Professor Frank Ellis MD FRCR in interview with Sir Christopher Paine
Oxford, 14 July 1997

CP Frank, I’d like to start with asking you something about your school and how you came to do medicine. You were at the King Edward VII Grammar School in Sheffield. Was it a struggle to get there and how did things go with your life at that time?

FE Well, I decided when I was five that I wanted to be a doctor. I never changed my mind; I never wanted to be any fireman or anything else. And I went to three primary schools, before I had a chance of going to King Edward VII School. The consequence was I was a year or two behind what I should have been. But I had not the slightest idea how I could become a doctor. But at the Ranmoor Wesleyan … well, Nether Green Council School, which was … moved because of the war… And my parents were chapel keepers at the Ranmoor Wesleyan, which was the girls’ part of the primary school; the boys’ part was down at the hall of the Ranmoor church. But the headmaster, Mr Feasey(?), was … thinking, thought I had some promise apparently, and although I was two standards below what I should have been he came to see my parents to see if they’d like me to go to secondary school. And there was nothing they’d like better because they were very keen on education. And I was given old examination papers and worked weekends, and it was fortunate that they were looking after that chapel and school because there was plenty of room to work without being bothered by other people, you see. And I used to work over the weekend and then Miss Rebie(?), my teacher at the elementary school, used to work with me after school during the week through what I had done. And we went on like that until just before the exams, I suppose. Then when I took the exams, there were only five scholarships in the whole of Sheffield and I got the third, much to everybody’s surprise I think. And, well, since then I’ve never looked back really, because it was a good scholarship. It provided a little money, which helped the family finances; I got my books and my tuition free. And I enjoyed my time there and worked and I did reasonably well in the School Certificate and Higher Certificate and I got a scholarship for Sheffield University. I was made captain of football, much to my surprise, and I was asked by the headmaster if I’d like to go to Oxford. And I said I would but didn’t think I should, because I knew friends of mine who’d gone to Oxford and still costing their parents money, in spite of the fact that they had got good scholarships, you see. And I felt that it would diminish my brothers’ chances if I left and cost the family money. So I didn’t do it. That’s why I went to Sheffield instead of trying to go to Oxford.

CP So you went to Sheffield?

FE I had reason to think, from what happened subsequently, that I might have been in line for the Queen’s [College] exhibition, the exhibition, Hastings Exhibition at Queen’s College, Oxford. But, well I never looked back. And since then I’ve
thought that many times in my life when I have been asked about things I’ve made up my mind and answered straight away, when I should have said ‘I’d like a little while to think about it.’ But that’s presumably the way I am built.

CP    Yes, and you worked very hard, although you said that you were captain of football.

FE    Yes, I worked very hard. I had to work, help with the chapel keeping as well, you see. I used to get cooks in and coals in(?) and sweep paths and mow lawns and clean windows and dust pews and things like that. But … well I seemed to be able to do it and still able to do my work. If I felt, for instance, that some maths problems were a bit difficult for me, I used to leave them till the end. I had to go to bed at eleven and when everybody else had gone to bed I got up and finished what I could, and then went back to bed.

CP    Well we’ll return to that later on because that’s been the pattern of your life, to work hard and sometimes overnight, hasn’t it?

FE    Well, I … well, I don’t know, but I did it then!

CP    You did it then. Let’s go on a little bit. You then read medicine at the university, and you qualified in 1929, I think, in medicine.

FE    Yes.

CP    And what happened, where did you do your first house job?

FE    The first house jobs I did at the Royal Hospital in Sheffield. The first job was a casualty officer, I’m not sure it wasn’t combined with a, an anaesthetists job. But I found them all very interesting, the responsibility. I mean, I remember very well the very first case I had. You see I qualified at twelve o’clock on a Saturday, and started work at nine o’clock on the Sunday as a locum for Sir Arthur Hall. And the very first patient I saw, we were on … the very first patient I saw was a woman sent in as a peritonitis… No, I’m not quite sure what she was sent in as, but I took her history and examined her. And it was the very first thing I did on my own responsibility, you see, and I decided she had a ruptured ectopic pregnancy, and I arranged for her to be taken over, and I turned out to be right. And that was the first thing I ever did on my own responsibility. And, well I enjoyed the work there; I did lots of other things. I think I got a reputation for doing things which I shouldn’t have done on my own responsibility, but I, I used to do it!

CP    I think that that lasted the rest of your life too really, but we’ll return to that when we come to biopsies later on.

FE    Yes. Well I, I got an infection of my eyelids, and...

CP    Yes, I was going to ask you about that because that was a serious factor in your career ahead, wasn’t it?
FE Yes, yes, it was.

CP What were you going to do before that though?

FE Well I was asked by the dean of the faculty … if I’d like to work with Bradford Hill. And I’d never heard of Bradford Hill.

CP That was Sir Austin Bradford Hill, who was the smoking, eventually published the work with Sir Richard Doll¹, yes, yes.

FE Yes, eventually. Yes, but, and I, knowing what I do now it would have suited me, but I, again I said no straight away, you see. If it had been AV Hill², who was a physiologist concerned with muscle, I would have probably said yes. But as it was, I’d got a government job and was intending to go to Southern Rhodesia, which is now Zimbabwe, as a medical officer. But I had, an infection in my eyelids developed, and it got worse. Eventually I got keratitis. And it was so bad that when I tried to look at a patient – you know the way they had big windows on either side of the beds – I got photophobia. I just couldn’t see. And then the ophthalmic surgeon decided to put me to bed and, off and on, I was in bed for about two and a half months, because I used to improve over two or three weeks and then get worse again if the... On one occasion it was the ophthalmic surgeon’s deputy who decided to change the treatment, on another occasion it was because the ophthalmic surgeon thought I should be able to get up. And I then got up, and went out on to the roof and I got the sunshine and the dust and the wind and it made them worse again, you see. And after two and a half months, I just said to him ‘I’m not getting any better. The thing to do is to give me protection and let me get up and get on with things.’ But while I was in bed the ophthalmic house surgeon, who was an Irishman and very flamboyant and outgoing, said ‘There’s a job here, Frank, that will just suit you. You won’t need to read anything, because nobody knows anything! And … you’ll just be all right.’

CP So in 1931 you were appointed to that job.

FE So, well yes, I applied you see in 1930. I was appointed in … I was appointed in 1930, and I had to serve a month as biochemist to the hospital. And I served the month and then went, first of all to The Middlesex Hospital for five weeks and then to Brussels for five weeks. People seemed to think that was a peculiar choice but it was because they seemed to have the best dosage measurements at Brussels. And although it was difficult for anybody to get an absolute unit for the radium, they had the best relative units at Brussels. They started peripheral distribution of radium and that kind of thing. And then I…

CP Was that before the Paterson-Parker system of radium dosimetry was published?

² Archibald Vivian Hill.
Oh yes, yes. And I used to make complicated arrangements. I used to have to have a bowl of water to … moisten my eyelids at times while I was doing these things. But eventually they gradually got better.

Yes. So how did you set up the service in Sheffield? You arrived there, you had a room in which to work, and how did you set about establishing it from scratch?

Well, the room consisted of a disused theatre, about four times the size of this room, I suppose. That was my department. And the hospital secretary showed me in, I asked for a table and a chair, because that was all the furniture I’d got, that was all the apparatus I’d got, and [they] said ‘This is your department.’ And then I had to sit down and think about what radium I wanted, and what apparatus I wanted, and to try and decide what to do. I tried to fit in with the surgeons, going and seeing what they did, trying to make models of things and suggesting that radium needles should go in in certain places. They had some radium in Sheffield, provided by students’ rag a few years before, [that] belonged to the Sheffield Radium Committee. And I ordered some more radium from the National Radium Commission.

How did you get the money for, for that? Did the hospital…?

Well, I’m not quite sure, you see.

They provided you with some money, anyway?

Yes. And we could get radium from the National Radium Commission, for peppercorn rent, you see, and all that was needed was for me to look after the radium and to keep the records.

I see, yes.

That was the condition. And I used to go and see what the surgeons did. They’d used the Sheffield radium at first, and they’d stick needles in, and one might fall out the same day and another two the next day, you know. And I felt that there was something wrong about that, and I used to fidget, and they eventually said ‘Would you like to do it?’ And eventually I was doing them all, and I used to, I devised methods of keeping them in.

So you really taught yourself and then taught the surgeons how to do it until you took the radium needling over?

No, I usually, I did them all myself. And I didn’t teach the surgeons, I tried to teach the surgeons and then they asked me to…

To do it, yes.

…to get on and do them.

And what about gynaecological applications? Did you do those then?
FE  Well, the professor, Miles Phillips, was a nice man. He took me one day to his
nursing home for me to give advice. And I, he was trying to put radium into a uterus,
and he had a vulsellum on the anterior lip of the uterus and he couldn’t get the sound
into the uterus. And I was fidgeting there, and he said ‘Would you like to have a go?’
And I said ‘Yes’, and the first thing I did was to take off the vulsellum and put my
fingers in and I was able to pass the sound straight away, because it was a very
anteverted uterus and the vulsellum was making it harder, you see. And after that, I
got all the cervix cases. Well now, probably they were being a bit cunning, you know,
getting, not knowing how much damage the radium was going to do and pushing it all
on to me! But I only thought about that afterwards.

CP  Yes, yes. Well, we’ll come back to radium in a minute, probably when we get
to Oxford. But there were some other things you did in Sheffield, and one of them
was develop the external-beam therapy for the first time. Tell us a little bit about how
you got the equipment for that.

FE  Well, I thought to get a big depth dose it would be a good idea to have a single
line around the neck, because of the uniformity of the curve, and thereby get a bigger
depth dose. And I did that for a man with big glands both sides of his neck, secondary
to a sarcoma of the tonsil, and the lumps disappeared but the patient died of aplastic
anaemia because the amount of radium I used...

CP  From lots of radium needles, yes.

FE  ...and the proximity to the chest wall meant it affected the bone marrow too
much. So I realised then that I’d got to have beam direction, to have beams that
would cross over inside the patient, you see. And I asked the committee for a radium
beam unit, because I was the radium officer, and they said ‘Oh no. Sir Stanford Cade
is just dismantling his radium beam unit at the Westminster Hospital.’ And, well I
thought I could have done better than that, because his was badly designed, but I said,
they said ‘Is there any alternative?’ And I said ‘Yes, x-ray treatment.’ And I was very
junior of course, and I went to the secretary in about three months and I said ‘When
are we getting the x-ray apparatus?’ He said ‘What x-ray apparatus?’ And I referred
him to the minutes of the previous meeting and then I realised that if we were going to
get any x-ray apparatus I’d got to deal with it. And so I looked into it and, oh I
decided that British made tubes weren’t working very well, they tended to break down
too much, and eventually arranged to get x-ray apparatus with Phillips tubes and a
Ferranti generator. And the night before I was going to Ferranti’s to place the order,
which was for fifteen hundred pounds, because I’d been to, I’d been to see Mr JG
Graves3 who went to the same chapel I did, and I occasionally used to meet him and
walk, when he went to his works and I went to the university…

CP  You walked back with him.

FE  …or when I went to school, first of all. And, so we were friendly and when I
wanted some extra apparatus, I went to ask him about it. And I, he said ‘What do you

3 Mr John George Graves was a Sheffield businessman and art collector, who made gifts of land and
money (used for the central library and art gallery) to the city. He became Lord Mayor and Alderman
of Sheffield in 1926.
want it for, Frank?’ I said ‘Treating cancer.’ He said ‘Do you think it’s a good thing?’ And I said ‘Of course.’ He said ‘How much do you want?’ I said ‘I’m afraid it costs at least twelve hundred and fifty pounds.’ He said ‘I’ll give you fifteen hundred.’ And, well, that was marvellous, you see.

CP So you were able to buy the equipment with that.

FE I, I’d spent four hours the night before trying to think what questions he might ask, and that was all he said! And then, you see, I started to look for the best x-ray apparatus. And the contract was to provide the apparatus for fifteen hundred pounds with six hundred pounds a year maintenance. But, I felt we were saddled with that, and the night before I was going to Trafford Park to see Ferranti and to sign the contract, I met a friend of mine from school who’d been working with Metropolitan Vickers at Trafford Park. And he was on holiday from Berlin where he was doing research. And we spent a long time to see each other home, and he said … he told me about an x-ray apparatus they’d got at Trafford Park, which could be taken to pieces and put together again. And I thought that sounds like the kind of thing I want, and so I wrote a letter and posted it at three o’clock in the morning in Fitzalan Square in Sheffield, and said I’d be there at nine o’clock in the morning. And I was at Metropolitan Vickers at nine o’clock in the morning and they were there to meet me. They showed me this apparatus, told me how it was worked, and it depended on Apiezon oil. And it had ten times the, well it had one-tenth the vapour pressure of mercury so that it could get a better vacuum, you see. And then I went along to Ferranti and told them I wasn’t going to sign the contract, and they weren’t very pleased. But then I went back to the committee, and the committee weren’t very pleased either.

CP No. So that really was how you got it, I mean it was by...

FE I got the apparatus because Metropolitan Vickers produced two tubes, working off a Greinacher circuit, continuously evacuated – I contributed a bit to the design, you know – and that was the beginning…

CP And that was the beginning, yes.

FE …of my chair practice, you see. Two hundred kV.

CP Yes. And the next thing I wanted to ask you about Sheffield was, of course the war came soon after this and you had to move the whole department out, didn’t you? What happened then?

FE Yes well, when Mr Chamberlain\(^4\) came back, I think it was September the 30th 1938, waving a bit of paper, I didn’t believe him. And I bought a house in the country and booked a seven-ton truck on that day, to be available at any time within fifteen months to move my x-ray apparatus. And then, of course, when the war actually, when the Germans went into Poland on Friday September the 1st 1939, I immediately, as soon as we finished work on the, at five o’clock on that Friday, I got the man to

\(^4\)Neville Chamberlain.

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bring his truck along. He didn’t want to because he’d got lots of customers then. And the chairman, incidentally, had given me a *carte blanche* to do as I thought fit. And we moved fifteen tons of apparatus about fifteen miles, five miles out of the centre of Sheffield to the kennels, where Sir Edward Mellanby used to do his work on vitamin A in dogs. And that was where we set it up to work during the war, and eventually we got it working with a hundred, and were able to deal with a hundred patients a day.

CP And the patients were able to get to you alright even though you were out of Sheffield, were they?

FE Yes, I had beds in the adjacent Lodge Moor Hospital. And the staff nurse there was Miss Hodgson(?), and she wanted a job [where] she could live out. And almost at that time, my nurse was taken by the radiologist, and so I was able to give her a job doing that, as a nurse, and then she joined the class for treatment, teaching for the MSR⁵, and became a radiographer and sister, you see.

CP Yes, and stayed with you for the rest of your professional life in this country as radiographer and sister.

FE Right, exactly. I, you see, when I went to London in 1943, I said to her she’d be better off to stay in Sheffield, as I thought she would. And then we needed a sister in the department at The London, and there were several applicants, many of them old London Hospital people, and Miss Hodgson applied. And she was head and shoulders better than anyone else; and so she got the job. And then when I left London to go to Oxford, I never dreamed of not taking her with me.

CP No, she went with you. But tell us about your move to The London. I mean, why did you leave Sheffield and go to The London really?

FE Well, when I got the x-ray apparatus in Sheffield, well even before that, I thought my knowledge and experience wasn’t such that I wouldn’t think of the financial gain I might have on my contract. I was, I had, I was on a part-time contract, you see – six hundred pounds a year part-time. And I asked the committee to put me on a full-time contract, so that didn’t bother me at all. And then in 1942, early 1942 I asked to be put back on my original contract, because I felt that my experience was such that I wouldn’t be influenced by the money side in deciding what to do about a patient.

CP No, no.

FE And I felt that somebody on, you know, doing private practice had a kind of different status with the other members of the staffs. And I was on the staff of all the teaching hospitals, you see, the two big ones – the children’s hospital and the women’s hospital.

CP Yes, yes. And was there resistance to you going back onto the part-time contract?

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⁵ Diploma in Radiology.
FE Well, they turned it down. And then when I was asked by The London Hospital if I’d like to go there I said ‘Yes.’ And then, after I’d said yes, Sir Ronald Matthews said why was I going there, they’d have given me anything I wanted, but…

CP But you’d made up your mind by then.

FE Well I’d promised, you see, and I don’t break promises.

CP No. Tell us a little about The London Hospital. I don’t want to spend much time on that because you were there a relatively short time; we want to spend more time on Oxford.

FE Fair enough.

CP But how do you look back on your years at The London really?

FE Well, my experience is that when I’ve changed from one place to another I’ve got a different set of ideas and, as a result of experience. And, I mean, at The London I was able to … deal with things, deal with things more from a biochemical point of view, but there wasn’t the liberty that there used to be before the war. One was restricted by wartime conditions. And things were going all right and then people started to come back from the war.

CP The war had ended by then, yes.

FE Yes, and I could see that they were rather, what shall I say, amazed at the idea of a radiotherapist having beds of his own and that kind of thing, you see. He should be somebody they could dictate to.

CP In the basement.

FE And I thought that it would be bound to cause difficulties, and I don’t like that kind of thing, because the only people who suffer are the patients. And so I decided to leave, and when there was a job advertised at Oxford, just relatively conveniently, I applied for it and got it.

CP Yes. And your family … I mean, you were married by this time, and perhaps you could just tell us a little bit about your family. Dorothy Ellis, whom you met, I think she was a student in Sheffield with you…

FE She was a student in Sheffield.

CP … and what was the situation of your family over these early years, you know?

FE Do you mean my own family?

CP Yes, your own family.
FE Yes, well, we married in 1932, the 3rd of September. The anniversary of the outbreak of war but a bit before that! And by the time we moved to Harrogate, which was where I’d bought the house, and I moved during 1938 you see, we had two children – David and Janet. And then … Anne, when did…? Anne was born just before I moved to London, and then John was born while I was in London and Francis was born. And all the others had been born and could have played cricket for Yorkshire, because we’d arranged things that way. But Francis was premature and he was taken into The London Hospital unit, and was considered, I mean he was two and a half months early and was kind of looked upon as a kind of pet, and he did quite well there. And … so I have five children now.

CP You always told me that your, all of your children were born during your heaviest period of radiation exposure. Is that a, was that a serious thought?

FE Well I think that’s true. David was, Janet was, Anne was certainly. And then, I mean I began to have less…

CP Did it worry you at the time that you were exposed to quite large doses of radiation in modern terms?

FE No. I, there were, the League of Nations had published a manual, and I followed the manual. And the maximum permissible dose for, with gamma radiation from radium was 2R per week. Well, it’s changed since then, but I feel either that I was immune to it, or it has done me good or something, because I haven’t suffered very much myself, and the children haven’t suffered very much except Francis. Francis was premature. Why was he premature? It might have been because he was fairly late in Dorothy’s life, you see, and he had a, at autopsy was found to have a slight stenosis of the aorta, which had presumably raised the pressure in the coronary arteries.

CP I see, but that might have had nothing whatever to do with the radiation exposure.

FE It might have had nothing whatever to do, but they never excluded the possibility.

CP Yes. Then going back to The London, there was one famous occasion when you received a cheque from Dr Walter Shanks. Could you tell us about that…?

FE Oh well, I…

CP …fairly quickly, because it’s a good story that should be heard, I think?

FE Well, I, it was when I was still in Sheffield. Walter Shanks had been a pupil of mine, with Gordon Orton at the same time, and he’d got his DMR [Diploma in Medical Radiology] Christmas 1942, I think. And when I was appointed at The London, I’d sent him along about a month beforehand to start getting things in some kind of order. And he came back to report to me at Hathersage. And we had bicycles and cycled up and down the Derbyshire hills, you see, and he said his legs felt like
jelly. Well I don’t know if you knew Walter Shanks, but he was always very argumentative, and he argued about this cycling. Eventually it, we finished up, and he said I couldn’t cycle from Sheffield to London in less than 24 hours and I said I could. And so we made a bet that I had to do this in 1943, you can’t allow these things to drag on, and that was that. And I started at The London on the 1st of May 1943, and it got to August bank holiday and I thought there isn’t another bank holiday before Christmas, if I don’t do it this weekend I’m not going to be able to do it. And I hadn’t got a bicycle there, and I borrowed a bicycle from Mr Reeve(?), who was one of the radiographers in the department, and I started off at seven o’clock on the Friday night and cycled to Bedford. And I wanted to sleep there, but I had difficulty till I asked a policeman about John Bunyan’s cell, and he put me in the Bridge Hotel on the settee provided I cleared out before about half past six in the morning. And then I cleared out at half past six in the morning and cycled the rest of the way to Sheffield on the Saturday. And there was a thunderstorm and I got so wet through and so on, and on the Sunday I cycled around Sheffield to see friends. And Monday morning at three o’clock I rang Walter Shanks and told him I was starting back because I had to cycle from Sheffield to London. And the bicycle was a single speed and the pedal clicked every time it went over. And I left at three o’clock in the morning, it was very hard work at first because the wind was blowing from the south after the thunderstorm, and I got to Marble Arch with … about two hours to spare. But I’d been very worried at one time because I’d only been able to do four miles in one hour against the wind…

CP So you cycled both ways?

FE …until I got some tea at a café near the Ramjam Inn(?) on the Great North Road. And there I was able to drink twelve cups of tea – I could have cycled to the south coast! And so then Walter Shanks wrote me a letter, enclosing a cheque. Five pounds was a lot of money then and I thought he was a bit hard up, and so I thought it was better to frame the letter and the cheque.

CP And it used to be on your wall in your office.

FE Well, not there…

CP Later on.

FE …but I had to put it on my wall because it was the only evidence that I was a doctor, so to speak, at the Memorial Hospital [New York] later.

CP Well I think it shows two things: your great determination and also your great kindness to Walter in not depleting his resources. Frank, you then moved to Oxford, and what were the things that you really wanted to do then first, in setting up another new department with practically nothing there before?

FE I just wanted to do the best radiotherapy I could. And I had decided that it was important to keep in touch with other staff – surgeons, physicians, haematologists and so on – and so I decided to form as many contacts as possible in that way. And also I believed very much in outside clinics which I’d started in Sheffield and The London, but thought I’d make sure of doing it in a biggish way in Oxford, because I felt that in
that way we got patients earlier for treatment. And, I feel... Somebody did ask me once how I’d planned my life. Well I never planned my life.

CP It just happened. But anyway, you did set up a lot of clinics – I knew that when I came to work there in Swindon, Aylesbury, Banbury, High Wycombe towards the end, and Aylesbury, so that meant you had contact there. But within the department, tell me a little bit about how your, how you were thinking about the physics of radiotherapy then. And tell us a little bit about the Oxford cobalt unit, because it was one of the first cobalt units to be used for treatment in the country, wasn’t it?

FE Well, I decided that we wanted a cobalt machine. Before that of course, Mr Sanctuary(?) – the administrator of the United Oxford Hospitals – had said to me ‘We’ve no money for radiotherapy in Oxford, there’s a nice job going in Belfast.’ And that was after I’d been appointed and been there about two or three months, and children going to school and that kind of thing. And I said ‘Well, we have got to get some money haven’t we?’ and I went and saw Janet Vaughan and Lord Cherwell⁶, and they must have seen the government and we got that settled. And then I … wanted x-ray apparatus and the, it was no longer possible to get Metropolitan Vickers apparatus because they’d been taken over by an American firm and so we had to order Resomax(?), I think it was called. And the first machine I got was from the dermatology department at The Slade [Hospital] and I took over its second hand machine, put it in the department and it’s still there working.

CP It’s actually going to be dismantled next week, Frank.

FE Is it?

CP I was in the department this morning and I thought you might like to know that. But it’s done fifty years since you took it over from the dermatologists so that’s not too bad!

FE And, I mean, I used the kind of radiation that was necessary to get the necessary depth dose for the cases concerned. Every, every case was a puzzle to be solved, you see. That was my attitude.

CP But how did you get the cobalt unit built? Tell us about that.

FE Well, I was allowed, I think, three thousand unit, three thousand pounds for a cobalt machine following this visit to the Lord Cherwell and company. And … well, it was not enough to buy a cobalt machine off the peg, you know. So we decided to design our own cobalt machine, and we designed it having regard to the specific activity of the cobalt available, the kind of cases we were going to have to treat, the doses we were going to have to give and so on. And Ray Oliver and I did it between us. And then one day, on the way back from the Swindon clinic, I heard Roger Bannister break the four-minute mile on the radio newsreel and I heard the Jodrell Bank telescope described by the engineer who’d designed it. And he was HC

⁶ Professor Frederick Alexander Lindemann Cherwell.
Hasmond(?), who’d been at the university and at school at the same time as I was, and was a civil engineer. And I rang him up the same night and said would he see to designing and getting made a cobalt machine for us and he said yes. So that was how we did it.

CP So he designed that machine?

FE He designed that machine, and he wanted to make it a more orthodox design at first, but we wouldn’t have that, because we wanted it to be able to fit in here. We … well, we did that and Ray Oliver and I went up to see him. On the way we stopped in Birmingham to see about some couch to work on some brakes that had a dead-mans handle, kind of, setting so that we could use that instead of moving the top of the couch, you see. And I think that worked very well.

CP And that cobalt unit also lasted for about twenty-five years, didn’t it, and was finally…

FE Well, I think it was only got rid of five or six or seven years ago.

CP Yes it was. And it is now in the Science Museum for anybody who wants to see it. It is there, the shell of it anyway. But tell us about some of your other physical, physics advances in radiotherapy. I mean, wedge filters was one and compensators, tissue compensators was another. How did you come to devise those?

FE Well, people were treating the one tonsil by a group of fields from the other side. And it seemed to me a bit silly that we have to go all the way across the neck, and so I tried to think of a way of treating the tonsil from the same side. And I decided that if we thinned the beam out, by using a wedge, we’d be able to do that.

CP Yes, you put a…

FE And so we started using wedge filters.

CP A piece of metal of wedge shape in the way of the beam, didn’t you say? It traversed either the thick end or the pointed end of the wedge.

FE Yes, that’s right. And we used three or four, I think four wedges; two pairs at right angles to each other.

CP And had anybody done that before you did that or was it … that was a new idea?

FE No, no one had done that before, no.

CP Yes. And compensators were of a similar, perhaps, idea.

FE Well, when we got the cobalt machine I was away, I think. I was a member of the International Commission on Radiological Units, and I was away. And Charles Lewis was helping me there, and he treated the first patient with cobalt. But he built
up with wax on the skin so as to make sure of the dose being right. And I said that you lose the advantage of cobalt, of avoiding the build up on the skin. He said ‘Well, you’re always so insistent on the right dose at the tumour.’ I said ‘Yes, but we should be able to do it another way.’ And so I started using compensators.

CP And you had these made for each individual patient, didn’t you, out of aluminium blocks?

FE Yes, yes. And later I asked Ray Oliver and Eric Hall, who were the physicists I had then if they’d make sure that what we were doing was what we thought we were doing. And they wrote a classical article on the physics of it and showed that we were doing what we thought we were doing, but it’d be better done probably with aluminium, because it would be able to do it more accurately, because the brass blocks which gave the least secondary electrons had to be so thin, you see. And all the things were made in our own workshop, and put together by Mr Tidy(?).

CP Yes, well that brings us to the staff in the department. I mean, when you started in Oxford, it was the first time I think that you’d really had a radiobiological and physics team there, I mean...

FE Oh no, no, I had…

CP You had some before, perhaps?

FE I had a physicist in Sheffield, for instance.

CP Yes, I was more thinking of the radiobiology, because I’d like you to tell us a bit about the radiobiological developments.

FE Well, we did some radiobiology in Sheffield. We found, for instance, that the vitamin C in the blood was ten per cent less after a typical breast treatment than before. And I felt that was important. But, and we… Well actually, to get to Oxford; there was nothing there, but when I was still, while I was still at The London Hospital Laszlo Lajtha came to see me. He sent me all his papers and I read them, and he came to see me in the middle of outpatient clinic at The London Hospital, and said he’d like a job. And, well I decided when I’d seen him for a minute that I’d like to give him a job, because he’d obviously, he was obviously very bright and progressive and… So I had an idea that it was important to try and decide whether radiation was due, whether cancer was due to a virus from the Rous sarcoma in ducts(?), and which … where a virus was suspected of being the cause. And I thought first of all it was important to make sure, if we were going to try and treat it, that it was iron, not iron but copper, or something like that as in Tomacomosaic(?) virus.

CP So you, so Laszlo came to start that work off?

FE He came to start. But first of all I had to get him a job in the geriatric unit with Cosin7, and then apply for a grant from the BECC [British Empire Cancer Campaign].

7 Lionel Zelich Cosin.
And then he came into the department to do the research. And after a, a short time I thought well, his fundamental research on the haemopoietic system is more important than what I’ve asked him to do, and so I suggested he should just get on with that. And, well that’s what…

CP   That’s what he did. But then you, you were also gathering others around you. There was Professor Hall, Eric Hall; there was Roger Berry. How did they come?

FE   Yes, well, the first physicist I got was Oliver.

CP   Ray Oliver, yes.

FE   And I brought him from The London Hospital because although I had a terrific lot of faith in Kemp\(^8\) at The London Hospital I didn’t believe in taking away the real brains of the institution, you see. And so I brought Ray Oliver and I had some difficulty in getting him appointed but I got him appointed at Oxford. Well, he was a great success in my opinion, and he stayed all the time I was there. He wanted to leave soon after I left and got the chair at Hammersmith, and worked there for about three years and then got a glioblastoma which killed him.

CP   I know, yes, that was very sad. And how did you recruit Eric Hall and Roger Berry, who were both there?

FE   Well, Eric Hall came as a junior physicist from Cardiff – his first job, I think, after getting a degree. And then he went back to Cardiff and I didn’t want him to go back to Cardiff, so we broke all the rules and got him back to Oxford. And I only found out a year or two ago that Eric Hall had to keep paying back some money to Cardiff because we’d broken the rules. But I didn’t realise he had to do that, but, I mean, I was very keen on keeping him!

CP   So money was just as tight throughout your career as people say it is today, really? And all these people had to be got together by one means and another, didn’t they? But they were an effective team. I suppose, in a way, the culmination radiobiologically of their work, and your work, was in your concept of a nominal standard dose and this slide rule which you had made. [Christopher Paine passes the slide rule to Frank Ellis] Tell us a little bit about that.

FE   Well, I published a paper in 1940 on the relationship of area, depth, dose and so on to skin tolerance and tried to relate it to time as well. And I always considered these things important and I tried to do research in Sheffield in my spare time, but I didn’t have time to publish anything because I was so busy. And at any rate, I decided on certain things, and I did publish a paper in 1940 which a lot of people regarded as a classic, but I regard it now as a bit of a mistake. But it, one learnt from it. And then the question of time and number of fractions and so on became important, and I tried to think of a way of separating them. And I decided that the only way of separating them depended on certain data that had been published and I was responsible to a publication by Cohen(?).

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\(^8\) Dr Lloyd Kemp
CP  A thesis of Cohen, I think, wasn’t it?

FE  Yes, of … who subsequently worked at the Michael Rees Hospital in – have I got that right? – in Chicago at any rate.

CP  In Chicago, I don’t know where.

FE  And, I mean he was a very good man. And I used his work and considered that the difference between a tissue that responded to homeostatic forces and one that did not was due to the time effect, because that was the difference between them. And I thought the typical squamous carcinoma did not respond to hormones, and therefore there was a squamous carcinoma line that Cohen(?) had produced and an erythema line. I just subtracted one from the other and it gave a sort of .11 for the time, and...

CP  Well we can’t go into the details but it was a very major advance this because it enabled people to calculate different fractionation regimes, reasonably within limits, reasonably sensibly world-wide. And many people adopted it, didn’t they? That was why I particularly wanted to… There’s another thing I’d like to talk about [concerning] your time in Oxford…

FE  Well, one thing I would like to say about that is that people have shied off large individual doses, but I think that’s a mistake. Because there was work done by Tureson(?) and Hercheve(?), and they showed that you could make a correction of three per cent for every hundred rads above two hundred per fraction, you see. And it was the kind of experiment that wouldn’t be allowed now, but they got enough information and I find that it gives results that are satisfactory. I mean, I’ve treated an epithelioma of my ear but only had three doses and you can’t see anything wrong.

CP  Yes, well we used to treat a number of those with single doses, didn’t we, and a small volume? But we must move on I think, Frank. And I really wanted to, your other great contribution I think throughout your life has been with short-distance therapy. We started by talking about radium, but then you became interested in radium substitutes and you devised, for instance, this spreader which actually held radium but could hold anything else. [Christopher Paine passes the spreader to Frank Ellis]

FE  Oh this, this I used in Sheffield.

CP  And how did you devise that? Tell us about that, and how, what it was for and how you devised it.

FE  Well, it was so as to have a quick method of putting radium in, fixing it...

CP  If you just hold it up a little bit so people can see the structure of what it is, it’s just...

FE  Yes. The radium tubes go in here [Frank Ellis demonstrates] and one can spread them, which helps to fix them. You can estimate the distance apart – there is a
hole through here, which can enable you to know the position of the tube that’s in the uterus, here. And this article was published in the Swedish journal, and I think it’s the forerunner really of the Fletcher-Suit applicator, because Dr Suit\textsuperscript{9} worked in my department before he went to, back to Texas.

CP Well all these people we are talking about, we did talk about, are now professors or were professors in other places, that’s one of the things about them. So you devised that for treating cancer of the cervix.

FE My brother made it and I used it on… This is the latest design, but my brother made the first design in Sheffield because he was a man who worked with his hands, and worked so as to be able to use the Stockholm applicators in the, in treating cancer in the cervix.

CP And one of the reasons was so that you could really know that you’d got an accurate dose and you could position the sources accordingly. Was this the reason…? When you introduced that into the vagina, you had to pack it with packing at the back. And you of course, some of your fingernails are not quite what they used to be Frank. Do you think that’s because of the radiation from holding the spreader while you packed it?

FE I think, I mean I don’t think it was this so much, but certainly if I was feeling where the radium was going into the uterus, I got a big dose there. But I treated a lot of cases like carcinoma of the anus and had to feel, because I tried not to penetrate cavities…

CP With needles and so on, yes.

FE …but keep the needles in, inside the tissues, you see. And, well, everywhere when you’re using radium you have to feel where you’re putting it, and you don’t get much in these fingers because they’re at the end of the long forceps.

CP So there was some hazard, but now of course with after-loading that doesn’t apply. But I wanted to show this because it was a very significant advance in the accuracy of radiotherapy, wasn’t it?

FE Yes, but I think the thing I’m most disappointed about really is to see people not using, in conjunction with surgeons, implants at the time of operation. That I think is the thing that’s one of the biggest possible advances. And they’ve started doing that at the Memorial Hospital as a routine.

CP Well, we’ll come to that just in a few moments. This apparatus here [Dr Paine shows apparatus] you used for treating lip cancers on the surface of the lip, and that again showed your ingenuity in getting a proper distribution of the sources held by plastic.

\textsuperscript{9} Herman D Suit.
FE Yes, and it can be done quickly without anybody keeping their fingers, getting their fingers burned.

CP Yes, well all these advances happened while I was training and I’m very grateful to you for all the teaching you gave to me in this. Some of them have now, are now after-loaded with iridium wires and so on, but you devised the principles beforehand with radium. But you then had, unfortunately, to leave Oxford because at 65 one gets kicked out, and you went off to the States for several years. Just tell us very briefly about your experience, first of all in Los Angeles.

FE Well, in Los Angeles I tried to relate the NSD [Nominal Standard Dose] to cell killing. And I, they already had a machine which automatically was setting the patient up, but it took such a long time because it did one thing after another, you see. And I left the University of Southern California after a few months because I wasn’t satisfied that what I would have liked done was being done, and I wanted to have a freer hand.

CP Or not quickly enough. And so you went to Milwaukee.

FE I was asked to go to Milwaukee, and so I went. And there I was, I did something… They’d ordered a four million-volt cobalt machine from… Or was it, can’t remember if it was a cobalt or a linear accelerator now.

CP It would have been a linear accelerator.

FE But, but I suggested that they might fix it so that one blade of the collimator could move separately from the other. And that was the first time that had been done.

CP So that was, what is now claimed as a major advance, the multiple-leaf collimator, devised by you. And lastly…

FE Well, not multiple-leaved, I think...

CP No, but you have to start somewhere!

FE Yes, alright.

CP But afterwards you came to the Memorial. Now, the Memorial Hospital in New York is traditionally the place of the surgeon, and one wouldn’t expect the radiotherapist, even in these quite recent years, to have had a look in. Yet you left the Memorial a household name, having electrified them all. And how did you do that?

FE I didn’t know I’d electrified them! But I was very keen then on, well, joint clinics, which I used to attend. And I managed on one occasion at any rate to show that I knew a bit more anatomy than the surgeon! And … in, actually the thing I was keen on was simultaneous implantation at the time of surgery. And I did one or two cases which were successful, and of course one case which didn’t have a chance to be successful because the patient was too old and died. But they have since carried out a randomised series of radiation, at the time of surgery versus amputation which had to be for limbs of course, and found that radiation, implantation at the time of surgery...
CP Well, they remain convinced of that.

FE …because a surgeon I’d seen elsewhere had done something contrary to what I thought should be done, and done what I thought was a completely unnecessary four-quarter amputation.

CP Well, that was a very great advance to make. Now, just for the last few minutes I’d just like to turn to some other things that you’ve done. First of all, you’re a painter, and you have painted your own portrait and we have got it here behind the cabinet. So I’m just going to hold it before the camera. [Christopher Paine shows the painting] And this is your portrait, which you very kindly gave to me a few weeks ago, and it may not be perfect but it’s a pretty good likeness as far as I can see. Tell us about your painting.

FE Everybody recognises it as me, that’s the important thing! But they say it doesn’t look like me because I look too serious, but I reckon you can’t paint and not look serious because you have to concentrate on what you’re looking at.

CP Have you always painted, though? Or for many years?

FE No, I didn’t start until after I came back from America and I’ve not done much since. But I’m intending to try again.

CP Yes, well, it’s obviously something where you have great skill. And your skill was developed at an early stage because in your book of travels round Europe in 1930 there are not only pictures, illustrations drawn by you of patients with various needles in them here and there, but also lots of buildings and other things. So I can see where you gained your artistic talent.

FE Really? I see, I didn’t remember that.

CP And tell me one last thing. You were interested in the International Cancer Centre in Neyyoor, in southern India. Why should you be interested in that, miles and miles away on the southern tip of India?

FE Well I’m, I mean as you can see my first job which I tried to do was in southern Rhodesia, and I’ve always felt that if I could help in what is called the third world I should like to do so. And I belonged to a committee that was called the International Cancer Centre at Neyyoor, and I don’t really know how I got into it but I did. And I’d been there, and actually on one occasion when I went there I went to see a patient who was being treated and I felt they were missing the patient! And so I suggested that it would be a good idea now to implant the rest of it and I implanted the thing while I was there and took out the radium at the right time for, and then left. And I was told two years later that the patient was all right, but I felt if they’d gone on with the external radiation they’d miss the tumour.
CP  The beam was not being aimed correctly at the patient, no.  But, I mean, your philosophy of life as I have observed having being your registrar and so on has been to help always the individual.  And perhaps we’ve borne too much on the technical during this talk but, in a way, your only interest has been for the individual, hasn’t it?  In trying to…

FE    Well, for the individual patient.

CP    Yes, that’s what I mean.

FE    But I’m very much interested in helping communities.  I mean, I feel that … well, I’ve got a project.  I want to arrange things so that in time there won’t be any war, to help the whole world by simultaneous education of children and adults.  And it will take several generations to do it but I don’t see why it shouldn’t be possible.

CP    And how are you trying to pursue that one at the moment?

FE    I am trying to get in touch with some … do you want me to specify the names?

CP    Well, I don’t think it matters, I mean you can…

FE   With Mandela and Carter, President Mandela and President Carter, because they’re of sufficient stature, stature and interest to be able to further it with the United Nations, and with people like Rupert Murdoch, because I think that they’ve all got to muscle in and be prepared to do something over generations.  And to realise that it’s going to be to everybody’s benefit, especially to Rupert Murdoch and his like for there not to be war, because if there were another war they’d lose everything as everybody else would.

CP    So to stop another major war is really your great ambition now.

FE    It was through reading, which Einstein said if we want to stop war we’ve got to change peoples’ attitudes, and I want to change peoples’ attitudes and make them all into good global citizens.

CP    Well, all the best of good fortune in that.  Have you had replies from these people or not?

FE   I’ve had replies from some people, and I wrote a letter yesterday to somebody who I think might be able to help me to get in touch with Mr Mandela.

CP    Yes, oh that’s good.

FE    Well, I hope so.  That’s all I can say!

CP    Tell me another thing about your personal life.  I mean, you are a Quaker, and have been all your life.  I mean what...

FE    No, not all my life.
CP Ah. But what, what is your view of religion and the world, you know?

FE Well, I believe in what Jesus taught. He said ‘Love the Lord thy God.’ Well, as far as I’m concerned nobody knows what God is, and so I think it means loving the truth. ‘Love thy neighbour as thyself,’ which I have been trying to do all my life, and ‘Forgive your enemies.’ And I wish the pundits in religion would emphasise the last thing a bit more than they do, because if people forgive their enemies there wouldn’t be all this fighting and killing.

CP Do you think the Society of Friends is fixed on those targets?

FE I don’t, I don’t know what they’re fixed on. I mean, the point about the Society of Friends I think is that people can have their own views and I think broadly speaking you just have to be a Christian. And I stopped myself a little while ago and said ‘Am I a Christian, and is that what I ought to be?’ And I decided I was, and that is what I ought to be.

CP But I’m sure you have thought about it repeatedly during your life…

FE Oh yes.

CP …in different ways.

FE Yes. And, well, I’ve got other thoughts as well which have been developing recently.

CP You don’t want to tell us about those, before we...?

FE Well I, I’m beginning to wonder to what extent people should be allowed to do what they like to do, irrespective of what it might seem to them to be doing, you see. I believe that you’re doing something wrong if you know what’s right and what’s wrong and do the wrong thing purposely. And … well, it sounds very pie and all that but I feel, I’ve just been getting new views about these things and I’m hoping to get a chance to clear my mind about them.

CP And if you had to think of your life again, would you still do radiotherapy if you were given the option, as you were? Or would you rather do a, a different branch of medicine do you think?

FE … I think if I’d known I might have gone in with Bradford Hill and if I’d gone in with Bradford Hill, I think I would have had a different life altogether. But I didn’t know him and, as I say, I think I’ve been in the habit of making up my mind too quickly.

CP But you’ve enjoyed your life as a radiotherapist?

FE Oh, I’ve enjoyed life because I’ve never looked back and regretted what I’ve done and I’ve always looked forward to what I’m going to do, I think.
Well, it’s quite plain you’re still doing that. But just before we conclude, I’ll just mention these books. When you were at Sheffield, when you left Sheffield you were given this very nice book with a marvellous inscription in it for your work as director of the Radium Centre by Sir Roger Matthews.

No, Sir Ronald Matthews.

Sir Ronald Matthews, that’s right.

Who used to be head boy at Eton.

Oh yes. Well, it’s a beautiful book and there’s a whole series of these books. Here is the one when you left The London Hospital, collected papers, and an even fatter one when you left Oxford, because of course, partly because you’d had a large team working for you at that time.

Yes. I never wrote a paper in hospital time. And, you know, I started working, getting up at five o’clock in the morning to work. And that allowed me to write things which I otherwise wouldn’t have had time for, because Richard Doll came along and said would I look through some notes and … try and estimate what doses they’d got, people who’d been treated for ankylosing spondylitis? And I said I would, and then he said ‘We want the answers in a month.’ And I said ‘Oh, all right.’ And I had intended, you see, the notes might be looked at by Lajtha who was medical, and by Ray Oliver who was a physicist, and we’d divide the work. But … when I saw the notes, the hospital notes, you know, they were so frightful…

That you had to do them.

I felt [I] had to do it myself. And I reckoned there was a hundred hours work, and he said he wanted them in a month, and so I started getting up at five in the morning to avoid a petition for divorce! And…

And you did it. Frank, I’m very sorry, we’re going to have to come to an end in a moment, but the answer is you did it, didn’t you?

Yes.

Thank you very much for talking to us, it’s been very interesting to hear so many things I hadn’t heard before. Thank you very much.

Oh yes, right.