

**Sir Andrew Huxley OM FRS in interview with Lord Walton of Detchant.
Trinity College, Cambridge, 29 May 1992**

Interview One

JW Sir Andrew, as you know, this series of recordings for the video archive of the Royal College of Physicians has been in progress now for some years, in which various members of the medical profession and distinguished scientists who have contributed to medicine have been interviewed. This is a kind of complement to the biographical data in *'Munk's Roll'*, and I'm very grateful to you for agreeing to talk to me today here in your room in Trinity in Cambridge. I'd like to begin, if I may, by asking you a little about your early life. You were born in 1917, where?

AH In Hampstead, London - Bracknell Gardens to be precise, about a mile from the Heath, where my father used to take me on walks on Sundays.

JW You bear a very distinguished family name and you must, therefore, have some recollection of the other Huxleys who before you made major contributions to science.

AH Yes, of course the most famous in the family was my grandfather T H Huxley. Well, I was sort of disproportionately young because my father's first wife died young and I'm a son of the second marriage, so my half-brothers Julian and Aldous, well Julian was thirty years older than me, so they were more like uncles than brothers. But yes, that's my relationship to the famous members of the family. But my grandfather died twenty years before I was born so I never met him. Though, of course, it is common for people to know their grandparents, in my case, as I say, the interval between generations was exaggerated.

JW Yes, well of course I remember Julian on the Brains Trust when I was a boy and I also remember reading *'Chrome Yellow'* and other works by your half-brother Aldous - very well known names. You went to University College School and then on to Westminster School. What are your recollections of your school days?

AH Yes, University College School, there's a junior school, I'm not sure whether it's still there, up quite near the Heath in Holly Hill. And then I had a year in the senior school in Frogmore and then my parents moved me to Westminster. Well, I was a shy boy; I was very shy when young. I'm a bit surprised at the extent to which I seem to have got over it with age and experience. But I was a day boy all the time, I was never at a boarding school, but I enjoyed my school life. I haven't any friends whom I met through University College School with whom I've kept up: yes, several from Westminster.

JW At what stage in your schooling do you think it was that you decided that you wanted to go in for science?

AH Well at Westminster I was a classicist and I went on with classics for a year after school certificate and I did get to the point of actually enjoying some of the classics. I did one play of Sophocles and I went through a few books of Homer and a lot of Cæcilius. But it was clear to me and to my parents that my real interests were in mechanical things. Yes, I made things out of Meccano. Well, my parents gave to my brother and me a metal working lathe when I suppose I must have been about twelve at the time. It's a good instrument, I still have it and I use it for building my own equipment and I'm using it now. And that sort of thing, and yes toy trains, 0 gauge.

JW I see. And then you came up to Trinity College.

AH Yes, actually my mother had some difficulty persuading the then headmaster of Westminster to let me switch. There was a strong classical tradition there, and my mother says that he used the phrase that I was 'forsaking virtue for pleasure', which shows something about the attitudes of some public school masters at that time.

JW And you chose physiology from the beginning, did you?

AH No, no. I was taught physics extremely well at Westminster. Our teacher was Rudwick, he was really quite first-class. Chemistry was not so well taught and I never enjoyed it. But physics was clearly the thing that I was interested in and enjoyed, as I say, with primarily mechanical interests. And I came up to Cambridge expecting that I would specialise in physics and go into either physics or engineering, but under the Cambridge system, it's not much changed now, but the natural sciences tripos is divided into what is normally a two year part one and a one year part two. And in part one in those days, roughly, one had to do three experimental sciences. I naturally did physics and chemistry, but I had to find something else and a school friend, whom I'd really known in Hampstead through a family connection, Ben Delisle Burns a physiologist, Fellow of the Royal Society, was I think just starting physiology part two and he told me physiology was a nice lively subject. So, since I had to do something, probably something unfamiliar, I put myself down for physiology in part one and got interested in it partly for its own sake and partly because I'd been so well taught in physics at Westminster that much of the first couple of years at Cambridge were going over old stuff. Of course, what one was learning in part one in physics was stuff that was cut and dried for certainly, yes, I suppose rather little of it that was cut and dried for less than a hundred years, but physiology was largely new and even controversial material in part one. Also I was well taught in supervisions, in a small group, teaching with one or two or commonly alone, principally by William Rushton and Jack Roughton who were both fellows of Trinity at that time, both dead now - both their widows are still living in Cambridge - and also through meeting people a year or two senior to myself in Trinity, David Hill, D K Hill, also a Fellow of the Royal Society and son of A V Hill, and Alan Hodgkin.

JW Was it Hill that interested you particularly in muscle, do you think, or was there anything that directed your research interests in that direction, even when you were an undergraduate?

AH No, I don't think I took any particular interest in muscle as an undergraduate, no, I don't think I did, and, of course, my first work in research was not on muscle, it was on nerve. No, I really got interested in muscle through being asked to give

lectures to the part two after the war, after I'd come back to Cambridge, and yes I took over from D K Hill, who himself had come back to Cambridge. We had been together again during the war, anti-aircraft gunnery and such like things.

JW What would be your most abiding memories of your undergraduate time in Trinity, leaving aside the scientific training?

AH Well, I did part two physiology, actually, in a fourth year because, having decided to do physiology, I was advised to read medicine, largely for career reasons, so I spent my third year dissecting the corpse and did part two physiology in a fourth year. And it was an extremely agreeable group of people taking it in that year: John Waterlow, whom you probably know, John Gray, who became secretary of the Medical Research Council, John Black, you may know, A Neuberger well-known pharmacologist, Andrew Barlow, two extremely nice girls, both now dead, (?) Mallory, who was the daughter of the Mallory who was killed on Everest - she died young, I think about forty years ago of breast cancer - and Ruth Gill who died only a few months ago. She married one of the Mitchison family, Denis Mitchison, whom I expect you know.

JW Yes of course. Now what then? You were going ahead with medicine but never actually went in to the clinical course.

AH Well, at the beginning of the war, the obvious thing was to go ahead and to get qualified, but I had been planning to do a couple of years research before going to do clinical work, so I had not got a place at a medical school. And there were a moderate number of us, I suppose there may have been half a dozen or perhaps eight or ten in this same situation. Now, at that time, the Regius Professor of Physic was John Ryle who had been a famous clinical teacher at Guys. He loved teaching, he hadn't got anyone to teach, and here was a group of us needing to be taught. So he started up an introductory clinical course at Addenbrookes, the Cambridge hospital. The teaching was principally by him and R A McCance, whom I sure you know.

JW Yes, a leading name in nutrition.

AH Yes, he was then Professor of Experimental Medicine at Cambridge. Now, this ran for six months and I then got a place at UCH [University College Hospital] medical school in London but then when the bombing of London began, well most of the students were already evacuated from London, but I was in fact at the hospital in Gower Street, the teaching came to an end and I got diverted into totally different war work. So I didn't complete but I did have the best part of a year of clinical study which I'm very grateful for, I found it extremely interesting. If I had, in fact, completed in medicine, I don't know whether I would have returned to physiology or whether I would have made a clinical career, but I simply don't know.

JW Nevertheless, it explains your continuing interest and knowledge in many medical matters which you've exploited so effectively.

AH Yes, and I think it is important. Most of my career has been in teaching posts with the majority of my students being medical students and it's important that teachers of medical students should see how things look from the clinical angle.

JW Now, you went into work in operational research, in Anti-Aircraft Command, for two years and then for another two or three years with the Admiralty. What was the nature of that work, and in what capacity? Presumably it wasn't the uniformed branch, or was it?

AH No, I was briefly in uniform at the end of the war but this came about through A V Hill, whom I mentioned. He had been one of the pioneers of anti-aircraft gunnery in the first world war. He was the principal author of a text book of anti-aircraft gunnery, a multi-author work of which, I think, seven or eight of the authors either already were or later became Fellows of the Royal Society, so it's a very distinguished volume. But from the beginning of the war, he was one of the MPs for Cambridge University. I think he was chairman, he was certainly on the parliamentary and scientific committee. Through this he was in contact with General Pile, GOC Anti-Aircraft Command. He recognised that Pile needed a scientific adviser and he put Pile in touch with Patrick Blackett. Did you know him? But you certainly know he was the discoverer of the positron, a very great physicist. Well they hit it off, and Pile appointed Blackett as, I forget his title, I think it was chief scientific adviser. And then he wanted a few assistants, a small staff, and of course a majority of people with a training in physics were already busy on other war work, so A V Hill, proceeded to supply Blackett with a staff of physiologists. Leonard Bayliss, the son of the famous William Bayliss, Leonard was then a reader in physiology at University College where A V Hill worked, and then A V's own son, David, and through him myself. So, we started off as a team of physiologists, but all of us with a fair amount of background in physics, as a team doing what was called operational research. The problem at the time was principally the application of radar to anti-aircraft gunnery, to blind fire at night, and adapting predictors for use with the very erratic data that you got from radar of those days compared with the visual data for which the predictors were designed. They were designed to be used either in daylight or on aircraft that had been caught in searchlights at night, but radar gave very much poorer information, so there were all sorts of problems in applying the data.

JW Now during this period, were you working in Cambridge, because I see that you were elected a Fellow at Trinity at the very unusually early age of twenty four, I think, in 1941, while you were working for Anti-Aircraft Command?

AH Yes, I was elected under wartime regulations. In the ordinary way these fellowships, well, in those days probably about four were awarded every year and normally awarded on the strength of a dissertation describing research work done in the first three years after graduation. Now I just did start research in collaboration with Alan Hodgkin, who was four years senior to me, in the few weeks immediately before the war, and I was told that I could submit a token dissertation, a few pages based on this.

JW Not by chance the giant axon of the squid?

AH Yes, it was. So I put in a token dissertation and, as I say, the college made wartime rules under which people could be exempted from submitting a full dissertation. Well, I was elected on that strength. Yes, I was youngish but in fact it was at the end of my third year after taking my degree, so it was the last time at which

under the rules I could be elected. Alan Hodgkin was elected a good deal younger. He was elected after only one year of research and after a three year first degree, so he was elected four years after coming up as an undergraduate: I was elected after six years.

JW So when you came back after the war, you held a succession of appointments: director of studies, demonstrator first, then director of research, then reader in experimental physics and then the Jodrell Chair of Physiology up until 1969.

AH Yes, the Jodrell Chair, that was at University College London, the other posts were at Cambridge. Yes, initially I was a junior research fellow at Trinity and I held a demonstratorship - I think equivalent in many universities to an assistant lecturer - in the physiology department, and then while I was still here in Cambridge I became assistant director of research, equivalent to a lecturer but with a lighter teaching load. And I had one year as a reader before moving on, and in the college I became one of the directors of studies directing studies and giving supervisions, small group teaching in college.

JW I am sure we would all love to know what it was that inspired you to work on muscle, and what you would regard over those years as being your major contributions to knowledge about the physiology of muscle.

AH Yes, of course, you, as it were, are skipping the work I did with Alan Hodgkin.

JW I am a little bit, but perhaps you'd like to comment on that at this stage.

AH Well, in so far as we're going chronologically, I had one or two invitations to work with different people in physiology, although this really arose just before the war when I took my degree, but I accepted Alan Hodgkin's invitation to join him, as I say, and we did do a small piece of work immediately before the war. This was at the Marine Biology Laboratory at Plymouth using giant nerve fibre that squids very conveniently possess. We pushed an electrode down inside so that we were able to record the full size of the electropotential change between inside and outside and there was this surprising result. Of course, we all knew that it started electrically negative. The general story at that time was that it went towards zero, that what happened was more or less of a short circuit through the membrane, created by the membrane becoming permeable to all ions. This was Bernstein's theory dating from 1902. But we found that it didn't merely go towards zero, but it overshoot and went strongly positive. But we didn't have an explanation for that until after the war. Well, of course, that was Hodgkin and Katz who in 1947 showed that the amount of the overshoot and the existence of the overshoot depends on sodium ions in the external solution. But when we joined forces again after the war, the major work, for which we shared part of a Nobel Prize in '63, was measuring the current voltage relations of the surface membrane. Well, the current, voltage and time, and the way in which these currents varied, particularly with the concentration of sodium ions in the external solution. We could separate the current in to the component carried by sodium ions and the component carried by the potassium ions, and we fitted equations to the way they varied with membrane potential and time, and then solved those equations numerically and showed that they gave a good simulation with the spontaneous action potential. So it was at that level of sort of gross current through

the membrane. It was a fairly complete account of the electrical properties that give rise to excitability of nerve membranes but also muscle membranes and the membrane of heart cells.

JW Well, you've clarified a point for me, which I should have known and hadn't realised, that your Nobel Prize was jointly awarded with Alan Hodgkin for that work. I'd always thought that it was to do more with the sliding filament theory. Tell me about the Nobel Prize then. Did you have any inkling that you'd been nominated for it or did it all come as a great surprise?

AH Well, when it finally came it was not altogether a surprise because two years before there had been a false alarm and a newspaper came though saying that it was going to be awarded to Hodgkin and me. I can't remember whether Eccles was included in the rumour or not, but now, I think, that year in the end it went to - was it Békésy for his work on the ear?

JW I see.

AH Yes, marvellous work, and the next year it went to Watson and Crick and Wilkins the most famous work of all, the structure of nucleic acids, and then the year after that it did in fact come to us. So we were forewarned to the extent that we'd had a false alarm, but I got quite a lot of pleasure out of the false alarm, to know that one had got near enough for it to be a public rumour. Even if it hadn't materialised later it would have been a very nice thing to know about.

JW The ceremony must have been an extremely moving one, was it?

AH Yes, well they do make a marvellous thing of it. It's the one occasion when for a week I've been treated more or less like royalty. A young man from the Swedish foreign office is appointed to look after each prizewinner, so one has no trouble whatever. He organises events and transport and so on and there's a whole series of parties of one kind and another. There's the ceremony itself, it was then in the opera house, and one gives the Nobel lecture. There is this splendid banquet. It is a marvellous time.

JW And you must have enjoyed going back again with many former Nobel prize winners for a ceremony a few years ago.

AH Well, actually just last year. I think there was a general get together some years ago which I wasn't able to go to. But just last December they celebrated the 90th anniversary of the first award by inviting all prizewinners back and it was extremely enjoyable. But of course one didn't get quite the same personal treatment as the prize winners, but took part in all these splendid events and the dinner in the City Hall. Well, there was a much greater number present and it was even more splendid than on the original occasion.

JW Now let's come back then to your move from Cambridge. It must have been a very considerable wrench in many respects to leave Cambridge to go to University College in 1960.

AH Yes, well may I tell you another anecdote relating to A V Hill.

JW Please do.

AH A V Hill had started in Cambridge before the First War. Well, he did the mathematical tripos for his first two years and then moved into physiology. And during the First War he was one of the originators of anti-aircraft gunnery, and then returned to Cambridge immediately after the First War and was comfortably established with a university and college appointment when he was offered the chair at Manchester. And he was naturally in some doubt whether to leave the comforts of Cambridge. But at that moment Rutherford had returned from Manchester to Cambridge, so A V Hill originally at Trinity where Rutherford had come back, asked Rutherford's advice. And A V Hill....well, when I was offered the chair at UC [University College] to go there in '60, A V was there and had been there for many years. And he wrote to me encouraging me to accept and saying that he had received advice from Rutherford and that he had followed it and never regretted it, and the advice was: Cambridge is a splendid place when you're young and Cambridge is a splendid place when you're old, but for the middle of your life, for God's sake get out!

JW I see yes.

AH And I had friends at University College, John Gray whom I'd mentioned, who'd been in our part two class and whom I had indeed known in Hampstead from the age of six or something. He was in the physiology department at U C L. And, I mean, in Cambridge the competition is severe, there's something of a shortage of space, and clearly going to University College London as head of department gave more opportunities for developing my work.

JW Was Bernard Katz there when you moved there?

AH Yes he succeeded A V Hill. A V had this - it wasn't even called a sub-department it was a sort of unit of biophysics within the physiology department and when he retired in about 1952, I'm not sure of the year, Bernard Katz succeeded him and it was made in to a separate department and it then became the department of biophysics. And yes Bernard was there with the staff that he inherited from AV Hill, strong characters such as Parkie, Parkinson [J L Parkinson], A V's technician.

JW Well now, forgive me if I steer you back again because through our mutual interest in muscle, myself in the diseases and yours in the physiology, we must hear a little bit about how you got into muscle and the kind of contributions that you made.

AH Yes well, it was really through giving lectures on muscle that I became interested in it. As I mentioned, D K Hill, who I'd known here before the war, he had been together with Anti-Aircraft Command, he came back, as I did, very soon after the war, and had already been following his father in working on muscle and he was the natural person to be giving the lectures on muscle to the final year of the part two course immediately after the war. And then a couple of years later he moved to the post of physiologist at the Plymouth Laboratory of the Marine Biological Association, the place where we did our squid work, and I was asked to take over his

lectures on muscle. I had no special knowledge of muscle but he gave me his lecture notes and I duly read it up and gave these lectures and became interested and in particular I learnt from these lecture notes of a phenomenon that was almost completely neglected at that time, but which had been common knowledge at the end of the last century called the reversal of striations. All our voluntary muscles and all muscles of all arthropods have little stripes across them which principally show alternations of higher and lower refractive index, higher refractive index simply due to a higher concentration of proteins in those bands. And it had been repeatedly observed in the last century that when one of these fibres shortens sufficiently, the region that had had the lower refractive index came to have a higher refractive index, so the appearance reversed. Well, I've had an interest in microscopes since boyhood. Again there were family microscopes around, not Huxley ones by the way, but on my mother's side there were microscopists in the last century, and again my parents gave us one of these small - not really a toy - a useful but small portable microscope. And to investigate details of change of structure, which are differences of refractive index, this is not altogether straightforward, as an ordinary microscope is designed for making a good image of structures which absorb light. Now in a muscle fibre there's almost no absorption of light, and the striations and other structures are seen because they have higher or lower refractive index. Now, with an ordinary microscope you get some sort of an image by deliberately going out of focus, the image you get has reversed contrast according as you're focused above or below. This is not bad on a really thin muscle fibre with broad striations, and the nineteenth century work was done on thin fibres from the legs of insects, and beetles in particular. But these muscles don't give all or none contractions, it's not easy to put them to a full state of contraction. On the other hand, with isolated fibres from the leg of a frog, it had been shown by Ramsey and Street in 1940, it is possible to dissect out these fibres in a perfect undamaged, living state, that give full blown twitches or tetanic contractions and they will go on doing this for many hours. But those are thick fibres, typically a tenth of a millimetre across, and the striations are rather narrow, two or three micrometres, so the diameter is perhaps fifty times the spacing. Now, this is an almost impossible specimen for the ordinary microscope. Attempts had been made by various people between the wars and had reached totally wrong conclusions. Now, phase contrast is an ingenious trick for making differences of refractive index visible in a very satisfactory way with the light microscope but it does not work well on thick specimens. Another way of looking at muscle fibres which does give a good image is to use polarised light. The high refractive index bands have this property of birefringence. Polarised light gets altered in its characteristics so that when you look with a polariser and analyser, you get a dark background and these birefringent bands show up bright. Now, you can use a fairly high aperture in the objective and get a satisfactory image, but the nineteenth century reports of this phenomenon of the reversal of striations were that the phenomenon did not occur in polarised light, the birefringence did not reverse but the difference between simply high and low and ordinary refractive index did reverse. So it needed a microscope of a different type to get a good image showing refractive index differences in a thick specimen. Now, what you need is an interference microscope, and from my interest in microscopes I already had a scheme in mind for making such a thing. So when Hodgkin and I got to the point at which we couldn't see how to make progress on nerve - there's been tremendous progress since but using techniques that couldn't be foreseen at that time - I had this idea of what might be an interesting experiment on muscle which would also allow me to exercise my hobby of microscopy. So, I settled down and with help

on the optical components from the firm of R and J Beck, who were extremely helpful, I built first a low power instrument and then a high aperture - well it was aperture 0.9 - system that gave very nice images of the striations, and that was how we got started.

JW So the rest in a way is history, isn't it, because that in a way led on to your subsequent work which confirmed the sliding filament theory of contraction.

AH Yes, well actually we got on to sliding filament idea simultaneously with Hugh Huxley and Jean Hanson.

JW Who of course is a namesake but no relative.

AH Yes, very confusing, but we got on to it as well. As I say, we were looking for this reversal phenomenon when the fibre is stimulated, and indeed we did see it later on, but as soon as we looked at these fibres under the microscope - you can stretch them out - and it was immediately obvious that the width of the high refractive index bands stayed virtually constant when the fibre as a whole was stretched. And this was the reverse of what was in every text book and it immediately suggested that the high refractive index was due to little rods in the A bands, that's to say the thick filaments. And I did this in collaboration with a German, Ralph Niedergerke, who had learnt something of the nineteenth century German history of physiology when a student and he told me that he thought he had a memory of something of this kind in the old literature, particularly from Krause, and I followed this up and this was all common knowledge from 1870 or so till early this century.

JW Of Krause bulbs?

AH Yes, and the end plates. He had this famous book 'Die motorischen Endplatten'¹ and it's in that book he describes both the A bands, the dense bands staying at constant width, and the fact that you can dissolve them away with myosin solvents.

JW Fascinating. Well, Andrew, if I may, what I'm going to do now is divert you for a moment from science and talk to you a little about your family life. You were married in 1947, and have one son and five daughters. Your wife is also a scientist.

AH Well, she read natural sciences at Cambridge, including physiology and yes, I was teaching her when she was an undergraduate. She'd been in the States like many British children, Cambridge children in particular. She was evacuated to family friends in the United States, an absolutely marvellous family and she was very happy there but came back to enter Newnham. Her father was a well known geneticist of poultry, Michael Pease, working in Cambridge and living in Girton Village. My wife's mother was a Wedgwood, of the china family, Wedgwood china. She was originally one of six children.

¹ Krause W (1869) Die motorischen Endplatten der quergestreiften Muskelfasern. Hanover, Hahn.

JW Somewhere in the family, and I'm not quite certain where it is, not only your relationship to the other Huxleys whom we've talked about, but there's a relationship to the Darwin family. Is that right?

AH Well, my wife was connected to the Darwin family through Wedgwood because Charles Darwin's mother and Charles Darwin's wife were both Wedgwood. His mother was a sister of Josiah Wedgwood the second, and his wife was one of Josiah the second's daughters. He married his first cousin. So that was, at that time, the only actual sort of link between the families. More recently one of my nieces married George Darwin who was, I think, a great grandson of Charles Darwin. Richenda and I met at a dance given by the Barlow family whom I got to know, as I said, through Andrew who was my exact contemporary. Yes we did some of our dissection together. He too switched to medicine after an engineering part one and we were doing part two together. They had a dance at Sir Alan's house near Wendover each year before the war, then just after the war, and Richenda was there as a cousin.

JW Some of your family then, have they gone into science?

AH Well, our son is an engineer, a mechanical engineer, whether you call that science or not, is a debatable point.

JW Well certainly.

AH Well not all engineers would welcome that.

JW I appreciate that.

AH But he's been very successful and as I said much of my original interest was of a mechanical kind and much of my scientific work has been developing my own instruments. I was amused after I'd gone into physiology to re-read my grandfather's autobiography in which he said - he was a medic - that the only part of his medical studies that really interested him was physiology and his original ambition had been to be a mechanical engineer but he went into medicine. I think he had two medical brothers-in-law and the only part of the course that really interested him was physiology because it was the mechanical engineering of living things. And his ambition was to go into physiology but there were no posts in physiology, in England at any rate, but he applied for posts in, I think, Canada and Australia without success and finally accepted a position as naturalist and palaeontologist at the Royal School of Mines. But he accepted it on the understanding that if a post in physiology came up he would probably move into it. Well, it never did and his work was all comparative anatomy and palaeontology.

JW I'm going to switch again, if I may, this time let's turn to some of your very distinguished presidencies. The British Association for the Advancement of Science for a year from 1976, was that an enjoyable experience?

AH Yes, it is a one year presidency. The new president is inducted at the end of the annual meeting and his principal duty is delivering the address at the beginning of the next one, so I did it in 1977, which was based at Aston University in Birmingham. But during that year, the president, I think, chairs meetings of the main committees

and so on, so for a rather short period he is involved with the policy of the association. And I did remain associated with it for some years afterwards.

JW Having been a Fellow then of the Royal Society from 1955 you reached the pinnacle by becoming the president in 1980.

AH Yes.

JW In the meantime of course you got the Copley Medal from the Royal Society in '73. Tell me a little about that before we come to your presidency.

AH It's the top medal that the Society awards. I forget the actual wording of the citation. The president each year, before his anniversary address, awards the medals and says a short piece about them, but it must have referred to my nerve work and to my muscle work. Yes, by '73 I had done several substantial pieces of work on muscle by then.

JW And then the presidency, five years, and that must have been in many ways a challenging, but at the same time, a fascinating experience.

AH Yes, it was. With a very agreeable set of officers and staff at the Royal Society, we got on very well together.

JW If you had to summarise in a sentence or two what you see as the principal roles of the Society in British scientific life, what would you think that they are?

AH Well, there are two or three different threads to this. Of course, electing the Fellows each year is an important thing. It's an important way in which scientific achievement is recognised, but on the larger scale it's the body that represents British science internationally. It has exchange agreements with, I think, about forty or fifty different countries so it's one of the two principal routes for scientific exchange, the other being through the British Council. On the whole, the British Council operating with education establishments in other countries while the Royal Society operates in collaboration with academies in other countries. And the other principal role is advising on science policy. It is a fully independent body. It receives money from the government, but that's all for specific purposes and it has enough funds of its own to remain a genuinely independent body. So it can say what it thinks about policy generally, and it is sometimes consulted by government, and it sometimes puts out statements about policy on its own accord. But the most important thing we did while I was president was starting up the scheme, which is still running, of awarding what are referred to as university research fellowships. These are research fellowships, post-doctoral fellowships for young people. The great difficulty at that time, which still persists, was the shortage of long term appointments, appointments leading to tenured appointments in universities in Britain, and this made a very discouraging situation for young people. And these research fellowships awarded by the Royal Society - I mean distinct from being a Fellow of the Royal Society - are short term research fellowships. These were designed to tide over the interval until substantial numbers of retirements would be coming up under the ordinary ageing process. And they're awarded initially for five years with the possibility of extension for a further five years, and not quite an undertaking, but some degree of understanding from the

university that there would be a good prospect of the people moving on into university posts when they came up. This has been a successful enterprise.

JW The Royal Society research professorships of course have existed for some years. You had one yourself after giving up the Jodrell Chair. Was that to allow you to concentrate primarily on research rather than teaching and administration?

AH Yes. And I had done nine years in the Jodrell Chair and I felt that was long enough, time for someone else to take over. This is exactly what happened to A V Hill. In the earlyish 1920s he moved from Manchester to University College, to the Jodrell Chair, succeeding Starling who had done exactly the same. He had held the Jodrell Chair and was given one of the Royal Society research professorships.

JW How many of those are there?

AH Well, there are now, I have in mind the number eighteen. Now I can't remember whether that does or does not include a few named ones, the Foulerton, the Napier and so on. But after the second war and before I was president, the Royal Society got additional money from the government in the government grant to establish more of these professorships, which are very nice things to hold, with a professional salary plus a substantial allowance for research expenses and for secretarial and technical assistance.

JW Are these appointments made by invitation, nomination or by application?

AH By application. Yes, I think when I applied Bernard Katz was biological secretary of the R S and I think it started with me muttering to him, asking whether I'd be eligible if I applied. But the result is I've never really had to apply for a full-scale research grant. Until that post I was supported on university money. Well, starting with Alan Hodgkin, he had a grant from the Rockefeller. I started helped by that and then virtually entirely on university money until I became a Royal Society research professor, and then that provided what I needed beyond ordinary university funds.

JW Now, you were knighted in 1974, that in itself is a moving ceremonial at the Palace, but then you joined an exceptionally select band by becoming a Member of the Order of Merit in 1983. Does that involve a rather similar ceremonial occasion?

AH Not similar, it involves something like a quarter of an hour private interview with Her Majesty. It's an award that's very specifically in the sovereign's gift, as opposed to the usual honours system which goes through all sorts of committees and things. I've no idea how she's advised on this but it's a particularly attractive thing to belong to, representing science, the arts, music and literature. Technically, it has a military and civil division, but I think at present there's no member in the military division, and it's limited in number.

JW Yes indeed. Well, I suppose you would regard it in a way, as a Trinity man, an association which will soon be amounting to sixty years, the pinnacle to come back as Master in 1984. Was that an invitation again that you half expected or was it one that came as a surprise?

AH Of course, there was speculation in newspapers. No, I certainly didn't expect it, but mine was one of the names that was being bandied about so it was a possibility. Of course, that also is a crown appointment, but in that case it's definitely on the advice of the Prime Minister's office.

JW What would be the highlights, do you think, of your six years as Master of this very notable college?

AH Yes, and I think there may have been five presidents of the Royal Society who've also been Masters of Trinity, including the present Master and also including J J [J J Thompson] as well as Hodgkin and myself. Actually, I have had a relatively quiet time as Master of Trinity, for which I was grateful. The Master has, partly because of it being a big college and partly because of the Master being appointed externally, probably less administrative duties than he does in most colleges. He chairs the College Council and he chairs meetings when all the fellows get together for major decisions, but otherwise things are done by committees and by the senior bursar, the junior bursar, senior tutor, the dean of college and so on. So it has a substantial figurehead element, and standing in reserve in case some division amongst the fellows happens that has to be resolved. I was fortunate in that there were no serious....

JW No C P Snow type crises while you were here?

AH No. One or two other colleges did, which I expect you know about. But I was very grateful that nothing of that kind happened. The College Council was very kind really, I had an easier time. But there were major things going on in the college as we'd already begun - well, we began to admit women students in 1978, I think. That was when Hodgkin took over, so that was well established by the time I was here. There was a big building programme, the Blue Boar Court, which is across Trinity Street from the main part of the college, and a major programme of going over the old buildings, but these were underway before I was Master.

JW Is it very heavily endowed, it must be, the college?

AH Yes, it's far more wealthy than any other Cambridge or, I think, Oxford college, deriving originally from monastic lands with which the college was endowed when Henry VIII founded it. He founded it by combining two very much older colleges, the second and third oldest colleges in Cambridge, so we lost our seniority but gained the basis of our wealth. But the wealth has been immensely increased during this century by notably - well, really in the last hundred years, just under a hundred years, we have had only three senior bursars, the treasurer of the college. The second of these, geologist Tress [Tressilian] Nicholas, and third John Bradfield, who's just approaching retirement age now, both have been immensely successful in building up the wealth of the college. Well, we've had as much hard work deciding how to use our wealth as other colleges have had working out how to struggle by and survive. Yes, we've passed large amounts of what we don't actually need for our own purposes to other colleges and to the university in a whole variety of ways. The recent establishment of the Isaac Newton Trust, which was endowed from college funds specifically to help the university and other colleges.

JW Well, of course, this has made major a contribution, and similarly the comparable organisation, the College Contributions Committee in Oxford, has done the same for some of the poorer colleges. And no doubt it enables you to produce scholarships and fellowships.

AH Yes.

JW Turning now, just very briefly in the short time left to us, you've given innumerable eponymous lectures around the world. I remember particularly one that was a sparkling occasion when you came to Green College [Oxford]. Also you've received a large number of honorary degrees, honorary fellowships, membership of overseas academies and so on. Would you say that there are any of these that stand out as a highlight that have given you very special pleasure?

AH Well, yes I would say one of the earlier ones, St Andrews. My father was at St Andrews for a year or two before going to Oxford and St Andrews gave him an honorary degree, I think, shortly after I was born. I was given the name Andrew partly through the association with St Andrews. So that gave me great pleasure, and my Cambridge honorary degree, as I did not take a PhD: if it had not been for the war I probably would have. And I never put in for a ScD, as I might have done, so in fact I hold no honest doctorate at all.

JW But having a DSc of Cambridge has been particularly useful.

AH Yes, that was very pleasing.

JW Looking at your hobbies walking, shooting and designing scientific instruments. I'd never seen you somehow as a shot, but you enjoy those country pursuits?

AH Yes. I think the actual killing aspect I enjoy less. I mean I didn't actively enjoy it. No, one enjoys it as an exercise of skill and a means of taking vigorous exercise in the country. I was introduced to shooting by George Trevelyan whose wife was a sort of step-cousin of mine. She was a straightforward first cousin of Julian and Aldous, but through this family connection, I stayed with both George Trevelyan in Northumberland and with his brother, Sir Charles, in the family house, Wallington, which I'm sure you know.

JW Very well. And in fact it was Lord Trevelyan who conferred my first degree as Chancellor of Durham University, so the family are well known. And of course the Huxley Scientific Instruments, the Huxley microtome. We haven't talked about our relationship with the Muscular Dystrophy Group, time has not allowed us to do so. But the first microtome we used for our electron microscopy in the Muscle Unit at Newcastle, was certainly a Huxley.

AH Glad to hear that, I hope it's still in use. I do know first-class electron microscopists who will use nothing else.

JW Thank you it's been a pleasure talking to you.

AH Well, thank you very much John I've enjoyed it too.