you have fundamentalist religious people coming to the door and talking about the pace of modern life and anxiety and all the rest of it. And I know one sun – lovely sunny July day and it was a Sunday I think, I can't remember now, and my elder brother and myself were leaning against the front gate feeling very relaxed and along comes some religious group trying to persuade us that in fact that the world was coming to pieces and that anxiety and desperation was everywhere. And we were trying to persuade this religious person that it actually wasn't as bad as all that after all. And they brought the subject around eventually of course to evolution, 'Do you believe in evolution?' to which I said of course. And they said, 'Well, what's your evidence?' I said, 'It's in the garage, do you want to have a look?' And they never came back. So if you want a method of deterring fundamentalist visitors may I recommend that you say that the evidence is in the garage and see what happens. But those are variations on a theme actually.

[04:01]

*Thank you. Can you describe your relations with your parents as an adult? We've sort of left it where you go to university really and I wondered about, particularly about, the sorts of things that you noticed about your parents from the point of view being now an adult so you're able to be a little bit more – I don't know, a little bit more critical or a little bit more comparative about them in relation to other people. And what did you sort of learn about their characters, seeing them from –?*

I think that we have to take them separately. My mother was much more simple, she was in fact a very intuitive general practitioner and a religious lady who therefore felt my work on fossils, particularly anything to do with fossil men, was almost impossible for her to adjust to. Therefore I remember on one occasion when I was going to take the family up to our home in Cheshire, my mother said how nice it

would be to see you but I don't want to hear any of that nonsense about fossil men. What she was doing was setting up her stall. She was saying, yes, we'd like to see you but I don't want to become involved in the discussions about your science. It's like being – adopting a rather, what shall I say, slightly risqué sort of profession. That's putting it sort of mildly. My father, on the other hand, had completely different views. Very scientific in his ways of thinking but also very practical. So my father was very sceptical about me being an academic because I think his upbringing was largely to look at practicality. One of his ancestors I think, father or something, had been an engineer, and engineers apply science, medicine is applied science. And because at the time I was working on things for which there was no obvious application he saw it as a waste of time. In fact at one time he actually said, you know, 'This university life,' you know, 'why can't you get a proper job?' And a proper job, explanation for things, satisfied him but he felt somehow that I wasn't fulfilling the conditions which presumably he'd paid for during my education. So I was letting him down a little bit but – so that he'd been – he was very, very practically minded and I wasn't, and I suppose in some senses I was therefore a disappointment to him.

*Do you remember how you felt when he said this sort of thing?*

Yes, there were two sorts of things. First of all, when you're an adolescent you go through this phase of not getting on with one parent or the other, in my particular case not with my father. And then I went to Keele University for my first job and I came back to a completely different relationship with my father. And I remember my father – I came into the house and my father said, 'Would you like a beer?' Now I'd never heard him say this before 'cause he was nearly always telling me what to do, and to ask me whether I would like a beer. I suddenly realised who am I talking to? I'm talking to a different man. So this was the usual business of adolescence, having to go out and come in again. And as far as I was concerned my relationship with my father after that was on a much more adult basis but scientifically I think I was a disappointment.

[07:46]

*And can you say something about the way your mother and father were similar or different as GPs in their approach?*

Oh, totally, and my mother being an intuitive GP just went entirely on hunch. She felt that in fact she would diagnose instantly, and nearly always correctly, what the problem was almost from the foot of the bed, you know, without much in the way of enquiry. My father being scientific would spend a lot of time – he had his own little laboratory and he would do all sorts of things like analysis of blood samples and discover in fact what relationship between white blood – white blood corpuscles, red blood corpuscles as well, lymphocytes, leukocytes, and all the rest of it. My mother didn't even look down a microscope; I don't think she knew how. So one of them was totally scientific and the other was totally intuitive. But sitting on a bus one day coming back from Macclesfield, I heard two people on – just behind me discussing the merits of the village doctors, i.e. my mother and father. And one of them said, you know, Dr Eileen, she's marvellous, she knows what's wrong with you straight away. Dr Geoffrey on the other hand is useless. He does all these tests and even then he doesn't know. So there is, you see, the general public's opinion of what constitutes good medicine is very different from what a medic – a doctor feels about the value of his work. My mother was an instant diagnostician, my father thought about it much too long for the patients' satisfaction.

[09:31]

*And what was your parents' view of your sort of relations with animals, your sort of rearing of animals and looking after abandoned –*

*Ah, well –*

*And falconry?*

Oh, well, my mother was – didn't like birds, my mother was frightened of birds. Her view of birds was a sort of – that they were nasty things that were best kept at arm's distance. Er, so my mother was terrified of all birds, and my birds used to know and therefore to torment her. For instance, when I had jays and jackdaws and things

flying around in the garden outside, these birds would fly into the bathroom for instance when she was having a bath, realising that this was the best way of getting a great shriek out of my mother, which of course I think was the object of their tormenting. So falconry wise, I don't – this fear of birds was something that in fact overrode everything so that she didn't – in fact she wouldn't understand this at all. My excitement at falconry really – or my enthusiasm with falconry really developed after my father's death, so I really haven't got anything of that. But my father kept laboratory animals or – so that the laboratory animals were working animals, it's like having a farm with a working horse.

*Your father –*

My animals were pets. My father had a different relationship.

*Your father had laboratory animals at home?*

Yes.

*What do you remember about the sight of those, were they were, how they –?*

Well, he had cages for laboratory animals, particularly white rats, because at one stage he was working on embryology. It was another of my father's enthusiasms, working on the embryology of the adrenal glands in rats. And ... I can't remember the details of it other than he kept, you know, there were large numbers of them in cages, for which I don't think I had much access, I don't think I had much access to these at all. But I did have my own things, you know. Every child has lots and lots of little animals like guinea pigs. Hamsters are popular now, I had guinea pigs and rabbits and the usual things like that, tortoises and ...

*Did your parents visit you as an adult? You talked about visiting them at Christmas and your mum saying –*

My mother – 'cause my father died really when I was actually – just after I left Keele and started at Birmingham. And my mother, yes, came to visit us of course. But

again, she was very busy, it was only when she had stopped being a general practitioner and actually retired that she came and visited us, yes.

*And what was her reaction to the sort of badgers and the deer and so on at home?*

I think abhorrence is the answer to that. I mean when my mother said – she would say, ‘Oh, I don’t know how you – how you can like such horrible things’ and she really didn’t like them. And it stemmed primarily from fear, she was frightened, primarily feathers. And I mean if you really want to frighten a phobic, a feather phobic, then try falconry, that – because it’s an intimacy between a bird and you, which is very, very close indeed. It really offended my mother, oh yes, she didn’t like it at all. But because I was her son, her beloved son, she would put up with it but it was only a matter of cringe at the same time [laughs].

*Do you remember your feelings when your father died?*

What do you mean? He’d been a sick man for a long time, so it was expected, yes. So in other words, it’s not as ... it doesn’t come as a shock, it comes as something which has been, if you like, looming for quite a while, yes. I don’t think I felt anything very seriously, incommenced by the fact that I knew once he died that was it, you know, it was the tail end of a process that I’d been seeing for a long time.

[13:51]

*Thank you. Could you tell the story of events leading up to collaboration with Tim Atkinson and Keith Briffa, how that started?*

Erm, well, I’ve got to go back prior to this.

*Yes, of course.*

Because I was beginning to see a pattern of climatic change in the late glacial period in particular, because this is the bit that really matters here because you’ve got a handle on both timing and of intensity. And by simply looking at the geographical

ranges of species and seeing how they changed on a huge scale, by looking at the sort of geographical areas where the beetles occur today and looking at the environments that climate played in particular of these areas, and then extrapolating from that to say those sort of environments also occurred in Britain, when these same species occurred in Britain, I was able to come up with a picture of climate change. And one day Tim Atkinson said to me, 'Why are you plotting your distributions on geographic coordinates, latitude and longitude?' To which I thought the obvious answer was that's because of what I've got, the literatures. And Tim said, 'Well, we could always plot them on geographical coordinates' sorry, I beg your pardon, 'climatic coordinates.' Instead of on geographical coordinates, on climatic coordinates. By that he means that the graph, instead of having latitude and longitude, had in fact got let's say the mean temperature of the warmest month in that – in those particular days with a temperature range between the mean temperature of the warmest compared to the mean temperature of the coldest month. We call that T range, temperature range. So there are two coordinates, one's called T max and the other's called T range. And it suddenly dawned on me that this was a much more sensible way of looking at distribution because you could directly read off for particular species what climatic conditions it finds acceptable, and also what conditions it found unacceptable. And for each species therefore you could plot what was the – an envelope of suitable climates. And this meant also that from the beetles point of view if areas occurred in the world which were suitable climatically but the beetle didn't occur this didn't matter because these would be all grouped together and condensed in these climatic envelopes, so that it produced a very, oh, coherent picture of the climatic conditions under which an animal lived. And not subject to the vagaries of geography, accidents of space and time, this island was inaccessible and this sea got in the way, and the usual problems that you have of geographical ranges. So that was an eye opener to me, and the interesting thing was that it wasn't just an eye opener, it suddenly occurred to me that this was the obvious thing to do because you can now stack in the computer database all these envelopes. For each species has an envelope, then you go to an assemblage, a fossil assemblage, and you extract from the database your envelopes, produce a simple program of overlapping, and find out whether it's a mutual area where most of them or all of them live. And so we could reconstruct past thermal climates in this sort of fashion, and we called it mutual climatic range.

[18:02]

Now the advantage of this is that we can now test it to see whether it works. By going to a modern fauna near to preferably to some meteorological station, treating the fossil – the modern fauna as if it was a fossil fauna, collect the information as if it was a fossil fauna, and then make the reconstruction, the mutual climatic range reconstruction, and then compare it with reality and see if they match. And to a large extent they matched with a minor amount of difference, which is probably due to the fact that we were rather conservative in our view of the envelopes. We were giving species too much credit for what – for their distribution because we preferred to err on the side of being generous than being restrictive. And the result was that they matched very closely but on the whole the mutual climatic range figures are less intense, either cold or warm, than reality. So when I quote mutual climate range figures, the actuality is that the actual temperature at the time was more severe than others, hot or cold since, than in fact my figures suggested. But that's how it gradually started, and it relied not only on this idea of mutual climatic range but also on research students doing the hard work of relating the, er, geographical distribution to the climatic distribution, and that took a lot of doing. And I would mention David Perry and Margaret Joachim, and between them they put together the envelopes which made the system possible. It's very easy to dream up a system, it's much more difficult to put it into practice. And so the people like that, particularly I say David Perry and Margaret Joachim, together made it possible. And without their work I think it wouldn't have happened, it would be a daydream. And from then onwards the mutual climatic range has proved a very, very powerful tool in paleoclimatology.

[20:42]

*Where were you when you say that Tim Atkinson said why don't you –?*

I cannot remember, I can't – I think it might have been at the UEA, the University of East Anglia, I think that's where it was. But I remember the time and I think it was one of these marvellous conversations you have round a beer in a pub, but that might be just a fantasy on my part, I can't be sure. It's a comfortable fantasy anyhow, it's nice, it's one that's nice to live with. It might not be true, I can't tell you, but it's how

I would like to think about it. And I tend to actually remember it in the way I like rather than the way it was.

*And the paper on this comes out in 1987.*

Yes.

*Does that help you to decide when you think this conversation took place?*

No, it was very much long – I mean it was much before that because the conversation which triggered it off was the first stage in a long protracted process. And the long protracted process was getting people like Margaret and David to actually do the hard work, and it took them several years to do it. Not non-stop because it was running concurrently with doing the PhD thesis in both cases but, erm, I would imagine it's five years before the publication. And it's to some extent – it's rather like Gilbert and Sullivan produced something magnificent in their operettas but fought like cats and dogs as individuals, and they disagreed on almost everything you'd like to think. There were fractious times when Tim and I didn't agree because something funny was happening and then we discovered, for instance, that some of the Met stations which we were using were actually on top of mountains, where is where people used to put Met stations in the old days, which are the most totally atypical. It's only when you look at one – there's something badly wrong with this but what it is? And it's a simple matter of altitude, and we were not taking much notice of altitude, things like this. You know there's something wrong but you know what it is, and these are times when I would have a discussion every now and then. We didn't quite get down to shouting matches but at times it was very close, with Tim. But this is what you need 'cause this is the way a technique develops, you do it, you find it's inadequate in some respects, you discover to what extent those inadequacies are real or imaginary, and then you rectify them. And all that is quite a time consuming operation. So if I say five years between the thought and the operation of that thought, that is an underestimation I think. I'm sorry I can't be more accurate about that.

*Thank you. And what Keith Briffa's in the –?*

I'm not quite sure, he was in East Anglia too, but I think he was the person – we provided the data and he transferred the data, if you like, to a computer. So Keith, as far as I'm aware, was involved in the construction of the database.

*So the computer wasn't at Birmingham, the computer that was running?*

Initially East Anglia. I think it was in – I'm pretty sure it was East Anglia, yes.

*Did you ever see or even use the computer system?*

Well, I used our own because when we swap them, you see, when you swap your programs.

[24:21]

*When did computers –? When did you start using computers at Birmingham? Again, very –*

I can't tell you that, I really can't. Right at the beginning they were cumbersome things. I mean don't forget that when I started there at Birmingham we had a computer building complete with humming wardrobe size machines with grey tin surrounds and the whole thing smelling of electronics, you know, there's that strange smell of electronics that you get, huge voltages of things. And all that did what a hand held computer would do today. The shrinkage of – in terms of the miniaturisation has just been enormous in the time. Well, we were always involved with that, we had always – long before computers we had things called punched cards. Terribly laborious business of having all your beetle data on cards with little holes in and little wires you put through, and then you shut the thing and the data fell out onto the floor. And this was a sort of mechanical way of doing what was so much more easily done later on by databases.

*So you were using computers with punched cards before any thought for the mutual climatic range –*

At the end I got so fed up with punched cards that I think I abandoned it long ago, yes.

*And what did the computer program for the mutual climatic range sort of look like on the screen?*

... The easy answer to that one, I could show you but I – I don't quite know what you're asking here.

*Well, I wondered for example, you know, whether it's a sort of series of graphs or is it a table of numbers or, you know –?*

Yeah. To start with each – you can call up any species and see its climatic envelope, any of these at any time. And therefore it can be modified when new discoveries are made which means that some occurrence falls outside its normal climatic range. Of course new discoveries nearly always fall somewhere inside that climatic range, so you can – so maps you can – then each species is given a code number. Then you can arrange it so that your fossil assemblage, consisting of end species each of which has a code number, is then fed into the program as a sequence of numbers. Each of these numbers of course represents on the database an envelope. Then through a certain processes of overlapping, what you do is each of these numbers conjures up a map and these then are overlapped, and you finish up with numbers, T-max for the mean temperature of the warmest month, as measured on a Stevenson's screen I ought to emphasise. This is the macro climate in a way or T-min, which is the mean temperature of the warmest – of the coldest months, i.e. February and January, and these just come up as numbers. So maps are available to be modified. Each map, each species map, has a number. These are then fed into a system which can enable them to be all overlapping with one another, and these just come up with a figure which is the area of mutual overlap. And we normally consider that if it's less than ninety-five per cent of overlap it's unreliable, so we like it to be 100 per cent if possible that the end species evolved in the fossil assemblage have an area, a climatic area, which is where all of them live. Okay?

*Yes. And I think that is it so that certain species are more useful for reconstructing past temperatures because they're more fussy about temperature? So certain species are useful in this and certain species are a bit too sort of floppy in the –?*

Yeah, absolutely, that certain species are clearly valuable, which have a smaller climatic envelope than ones which have a universal climate. I have a beetle species, for instance, a little fellow called *Notiophilus aquaticus*. Funny it has the name *aquaticus* but it's a Xerophile, in other words it lives in dry conditions, but that's one of the quirks of Linnaean classification. It lives high up in the mountains of Scandinavia and at sea level in North Africa. Well that's not terribly valuable from the point of view of trying to differentiate sort of climates, but I don't make the choice about which I like and which I don't like. The moment that you start to select species which you think are important, and thereby neglect species which you think are unimportant, then you're introducing personal selection and personal bias, so we use everything. That fact that some of them are not really adding very much is – is in my mind unimportant because I have not done the selecting, the computer program has done the overlapping. So although I know some species are more valuable than others when we come to making mutual climatic range we make no difference between those which are, oh, very, very restricted in their range and those which are obviously universal.

[30:24]

*What do you remember of the response of other scientists to the Nature paper where you for the first time showed this method being used to reconstruct –?*

No, it's really interesting this because the response – and let's go back again a little bit. The response to my versions of the climates that I've done by simply eyeballing the data were highly sceptical, at least in some places were sceptical. On the whole the sceptics did try to conceal their scepticism from me at times so that I wasn't terribly – I'm not a terribly good – a witness on all of this. But as soon as it could be repeated on a computer it became credible, as if somehow it has to go through a machine rather than go through a brain and somehow – and therefore it was much more acceptable and lots and lots of people then were interested in the mutual climatic

range story. I would single out people like John Lowe at Royal Holloway who was very, very helpful and Mike Walker at Lampeter. People who really did help enormously at every sort of level, at least in part also by saying, yes, we think this is the way forward, so I was very, very encouraged by their activities. But on the whole sceptics didn't come along and challenge it because once it had been done with a computer it's much more difficult to challenge the computer, if you like. And it became even more convincing when the Danes and their ice cores start to produce a similar pattern of change, i.e. sudden change, intense change. And this added, if you like, confirmatory – a confirmatory view of the climatic change at the end of the last ice age which so looked so like the mutual climatic range, and indeed the eyeball story too, that in fact credibility started to swing in our direction.

[32:44]

*Why do you feel that it's the computer representation of this that was the thing that was convincing?*

Because it's repeatable. You see if my brain has done the job then it's not independently verifiable, but if you have something like a computer program and a list of species then a lab technician can press a button and come out with the right answer or come out with an answer. But it's only been – if the process has only been done by my brain there's nothing you can do to press that appropriate button. So it's the repeatability I think that really helps to convince people.

[33:30]

*And the Nature paper comes out in 1987. It's not long after that, for example, the intergovernmental panel on climate change gets going and I wondered to what extent you were beginning to be approached by what was becoming a very big business almost, the interest in climate and climate change and evidence for and against – to some extent the politicisation of it, to what extent you became asked to be a witness for things like the IPCC and so on.*

Well, surprising, not at all is the answer to that one. Very, very little of my beetle data has actually been used. Erm, I think primarily because the committee on climatic change is interested in prediction, and future prediction, and to a large extent palaeoclimatology has been rather, what shall I say, subservient to physics and models and that sort of thing. If you look at the reports, the models have a very, very strong part to play. And palaeoclimatology has been on the whole I think on the back burner a bit, and then with it goes of course the story of the beetles showing sudden climatic changes. Much more relevant of course from their point of view is – are the ice cores, so that in a sort of way I've been rather disappointed that our work on beetles and climate hasn't been used more. But I suspect also that you can find the same response if you talk to palynologists. They would say, yes, but we've got all this data that has been barely used, presumably because it's difficult to use it in the predictive sense of the word. And the politicians ask for a prediction, what's going to happen, and the modellers provide just this. So I've been marginalised, and so I haven't felt I've been involved as much as I would have liked to have been.

*Have you made any attempts to become more involved in it?*

No, really, no no.

*No. Why do you thin –?*

I've been too busy actually if you really want to know [laughs]. I've so many projects on the go with exciting ideas that are still developing that I don't want to get involved in the politicisation, if you like, of my science. It's been recognised for what it is but not in the – in the realm of trying to assess future climates.

*Do you read these sort of reports, IPCC reports?*

Yes, I do. Upstairs, lots of them, yes.

*And –*

Some I don't understand a word they say and I find it very difficult sometimes because models use such obscure languages and approaches. And I must admit that my mathematics is a wee bit weak, so I'm not into the sort of symbolism of quite a number of equations which I can't make head or tail of. But once again I've not made a lot of effort to try to rectify the situation.

[37:00]

*And why do you think that the ice core data has been used by more, for example, IPCC, this is what you said, than the palynological data or the beetle data, why?*

Well, I'll tell you why. The ice core has – the ice core data, as is the ocean core data from the deep ocean record, has a huge advantage over the terrestrial record, whether it be pollen or beetles or what, in that they have long continuous records of sedimentation. You've got to think of snow as sedimentation. Whereas ours is spasmodic, it is little bits and the attraction of the ice cores in particular, or the ocean cores, is long continuous recording, and that's the main excitement here, and the precision now with which they can allocate particular events in the ice core to some chronological sequence. For one reason or other you have to compare it with dust in the ice core so that you can compare it with known volcanic eruptions, so dating the Holocene can be done in that fashion. Or in fact, to go to other things, comparing ice cores and so you can – because you're nearly complete in the records you can therefore match, middle match if you like, the ice cores together. The problem with terrestrial records is the gaps in the sequence which make correlation from one to the other controversial. And although we have the notional sequence of the ice core record we have to plug in our record where we find it most convenient or most likely. And of course we tend to change our minds regularly. You know, that nice definition of a scientist was somebody's who's trained to change his mind, and believe you mind Quaternary scientists are changing their mind all the time because different evidence arises as to where you should plug into the notional sequence, i.e. the ice core sequence, this particular event or that particular event. Where is the switch in interglacial? When we think we know that it's probably – the further back you go the more vague the relationship becomes. So that's why the ice core has become a critical position, it's continuity of record. The next thing is the advantage of the

terrestrial record is that the climate we're talking about is actually a terrestrial climate and not something that goes on in the deep ocean cores or are necessarily in the high Arctic, so I think the two are complimentary. I think you need the continuous record to provide you with the notional framework and the snippets of information we have from the terrestrial record. Sometimes nice long sequences of several – of interglacials and glacials but nearly always they're effectively spot events which we then have to sort of fit as best we can into the Greenland core.

[40:28]

*Is the kind of disciplinary science involved in the different techniques a factor too in that ice core work, for example, Nick Shackleton was a physicist who worked on this and, sorry I'm talking on the marine core, and ice work again would involve mass spectrometry of bubbles, and so those visits as well? Is there – I mean is it significant that the two you think are most closely related to IPC sorts of things are, in other words the ice core and the marine core, is work done by physicists, and terrestrial work tends to – we're talking about biologists and geologists and so on, is that a factor?*

I think there's a great deal to be said for that and because in a sort of sense if you've also got something which can be statistically analysed then you also have an advantage. And in the ocean work particularly you can statistically analyse the coming and going of various indicators in the core. And when we look at much of what I can look at, the statistics – the statistics which we have are much vaguer. So we're back again not only to continuity of record but precision of record, and I think this is quite an important reason why in fact the people who are trying to understand future climate are requiring actually precise records, both in terms of intensity and in terms of chronology too.

*Are you aware of any models –? You say that your data's been used rarely but that implies that it has been used by modellers but are you where in models beetle data has been sort of inserted, however this kind of thing becomes inserted into a predictive model? Is there a particular department in the country, or in another*

*country, or a particular modeller who you know has used, for example, beetle data in ...?*

I have to admit that I don't think so but again I may be not your best witness in this respect. Er, maybe this is for the next decade, you know, I feel somehow or other that we're still ongoing here. I always feel that the discussions about this are almost premature, that more information is coming up all the time. To give you an idea of what I mean by this, we're already looking at climatic events at the end of interglacials. And what I see at the end of interglacials, like the last interglacial or like earlier ones, is considerable periods of instability. Now quite a lot of people are of the opinion that the present interglacial has about run its course. Now if those periods of instability at the end of interglacials are general and not specific then it's really important that we know about them. In other words, I can see input in the future into trying to understand the nature of the termination of interglacials might be a very exciting area forward. But we're only just beginning to understand something about the climatic oscillations during those final stages of the interglacial - a final stage of an interglacial, that's right.

*And this –*

Holocene is very funny.

*And this is, I think what you were talking about off the recording in terms of the flickering.*

Yes.

*Yeah.*

In other words, the tendency is that during that switchover, and remember we talked about North Wales, about it happening exceedingly quickly. And there's more than that because in North Wales and in other late glacial locations we don't only do it once at about 13,000 years ago, we did it at about 10,000 years ago. It's almost exactly the same thing twice. And when you get a sudden change like that occurring

twice within a few thousand years of one another, you wonder does it occur like that elsewhere. Answer, probably. At the end of the last interglacial I think we flipped, so the transition between glacial and interglacial, either the one way or the other, either from glacial to interglacial or vice versa. So it does seem to be instability may well be reflected in a very intense flicker of climate. And we now know something about the intensity of that, in other words going from glacial conditions to interglacial conditions. Let us say it was in less than a century, that's a terrifically fast change but to have it doing several times over, this suggests that this may be a generalisation, not a specific one.

[45:31]

*Thank you. What I'd be interested in now is to explore your role not as researcher at Birmingham but as lecturer. And I think – I gather that lecturing at Birmingham and teaching tutorials started after the first three years of being a research fellow.*

The research fellow is expected also to lecture by the way. I mean although the term research fellow does suggest that in fact you're doing research and nothing else, oh, I was pressed into service as teaching in both practical and in lecturing and in taking field courses. So it was all – in all ways it was a sort of junior lecturing post.

*Well, I wonder whether you could give us a sense of the work involved in preparing and teaching, preparing for and teaching, undergraduates and possibly an indication of how that's changed over the period. But let's sort of break it down and think about I suppose teaching in the late '50s and '60s and the sort of courses that you were teaching and your – sort of your priorities I suppose in planning and preparing for this teaching.*

Well, I tell you what one of the interesting – we were allowed an enormous amount of freedom [coughs] – excuse me. I was given the sort of task of teaching the first year palaeontology course but I was not told what to teach except that it had to be first year palaeontology. So I was allowed an enormous amount of freedom in thinking what I should do in presenting the course, and at no time was I ever assessed. Nobody came and sat in the audience and said your handouts are inadequate or something, so that

the only test of my skill as a teacher was the exam results at the end of the year. At no time was my teaching skill being assessed during the course at the time, and this is rather different from the situation I found much later than this at the Royal Holloway where there was an inspector came round and quite honestly I was quite staggered, because being brought up as I was with a degree of freedom I never took lecture notes into my lectures ever. I used to do the preparation beforehand and could put the whole lot onto a piece a paper about as big as a postcard because I believed that in fact it you're trying to lecture to students that the appearance of spontaneity matters, and this is what I tried to cultivate. But when you see somebody sitting there taking notes about the inadequacy of my lecture notes you begin to get suspicious that we're on totally different tacks all together. So to begin with this lovely idea of complete freedom enables you to develop things which, if there'd been an inspector sitting watching you, you would never have done, so those days were marvellous. Mind you, lecturing I discovered right at the very beginning is acting. In other words, you put on a show, because if you don't the information isn't transmitted, so you introduce a certain amount of humour or the appearance of – once again going back to spontaneity, thinking out a problem as if you were thinking it from first principles. Purely and simply to illustrate how this process is actually done in spite of the fact you've done it three or four times previously, so it is acting but it's not – it is just as important that we recognise that actors convey information, lecturers convey information, that has been preceded by a lot of hard work. And I think this is what came home to me very, very early on, if you read your lecture notes, regardless I've got the lecture notes on it, and some of the lectures I've heard have been pretty appalling that have been read out, it is far, far less efficient in transmitting information than if you talk person to person, lecturer to one of the members of the audience. So it's this degree of informality that you build in, even though it is – oh, it is rehearsed informality that I think was very important in the early development of my lecturing.

*And how large an intake were you lecturing to? For instance, the first year course, how many?*

Well, you see there were two sorts of people. There were the honours geological students, and it was marvellous, in those days we would have half a dozen or a dozen honours students, as many teaching staff as there were honours students –

*Right.*

It was extraordinary. Now there were also subsidiary people. People taking, dare I say it, geography degrees who – one of the hoops they had to jump through was that they had to do some geological subsidiary course. And then engineers occasionally, very good. On the whole the engineers and the miners didn't do much palaeontology but every now and then you found that you were teaching them in the field or something like this, so that on the whole you had twenty or thirty people in a class doing the early – early part of the undergraduate course, not much more than this. Yes, occasionally we were up to thirty or forty if you add in the subsids.

[51:26]

*And to ask this, only because we were all talking about it off the recording last night, but I wonder whether you could say anything about the approach of male and female undergraduates on the course as you –*

Oh, this is dangerous stuff, dangerous stuff. In other words, you can talk about it off the record perfectly happily and get away with it but there is a difference in my mind between the girls and the boys at the undergraduate level. And it's always very unfair on the male undergraduates to be competing against girl undergraduates because the girls are on the whole very, very much more, oh ... efficient in so many ways. If you give them a lecture, sorry, an essay to write, let us say, the girls get it on time, the chaps are still thinking about it. There's a difference, the consciousness on the part of the girls was just – they worked hard and got things in on time and did what you asked them to do, whilst the men were more adventuresome but much more difficult to control. So the difference between the two was I preferred to teach the girls every time because if you say do this, they do it. If you say to the men, do it, they think about it and then come up with some inadequate excuse for why they haven't done it yet. So I know this is a gross generalisation but I often feel that in fact, you know, it is unfair to have somebody as conscientious as the girl students, not all of them, but as conscientious as them pitted against the ingenuity of the male students in evading doing just that. [laughs] Now I don't think I need to say anything more about the

difference because with all generalisations like that there are always screaming exceptions, and there were of course at my time at the university. But to give an example, one of the most conscientious research students I ever had was Margaret Joachim. She was so conscientious and so good at it that you didn't even need to suggest something twice. And I won't say that in fact there was a – what shall I say, the reverse of this penny, bolshie bloody minded male students, but I did feel all the time that I had – she would get things done superbly and all the time. Ann Morgan did the same, she was always very, very conscientious but rarely came up to me with some brand new idea. People do come up with brand new ideas but these came more from the male students I thought, than from the female students. Once again I don't like generalising because you can always think of exceptions to this general rule but it's curious, there is a difference between the two, and in results too. Girls had very, very good final year results. Girls did very, very fine PhD theses, I'm not saying the men didn't but the girls did very good ones indeed.

*Do you have to hand an example of a male research student who did come up with a sort of original idea or at least –?*

Oh yes. Yes, I mentioned Paul Buckland. Paul Buckland did a degree in archaeology and geology and he had one, or he has because he's still functioning, and he has the most extraordinary retentive memory with instant recall of something he's read twenty years ago, you know, which I always envy because I have to look things up and Paul can just simply remember things. And he is one of these chaps who fires off quick ideas lots of times. So he's a nice chap to remember because he – not just because of this extraordinary memory but the ability to elide things that he's read long ago. Very enviable, by the way, I'm very envious of the fact he can drag up information from the long, long past and connect it to something he's read yesterday, so I put him in that category, yes.

[55:56]

*And how did teaching, the demands of teaching, change from the sort of late '50s to, you know, your retirement from Birmingham, the sort of – the nature and content of teaching or the expectations of you?*

The worst – the worst change in my mind was simply numbers. The sizes of classes had got to such an extent that it was really impossible in my mind to teach, particularly in the field. If you take a party of students in the field, if you have more than ten they can't – you can't instruct, observe, in the field usefully if you've got thirty, forty people, maybe more. Because there are people who haven't yet caught up and there are people on the periphery who just haven't heard what you've said, so that it is just simply the numbers of students. I was appalled to discover when I went to Birmingham recently that some of the practical classes have got to be doubled up or even troubled up because of the numbers of students. Well, once again this destroys that very thing I mentioned about spontaneity. If you're in the field and you have to repeat something that you've done ten minutes ago for the stragglers who are just catching up, spontaneity has gone out of the window. So it's very much more – it's very much more difficult to teach now because the sizes of the classes have changed. The other thing that I suspect is that the quality at the top end hasn't increased, we've just grown a bigger tail. And personally I find it much, much, or did find it, much more satisfactory to teach enthusiastic people who are not only enthusiastic but able as well than having to continuously field flaggers who are finding it difficult. So I think numbers have been a problem, not only in simply the repeatability, you have to give classes over again, but also I'm not at all sure that we have really increased the average capacity, average sort of intellectual capacity of the student body. Now this may be talk through the top of my head but I feel that it increased the mediocre but not really increased the brilliant. And I'd be more than happy to be corrected on that any time and anybody ever contacts you on this [laughs].

*And when did you – when do you feel that numbers started to get too big in that way?*

[Sighs]

*'Cause if at the beginning you were having six or twelve honours geologists, when did things become a bit ... a bit big?*

Erm ... this was an insidious thing that crept on us. Because remember that the universities sort of – the departmental funding was based often on FTEs, full time

equivalent students, and the temptation therefore to admit more and more people because thereby you've got more and more credit in some sort of financial sense was something that every department I think increased its numbers. Whether there was ever any justification for this in terms of employment, I doubt very much, but we were churning out eventually more than – I've forgotten the figure now but more than 100 graduates in a year. I would awfully like to know what's happened to them since but I don't. So I'm now a little bit out of date in that I had retired before the real big bulge of intake took place, so I don't know enough about it to make any sort of, what shall I say, sensible comment on what you're asking.

*When did you retire from Birmingham?*

Twenty years ago, but I have to say that I only retired partially, so I was partially employed to give odd lectures, and then Jim Rose down at Royal Holloway, there was a job in the geography department, wanted me to go and give courses there, so he got my – an honorary chair down at the Royal Holloway. And therefore although I was officially retired I was still doing quite a lot of teaching until a decade or two ago.

[1:00:55]

*And could you talk about other changes in university life over the – what's quite interesting is that you were at Birmingham for quite a long continuous period, from the mid '50s to round about 1990 if you're saying it was about twenty years ago. And you talked, for example, at the beginning about the seeming informality of it and the freedom, the handing over of the toilet key as the only indication that you'd been appointed, Fred Shotton pointing out to you that you had freedom to decide what to – how to spend three years of research money. What was – from your point of view how did academic life change over that period?*

I think that when I first came to Birmingham the administration in the university was in the hand of academics, who I have to admit were not the most efficient at running a university, but they did it very well, rather like the – oh, the Gilbert and Sullivan one, the song, which went, you know, 'The house of peers throughout the war did nothing in particular but did it very well'. It feels somehow or other that there was a bumbling

along of the administration which worked, not to the satisfaction of the specialist administrators but in fact it worked. And the illustration of this was the degree to which, for instance, I never had a contract, no employment contract, no job description and the usual paraphernalia that goes with jobs nowadays. And then with the gradual diminution of the – of the British Empire, an awful lot of administrators returned from the colonies, I don't what you call them, the dominions I suppose, with almost nothing to do. And we got quite a lot of professional administrators employed by the universities, and the first thing they did was increase the 'efficiency', erm, put that in inverted commas several times over, of the running of the place. I think in a sort of sense that changed everything from the way in which mere academics ran the thing, and the way in which professional administrators started running the thing, and I think that is one of them. Looking back in a sort of generalisation I prefer the earlier form [laughs].

*What did you prefer about it? Why was it –?*

The total informality. I mean I don't want to start to make, for instance, confidential reports on my colleagues, to give you just a simple example, simply because I feel it's almost an impertinence. I was very unsympathetic to reporting to my overlords what my underlings were up to and doing, to such an extent that I really didn't want join in on this at all. One should, okay, assess but one doesn't want to have sort of league tables almost of quality, that I didn't feel – I didn't like to have my teaching assessed by students with tick boxes, good, bad and what have you. It's the whole business of – and I'm sure it's very important from the administrators' point of view in order to assess, but what I wasn't, you know – sorry Beryl [interruption].

[End of Track 8]

## Track 9

*Could you say something of your memory of two linked things? One is the introduction of geophysics into geology departments, in particular the Birmingham geology department, and the linked effect on the discipline of the discovery of plate tectonics in the late '60s.*

Yes, first of all I'm not the best person to talk about this because this is far from my speciality, but as you'd imagine you can't live in a department like the Birmingham department that didn't have some of it rub off on you. And so if we go back to pre-plate tectonics, when I was an undergraduate there was a barmy theory going around, invented by a chap called Wegener, who by the way was a climatologist, who thought that it looked as if the continents had once moved relative to one another. And this, though superficially attractive, particularly to geologists in the southern hemisphere who saw evidence of glaciers coming in from the sea where they couldn't possibly have done so, he was I think universally, erm, considered a crank. People thought, well, it looks a nice story but it can't be true. And the reason why it can't be true is very interesting, nothing to do with geology but to do with physics. Physicists told us that in fact there were no processes known on this earth which could shift the continents about like that, therefore because physics rules okay, geology had to toe the line. And geologists, particularly in the northern hemisphere, thought that this idea was really unlikely to be true. This is being as economical with the facts as I possibly can. Then the development of plate tectonics arose from the application of geophysical ideas, primarily of the oceans, using both boats and planes, to measure the palaeomagnetic evidence on the sea floor, to discover that in fact parallel with the middle ocean ridge was a series of stripes, if you like, of normal and reversed magnetism. And what was strange about these stripes on either side of the mid-Atlantic ridge was they were symmetrical. And I remember seeing that for the first time in Don Griffiths' room, he said, 'Just look at this.' And to my amazement it just looked magic, it looked impossible that here you have a process which is repeating itself away from a mid-Atlantic ridge. And that was the first inkling I had of plate tectonics, that not only was Wegener right but there was now a mechanism. And so the mechanism was that somehow the ocean floor was spreading from the mid

Atlantic ridge, hence on either side you get the same sort of pattern as the floor spread laterally outwards. I go back now to my first term at Manchester where our text book was Arthur Holmes *Principles of Physical Geography* and there it all was. The mechanism had already been known. Arthur Holmes must have been a genius because he recognised the fact that, yes, currents within the mantle could move the continental masses apart, and there's pictures in the book. This is long pre-dating the notions of plate tectonics, and therefore in a sort of way it suddenly all started to crystallise. Then of course the notion that on the continents you can measure the palaeomagnetic direction of where the magnetic pole had been as seen from that continent, only to discover that we're different. In other words, either you had two magnetic poles or the continents had moved relative to one another. And it was so convincing to see this that only then reading in papers about the way in which it happened, that the mid-Atlantic ridge, or the mid-oceanic ridges, were spreading laterally, pushing the continents riding on the surface aside. Now you can't go on doing this without consuming continents somewhere else. You can't go on generating crust unless the earth is expanding. The earth isn't expanding at that sort of rate, therefore it must be disappearing, so suddenly we have subduction; we have continental masses being driven underneath others, thus shortening the crust in some places, compensating for the expansion of the crust in others. And it all made so much sense because when I was an undergraduate we had mountain change, we had ocean deeps, we had strings of known earthquakes, for instance, around the Pacific Ocean, all these discreet entities. And suddenly instead of these being isolated pieces of information they all start to come together. And that was enormously satisfying, to have what – plate tectonics appeared as the, as if you like, the universal theory of the earth. As opposed to having bits of data it all latched together. And this fitted in very well with my way of thinking, as lots of biologists' way of thinking, that biology didn't just exist as a series of discreet entities but they were all interconnected. And so this synthetic approach that biology had been recognising in ecosystems and the like was also being mirrored in the geosystem, if you like, of plate tectonics. So you asked me what my opinion was. The answer is I was absolutely amazed to find that there really was a geosystem that explained lots of discreet things in one particular whole.

*Did it directly impinge on your thinking in terms of things like movement of species, knowing that the continents hadn't been in the positions they are?*

Not really, no, because all this takes place on a sort of scale very different in terms of time from the one that I was living in. I was living in a world of tens of thousands of years, or about, so hundreds of thousands of years, but plate tectonics is measured in millions and tens, even hundreds of millions of years. But there is a way in which plate tectonics does impinge upon what I do in that, for instance, the rise of the Himalayas and the Tibetan plateau clearly had its effect on the way in which the Earth's circulation of atmosphere goes. People like Bill Ruddiman could see this as one of the causes, if you like, of the comings and goings of glaciations. And therefore there was a sense in which it was relative, or relevant I should say, to what I was doing in that people were beginning to use the ideas as the link between the earth system and the atmosphere system. So once again we have this unification of saying that it's not just the existence of mountains but the existence of mountain atmosphere relationships.

[07:50]

*Roughly when was Don Griffiths appointed to the department as a geophysicist, the first geophysicist at Birmingham?*

Ah, I will tell you in a minute, about '54 approximately.

*And therefore appointed by Fred Shotton.*

Appointed by Fred, yes.

*And how was he and the geophysics generally regarded by existing geologists?*

Well, you see there's – there's a sort of tradition of geologists from meteorological maps of everything and these were brought up really on the idea that from discrete entities we have a geological structure, it must be mapped, it must be described in detail, and then you move onto another one. Geophysics when Don started was very

peripheral. It was slightly mistrusted I think because it was physics, not geology, and I may be totally wrong in this but geophysicists were really rather rare in those days. Classical geologists were very, very common and so that in a sort of way geology was one world and physics was another, and to elide them together was a little peculiar but it very, very rapidly became obvious that in terms of economics, geophysics, oil exploration and the like, geophysics was going to be the most – one of the most important factors in exploration geology. And in terms of understanding the Earth's processes, it was also a key thing to understanding them too. So the role of geophysics expanded exponentially. Again being outside my general area but as a viewer from the outside I was really rather envious of the fact that they'd got this universal idea and therefore to get back to my – to the climatic change, is to try to bring together the processes of geophysics if you like with the processes of the geological process – the climatological processes made the ocean core story so attractive 'cause it unified things again, brought things together in a long continuous sequence; and the ice cores. And to me these were – had the same sort of general feeling that you have where you begin to get a real grip of the subject which up to now had been piecemeal, now it's become general.

*And how did Don's presence in the department look different? For example, when you've talked about your office being sort of covered in mud [RC laughs] there was a clear sense that what you were doing not only was different from what any of the other geologists were doing but it sort of looked different as well. If you're going to look in your office compared to that of another geologist how would Don Griffiths' sort of set up almost have looked different? I don't know whether you had a particular laboratory.*

Well, they had a workshop and physics, geophysics, has much more in the way of obvious machinery of science, and this is terrifically attractive. And Sam who was the general factotum and made lots and lots of things, he was the sort of mechanic, lab technician and everything rolled into one, constructed marvellous models including huge sort of models of the earth in which you could shove the continents about and put them back together again. This was the fascinating thing. But the difference between us was whereas I was getting my hands dirty in a procedure which is

necessarily, as you hinted earlier on, rather a dirty procedure, geophysics was clean, it was mechanical, it was superficially very attractive. So the contrast was very marked.

*What did he have in his office or place of work?*

Oh gosh I can't remember.

*No.*

I can't remember in that sort of detail but I remember – I remember the lab had all sorts of extraordinary things, trying to model ideas and, as I say, the most exciting thing of all was to have a sort of globe in which you could start to move around the continents. Instead of doing it on a map, which is a projection onto a flat surface of a three dimensional continuum, you have a genuine three dimensional pattern and it was like a three dimensional jigsaw puzzle. I used to go down there and play with it, it was great fun.

[12:33]

*At any point over the time that you were at Birmingham did you consider moving elsewhere, looking for a post elsewhere?*

Yes and no. And one of my problems was of course my wife was a medic anchored really to both Britain because of qualifications which are British qualifications and don't necessarily apply in other countries, and also because very rapidly she became involved in the village practice which really meant that I wasn't very keen on moving anywhere because that would involve digging her and the family up and her relationship with her patients. So really that was one of the reasons why I didn't take up other jobs. Offered them but never tempted enough to actually change over.

[13:22]

*To what extent were you, I guess this is a sort of confidentiality thing, but to what extent were you involved in wife's work in sort of, I don't know, support, advice, help, practical help? I don't know.*

As far as the, er – as patient confidentiality goes, absolutely nothing. Fun yes, in different sorts of way, but nothing to do with the relationship between the patient and doctor, I knew nothing. But not unnaturally being the husband of the village doctor did rub off. I had status in the village but not in my own right but merely as Beryl's husband. So if I drove Beryl's car people used to be ever so cheerful and wave at me until they realised it wasn't Beryl and then they would unwave in a variety of elaborate fashions. So in other words there was a lot of reflected glory. I was the moon to Beryl's sun, had only reflected, which was the complete opposite of course of the scientific community where Beryl was my partner, in the practice I was Beryl's partner. But of course I had jobs to do like minding the phone because in those days remember doctors worked seven days a week, twenty-four hours a day, and so that I had to – I had the job of being a sort of doctor's receptionist to some extent and fielding embarrassing calls like people on New Year's Day saying can the doctor come and meet us at three o'clock in the morning? My child's got threadworms'. And you think, well, hang on a minute, where have you been all this time? So we, oh there were lots and lots of funny stories that go on like this but they don't tend to add much to the tale.

*Did people in the village know what – you say that in the village your status was sort of lower than Beryl's –*

Yes.

*But what did people know of what you did in the village?*

Very little, except that in the village there were of course colleagues. And Don Griffiths lived in the village, and his wife and family, and other people who were also colleagues of mine in the university. With the exception of those, nothing, and neighbouring – because we lived between the village of Romsley, and Belbroughton to some extent the children went to the Romsley Primary School and they had a very

jaundiced view of what I did for a living. But since there was no way in which the teachers' experience of life overlapped with mine there was not much of exchange of ideas, put it that way. There was a lot of exchange of doubt as to my sanity I think.

*Really, like what?*

Well, if you spend your time according to our youngest son, our eldest son, sorry, washing mud for a living, this doesn't carry much in the way of kudos.

[16:28]

*And can you give me your reasons for retiring from Birmingham when you did, at the time that you did? Why then?*

Well, the department had changed hands to a very large extent and this meant – we had amalgamated with Aston University and I felt the marriage was not a terribly easy one. And therefore when – because the staff of the two departments was being gradually pushed together there was a chance of me retiring for financial reasons, which I grabbed with both hands because I thought I could do two things, I could come here to this house, which we'd acquired a few years previously, which I rather liked the general ambience of the highland environment, and also it meant that I could carry on research to some extent because it's not terribly expensive to do my sort of research. I could do it without impediment of people interfering all the time for one reason or other. But it also permitted me to do a bit of teaching, and so I did quite a bit of teaching as well after I'd retired. So I had the best of all worlds as far as I was concerned. I thought this was the ideal gradual easing myself into retirement.

*The teaching following retirement, is that the Royal Holloway or –?*

To start with at Birmingham but Royal Holloway as well, yes.

*And so you moved – when do you see yourself as having moved permanently here to the highlands?*

It sounds an easy question to answer but far from it because we started off by doing occasional visits here. And our son was living here at the time with his first wife, and we used to come and go, usually during the vacation from university, etc. And gradually the – because Beryl was still in general practice she – we gradually spent more and more time here. Not easy to say, we've been here about ... the best part of twenty years now.

[18:38]

*And you may not want on the recording to give away your exact position but could you give a sense of where you are and the landscape and the things nearby?*

Well, when asked this question sometimes I'm asked, well, where is your house near to? And the answer's nowhere, as you probably know by now. The nearest town is twelve miles away and we live on the south side of Loch Tummel with about 100 acres of farmland on which we have sheep. It's run almost entirely now by my eldest son and his wife and we're surrounded by odd animals that we always have. I've got wild cats which I breed and put them back into the wild, polecats, deer, you name it, and others. We're very involved with active conservation locally.

*As I'm going to ask you anyway and you've just mentioned it, could you say more about the origins and development of your work in breeding and releasing wild cats, including a sense of what's involved for who would have no idea what's involved in breeding and rearing?*

Now that is a sort of general theme which has run through much of what we've been talking about, there's always a role of accident. And I was up in Caithness doing a bit of falconry with friends and the keeper, the gamekeeper up there, saw a kitten dive into a cairn of stones. And the stones were very large and he wanted to help with moving them. I said, 'Look, I'm not going to move these stones, I'm not going to help you at all unless I can keep the kittens,' and he was delighted. And so I was given two wild cat kittens. This was, oh, thirty, forty years ago now and from then onwards, every now and then they start to breed. I was given cats from other people who have bred them and it's gradually built up in that sort of fashion so that people

got to know. We've had cats, wild cats, that were too much or too difficult to handle and have brought them to me here. I've had injured cats brought to me, and even gamekeepers who've given me cats and said, 'Look, I don't want to destroy this but if you don't – if you don't take it off me I'll have to do something about it, I'll have to kill it,' it's a sort of emotional blackmail. What I used to do was use a bottle of whisky as my sort of currency and say one cat and one bottle of whisky. There was no discussion about the quality of the whisky but that's different but – and then I used to take it a long way away and let it go. This probably would have been illegal at present – in the present status of wildcat protection but from that time onwards I have been – always had my – a run of cats which have been reinforced by people bringing me cats. Almost all of them have been bred in captivity. When I say almost all of them, occasional cats that would have been difficult to release, too old or something odd about them, are probably wild caught. But when somebody comes and offers you a beautiful wildcat you don't ask him where he got it from and was it illegally picked up. So to some extent the cats that I've had may have been taken from the wild but I've not been too officious in my enquiries about them. Now then the problem, what do you do with the leftovers, the kittens that seemed to turn up regularly every year? And to my amazement I discovered that there estates, which for reasons that must be perfectly obvious I'm not going to tell you about, who were keen to have cats back again, either because they'd been eliminated through persecution or they've never had any, unless not in historic time. And so I started a release scheme and different ways in which the release can be done, either from just letting them go, which I don't like because I believe a naïve kitten of a year old might not survive in the wild environment. So in the wild environment they may never have survived anyhow. Or to put them into a pen where they could acquire the sights and smells of the local environment before coming to release them. But whichever system I used it's been encouraging to me to know that the animals have survived and bred, and are still there, so whatever the system, it worked. So in a way we have reinforced the wildcat population. Now there have been heavy criticisms of some of the whole idea of wildcats in Scotland because they hybridise with domestic cats. And the argument has always been, well, all my cats, other people's cats are hybrids. They might be, it doesn't matter, because the wildcat population that I can see is not just what it looks like in a museum specimen but a whole behavioural pattern. And the behavioural pattern is so incredibly efficient at surviving in the wild that very, very rapidly the

wild type dominates in the wild environment. That's the justification if you like for putting them back. They are part of our natural fauna and they do survive, and hybridisation is not the menace that it's said to be because the wild type becomes very dominant, and you will convert yourself and you will see today or yesterday that wild type isn't just appearance, wild type is personality.

*And what's involved in looking after them day to day while you've got them here?*

I discovered very early on that the less you do the better. In other words, I have big pens where they can live. I don't put them outside because they'd be very vulnerable, they would also run away. But I've had, er, big pens with animals in them, apart from food and water and shelter, I've got a box, I leave them alone. Sometimes it's necessary to clean them out but they do resent having their nest boxes cleaned. So really the less stress the better, I've found. And I've found that with the – with them in general the less I mess with them, in sort of inverted commas, the easier they are to breed. And they breed very happily, very well indeed, but enormously defensively so I daren't go into the pen when the female's got kittens, when she's got small kittens, she's out after me as quick as light.

[26:16]

*Thank you. And how have you been able to continue your scientific work over the best part of the last twenty years from this fairly remote site in the highlands?*

Ah, this is – the reason for this is really fairly simple. My needs in terms of apparatus are extremely modest. I've got sieves and I've got bowls, polythene bowls, and the means – and microscopes and a collection, that's what I need, none of which necessarily costs a lot of money. To replace a polythene bowl is a matter of pence. To replace a sieve, I can use – I can go down to Birmingham and almost certainly find people who want to reject the sieves 'cause they've got new ones to replace them with. So no problem about getting materials and that's the most important thing. If – let's go back to geophysics, if I was dependent on the most complicated magnetometers it would cost the earth, or the ability to drill holes at the bottom of the oceans at astronomical prices, then I wouldn't be doing it now. So it's both cheap and

effective. The next thing is the fact that I can go for – be invited to go and visit excavations and sites where things are, and this is very easy from here. Or they can send me a bag of mud in the post, you know, as you know from today. So that in a sort of way the work comes to my door and I'm not hooked on expensive apparatus, so that's why I can do it, and I've just converted one room in the house entirely, so I have my library there, my microc' [microscope] there, my collection there, and I do an awful lot of the initial preparation work with the connivance of Beryl in the kitchen. So it doesn't require anything complex, so I can do it.

*What about communication with colleagues at a distance, how do you achieve that?*

That is more difficult. I personally find it really very satisfying to actually discuss on a person to person basis what I've got. And also we're increasingly seeing investigations which are multidisciplinary, and therefore there's an awful lot of communication necessary. Well, with the rise of emails you can do an awful lot of communication that way, and also of course telephoning. But in the end I have to go down there and discuss, so I go to meetings, and I go to meetings in London occasionally and I can give lectures down there at meetings, Quaternary meetings, where we can discuss or I can advertise needs. I can say what I'm really looking for is a site and then I give a series of desiderata to go with that site. And somebody will say, well, I know just the place you're looking for. So conferences are not only a means of, if you like, me transmitting information to them but me advertising needs which somebody in the audience can fulfil, so this is the way in which communication is done. I don't have to be on the doorstep all the time, it's just on a sufficient number of occasions to keep the ideas flowing backwards and forwards, or on a day to day basis via emails.

*Which scientific meetings do you – over the last twenty years have you still gone to regularly?*

Well, the big meetings, the INQUA meetings, this is the International Quaternary meetings, occur in places like America, Africa I was at not long ago. I tend now for health reasons not to travel abroad very far, so in this [country] – we have the QRA, the Quaternary Research Association meetings, once every year and we have a big

symposium and we have also field meetings and the like, and I tend to go to them. Then there's a little group, the AHOB meeting, this is the Ancient Human Occupation of Britain, which I've been very much involved with very recently, and they have meetings also in London, or excavations, for instance those on the Norfolk coast, and I'm involved with those too. These are current groups of people with whom I'm in constant contact.

[31:11]

*And could you just say a little more about when you established internet here? Again, I know it's going to be a rough date but if you've lived here for the best part of twenty years when did you – when were you first able to use internet here?*

About ten years ago. That's a round figure, and as Dr Johnson said, round figures are always wrong. It's of that order. And when we first came of course we had – I mean even telephones were difficult to run from this area here, and mobiles not at all because of course the mountains round about us made it almost entirely impossible to contact the outside world. And then gradually with increasing sophistication we now have fibre optics all the way down the valley, so that's – it makes life very, very easy.

[32:01]

*Could you then describe projects that you've worked on in the last twenty years? And you've mentioned human occupation on the Norfolk coast. So if we could have a brief description of those projects that you've operated remotely from here and then we'll look in a little bit more detail about the very current project, the one that samples arrived for yesterday.*

Well, where we ought to begin, with – apart from human occupation of Britain, this is on the north Norfolk coast, let's talk about that for a minute or two. This was a big complicated excavation. At the foot of the cliff at Happisburgh, and Happisburgh – by the way it's spelt Happis-burgh to the consternation of my firewall on my computer which thinks it's a drug of addictions, that the cliffs there are eroding quite quickly and organic deposits were found in the bottom. These predated the, as far as

we can tell, any glaciation of Britain. And one day an amateur geologist walking on the shore at Happisburgh found a hand axe embedded in a peat bed, which seemed to disappear under the cliff, that was very ancient. And that triggered off a big investigation by the British Museum and the Natural History Museum to excavate and see where that hand axe came from. And with it went a chain of excavations for the last, oh, four years probably. And the object was to look for evidence, and there in the deposits were found flakes of flint which from their structure clearly had been struck by human agency and that really was exciting because it meant that at some stage human beings have lived in Britain before the oncoming of glaciations. And although it's difficult to date precisely this may well have been the best part of a million years ago. And those deposits have organic remains in them, and therefore we were able to say not only were people here but what the environment was like in which they lived. And so this is how I got going on this, a huge fauna list of beetles in particular telling us exactly what the environment was like, exactly what the climate was like at the time when those people were there, so this was an opportunity, nothing really serious to do with the sort of climatic history but to understand something about anthropology, archaeology. So that's one of them. Now another change of tack as far as I was concerned, again because of opportunity arising almost capriciously, as you're doing one thing something else turns up, was a change of tack from dealing with things like the end of the last glaciation, things like this, to interglacials, and interglacials with preferably quite long histories. And the faunas from the interglacials started to become very exciting to me because not only every now and then do they – did they tell me that the climate was warmer than now but also something about its history. And so I spent a lot of time looking at interglacial deposits too. Because each interglacial is probably a sort of snapshot it's often difficult to know exactly what their relationship is. But if we go back two or three interglacial/glacial cycles ago, I'm alright beyond that, it becomes difficult – more and more difficult to actually allocate your deposit to any particular interglacial as it would be seen in the ice cores, so we have a difficulty. And we move them up and down the scale depending on how we feel. We sort of plug them in here or plug them in there, in that ice core framework that I mentioned earlier on. And when there's something really peculiar's happened – two things have turned up in the study of the interglacials. One of them is that at the end of the interglacials we seem to have this extraordinary fluctuation, which I think I mentioned earlier, between climatic

oscillations, and now we know something about the intensity of the climatic oscillations. Because these are beyond any means of dating precisely we can only date them relative to one another, but they are very rapid and very intense and quite frequent. And I'm dying for somebody to tell me exactly when they occurred, that technique is yet to be discovered. We can get relative age but absolute age we can't do. But give it a decade and we probably will. So ends of interglacials don't just happen gently, they turn off, [clicks fingers] snap, and they turn off and on, and off and on, several times, just as the changeover from the last glaciation to the present interglacial also had this flicker, this rapid change backwards and forwards. That looks as if it might just be a universal, in other words, not a particular phenomenon of particular interglacials but all of them go through this unstable episode. If that is true that's going to be quite exciting in trying to understand the end of this present interglacial we're now living through. The next thing is that if you look at pollen diagrams from some of these things there is very little evidence of change in the beetles. Every now and then in the middle of a warm period there will be a cold period. By cold I mean incredibly cold for a very short period of time. How does this happen? We don't know, because it's so – almost unexpected. You expect a warm period, an interglacial, to be nice and balmy all the way through, but for an interglacial to be able to turn off and then turn back on again is a phenomenon we know very, very little about. But these are turning up in the beetle record and I'm – if you ask what I'm doing now it's trying to understand just that. It is not just – it is trying to record to what extent these turns offs and turn on again episodes occur; many times, a few times, always in interglacials? We don't know but the site at Quinton near Birmingham was one of my first records of something which suddenly turned off. Research student Harry Kenwood was collecting the samples and to me it was absolutely amazing to suddenly find you're going through a nice warm period and Arctic beetles appeared. By Arctic I don't just mean things that can live in the Arctic but things that have to live in the Arctic, and they suddenly appear. Not one or two but several that live nowhere nearer than Arctic Russia at the present time, and then suddenly back to temperate again. How's that happened? I'm not asking you to sort of solve but my problem is how do you think about it? How do you get your mind around something when you think that we're not just dealing with a small oscillation like the, what shall I say, the little Ice Age? You're dealing with a situation in which the temperature changed by seven or eight degrees in July and probably a lot colder in

the winter, but much more colder, in what looks like an instant in time. And I'm sorry to keep harping on at this but it does look as if it's a sudden event but what's intriguing is it suddenly turns off again, so you get a cold episode.

*Do you have any theories about cores if [both talking at once] – .*

Every day a different theory turns up. I'm not enough of a oceanographic specialist to understand why the currents of the ocean turn off and on, but to some extent when people like Bill Ruddiman and colleagues looked at the way in which the polar water and the temperate water, and the tropical water, moved around in the North Atlantic he realised these can be quite sudden. How you did it, I don't know, because there must be colossal inertia of ocean currents. So some way or other we are probably looking at changes in the ocean circulation. I can say that without understanding the physics well enough to understand how it might happen but I think it's an ocean, in our particular case, a North Atlantic problem. And somehow or other the orientation of the surface water on the North Atlantic probably has a very, very close relationship with the changes in the atmospheric circulation, i.e. on the coming and goings of these cold periods. And that's rather unsatisfactory [laughs] 'cause we can't actually get much further than that ... but one day we will.

[42:25]

*And so what is the site from which the mud or soil arrived yesterday in your post box?*

This was from a bore hole. It was sent by a Cambridge group run by Richard Preece and there's a bore hole there, which in East – East Hyde and it's in Essex I think or I'm sure it must be, where they've gone through an interglacial deposit. They know it's interglacial because the pollen shows it's interglacial. It seems the most likely place to put this is to correlate it with let us say the Hoxne interglacial which is further up in Norfolk or in East Anglia anyhow. And I have – I didn't know very much about this until only a few days ago but there are beetles in it which are of southern European type, so indicating that at times this particular interglacial was warm. And then ... this is not yet certain but it just shows how hot this information is, I've got a beetle, a beetle, it's sitting in a pot there in the laboratory, which looks to me like an

Alpine beetle in the middle of the interglacial. Is this thing the same as that beetle I'm talking about? It's one specimen only, and there's nothing else in that sample but this one specimen which is what looks exactly like an Alpine species. Above it and below it are temperate beetles. Am I looking at just a cold snap in the middle of an interglacial just as I was talking about a minute ago? And I can't tell you now because the sample is still there on the table but that's the whole idea of having to look. Now I'm driven by curiosity about this sudden climatic reversal, or oscillation I think I should call it, and therefore when people send me samples like this I'm just waiting to have a go at them and see what happens. But I can't answer any more. Give me a week or two and I can fill that gap into your story.

[44:57]

*Thank you. And what do you think is the – sorry, this is a bit of an awful question but what do you think is the future for climate given that whenever we, in the newspapers or in anything of popular science we read something about climates about concerns about the future, what do you think might happen?*

Erm, this is quite a difficult question, I'll tell you why. If you look at the climatic oscillations, for instance, in the Antarctic ice cores there's a very, very close relationship between temperature and the atmospheric gases which comprise the gases which we often call as greenhouse gases. And the two run hand in hand, not necessarily synchronous but jolly close, as if there's some causal link between the two. Now, we can now measure the amount of greenhouse gases that are appearing in our atmosphere through things like tree rings or through the ice cores because there are bubbles trapped in the ice which give you little samples of earlier atmospheres. And we're now reaching a situation where the greenhouse gases in the atmosphere are higher than they've ever been for the last ... two million years. And this is the time when numerous climatic oscillations and glacials, interglacial, cycles have taken place. So what they've introduced into the equation is a total unknowable. What will be the effect of this is almost impossible to predict simply because if we go back in time it's never happened before. This is why I say we're tinkering with what seemed to be the controls without any idea about what we're actually going to do with them, so we've sort of broken the mould. The geological background may not now be

regular – relevant to the present situation or the future situation, which makes modelling in anticipation of future climate even more difficult. All that we can say is the chances are very high that it will be different from what has ever been before. I know that's a bit pessimistic, it doesn't actually answer your question other than I think we may well be in a situation where we have already got to a situation where we have no idea what the answer to your question is.

[47:46]

*And people listening to this interview who may like to follow it up by looking for archived material on your career, in other words, unpublished notebooks, photographs, manuscripts, that sort of thing, where should they be advised to look?*

First of all, the most important thing of all is not what I write but the material upon which it's based, because the only facts in this case are the actual specimens themselves, all the rest is interpretation. When I say I believe this species to be so and so, that's a description of me. And so all the material that I've ever collected is preserved somewhere or other, primarily in the Lapworth Museum at Birmingham University where all our material is present, and here the work of the last decade or two will be actually deposited there. So the Lapworth Museum is the repository for all the actual information. I have maintained a pretty comprehensive series of notes of what I've got, er, inside little files here. These are mostly lists of what I believe the species to be, so the specimens are there and my diagnosis of the specimens are there. The interpretation is nearly always – has already been published. And the publication now is taking on a different form than what it did when I was young. In the old days, when you just looked at the Upton Warren paper or the Brandon paper, the Royal Society in its generosity published everything, data and all, to extraordinary degrees. Nowadays commercial enterprises have entered into the field of scientific publication and papers consist mostly of the results and supplementary information is maintained electronically. I don't like it but I think it's inevitable. So there's beetle evidence in supplementary information on this – for instance, on the Happisburgh story. And there's more information on the supplementary, er – the information than the actual paper itself, and this is the way things are going to go. Most important I think is that the data, i.e. the specimens, should be preserved for all time insofar as it is possible,

and the interpretation, the notes interpreting it, likewise. And all this will, as far as I'm concerned, go to the Lapworth Library unless some – oh, unless the Natural History Museum are sponsoring some work and want to keep the stuff, or unless another museum, for instance, Cambridge, the stuff upon East Hyde which I've just been talking about, almost certainly will go back to Cambridge because that's where it originated. So that well known museums will be holding this stuff.

*And do you have any plans to collect more personal papers, I don't know, letters and diaries, that sort of thing, unpublished notes?*

Very, very few, I'm not very good at preserving things. I write them on the back of little pieces of paper which I then lose so that – no, I think no diaries – well, almost no diaries about events but, er ... I've been very lackadaisical in keeping notes, diaries or anything such part record of what we've been doing. So if you can warn anybody, if they're looking for them they're probably not there, you'll save people a lot of trouble [laughs].

*But you do have a bibliography that I know you're keeping up to date because of our conversation –*

I have a list of papers which I've published which – and I do my best to keep up to date. So that's true enough, yes.

[52:19]

*And the last question is could you comment your experience of being interviewed for National Life Stories? Meaning sort of how have you found the process of thinking about your life I suppose, prompted by the fact of having to do it.*

Well, it's quite – it's a bit alarming actually because recollected in tranquillity, I can't remember very much. But if you ask me questions this triggers off memories which I didn't even know I possessed. So in a sort of way it's been quite an interesting structure of time. Yes, I've sort of enjoyed remembering things, often enough worried by the fact that my memory might not have been as exact as it should have

been, so I'm – all that I can say is that I feel if anybody wants to criticise I want to appeal guilty but insane I think is the only [laughs] – only verdict. Remembering remote past is always coloured by the things that you want to remember and the things that you don't want to remember. And so that I think it may have been a little bit of a coloured version of actuality.

[End of Track 9]