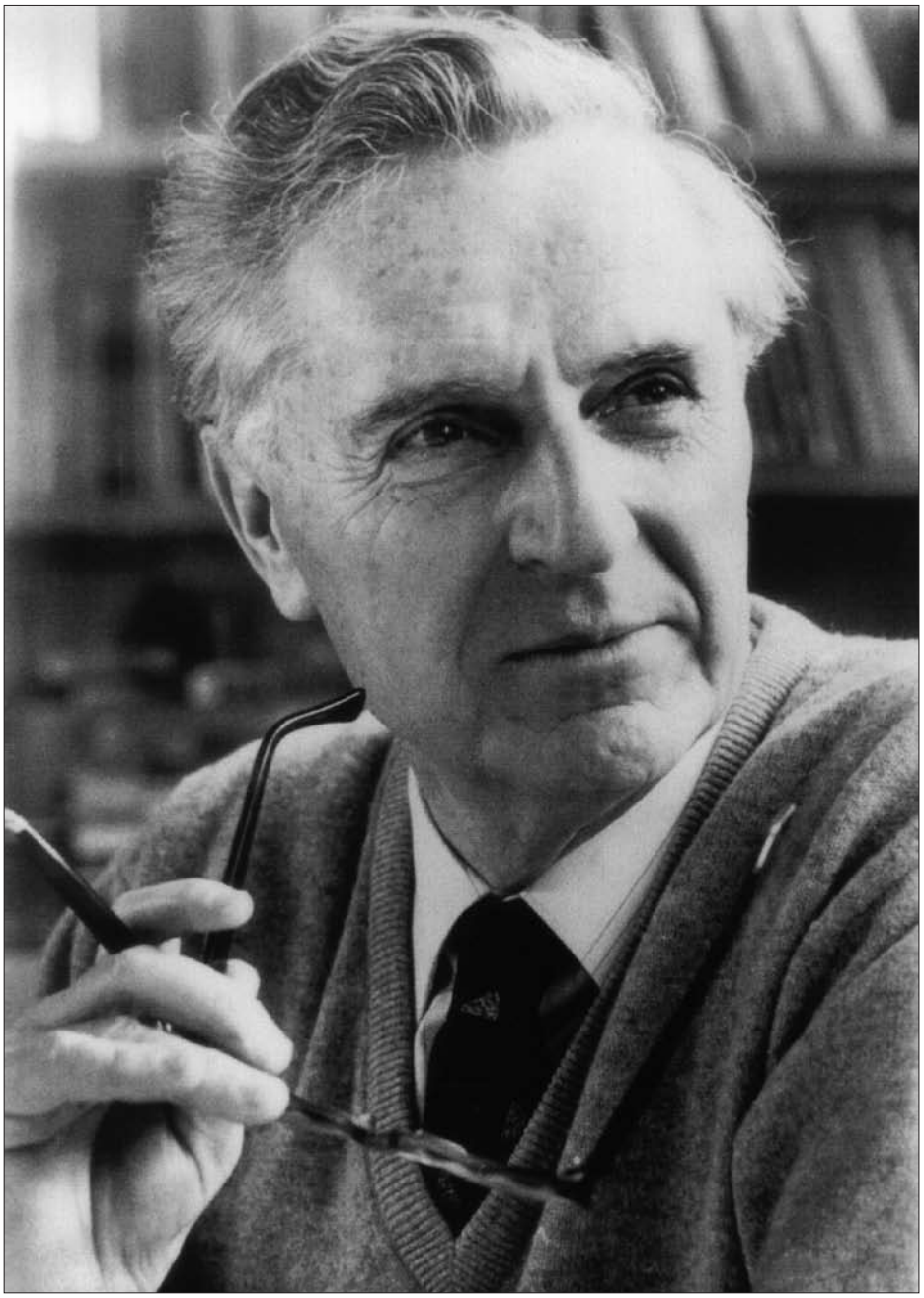

Profile: Prof. Sir Arnold Wolfendale FRS

Born in 1927, Arnold Wolfendale is now Emeritus Professor in the Department of Physics at Durham University. Here he discusses his career, from Stretford Grammar School to particle physics to being appointed 14th Astronomer Royal in 1991 – and beyond.

"I started my career as a physicist working on cosmic rays, mainly in tunnels in the sandstone in Stockport."

I grew up in Flixton, near Manchester, and at the Grammar School in Stretford I had set my heart on becoming a naval architect, visiting Liverpool and travelling on the overhead railway round the docks. I loved drawing ships and had even gone so far as to get details of degrees in naval architecture, at the University of Liverpool of course. But as I got older and the Second World War drew to a close, I thought it would be rather stupid to be a naval architect if there was not going to be much of a navy. A master at school got me interested in experimental physics and that's what I did, at the University of Manchester, so that I could stay close to my parents, who had considerable ill-health. Although I was good at maths at school, it didn't last. I found the mathematical part of the physics degree a bit tough, but I did get my first class degree, and so I could stay on to do physics research.

Cosmic rays

I'd heard about Blackett before starting at Manchester and I thought he sounded my type – an experimentalist through and through. I started my career as a physicist working on cosmic rays, mainly experimental work, underground in tunnels in the sandstone in Stockport, and acting as Blackett's deputy – or dogsbody! My career prospered and I went on to a full lectureship in Manchester, an unusual step in those days, when it was more normal to move on to another institution at that stage in a career. I carried on measuring various cosmic-ray parameters, gradually building up a repertoire of new measurement techniques in Manchester and elsewhere. In the meantime, two key changes at Manchester were that George Dixon Rochester became assistant director of the laboratories, and Blackett left for Imperial College. Rochester, together with C C Butler, continued the particle work at Manchester and indeed sent particle physics in an entirely new direction, through the discovery of 'V-particles'. Then Rochester moved to Durham and suggested that several of us move up here too, for a year or two. My wife and family liked it and we've been here ever since.

At this stage I was working on cosmic rays using big underground detector arrays, leading to the discovery of cosmic-ray neutrinos, using work in the Kolar goldfields in India. Our paper came out two weeks before that of Frederick Reines' group, but Reines got the Nobel Prize, for this and other work. I continued to focus on cosmic rays while Rochester and John Major moved on to nuclear emulsion techniques. It felt

like I was ploughing a lonely furrow. However, the various measurements we had been able to make – the neutrino, muon, proton, pion and neutron spectra – together made it possible for us to estimate the primary spectrum of cosmic rays at the top of the atmosphere. This was a very elegant calculation, rather like a calorimeter experiment, and it led me to wonder where these cosmic rays came from. That is what drew me into astronomy, in my forties, with no previous interest in astronomy other than general "natural history" awareness of the skies. I started a big programme looking at where cosmic rays came from and what they did on the way. This led me eventually into gamma-ray astronomy.

Absurd results

Coming into astrophysics, I was able to look at results from different fields and draw conclusions. I worked out from the accepted estimates of gas levels in different parts of the galaxy what cosmic-ray intensity would be expected – and got absurd results: cosmic-ray intensities higher in the outer galaxy than in the inner regions. In fact the levels of molecular gas in the inner galaxy had been overestimated by three times. This made us very popular with radio astronomers, among others! We were rather less popular with people who thought that the Earth's history of mass extinctions was a result of the solar system moving up and down relative to the galactic plane, disturbing the Oort cloud and sending in more comets. We showed that the molecular clouds were not big enough to have such an effect, and that the proposed movements were not enough to make any difference.

Once I started to work on the infrared and examined the heating of dust in the universe, I really got hooked. I got many of my colleagues to move into astronomy and that I think is probably my biggest contribution to the subject – not what I did myself. I managed to get the vice-chancellor here at Durham to come to the RAS Club and he was turned on by the subject. Together we got people to move to Durham. We established cosmology here. One of my staff was working on fundamental quantum theory and getting nowhere. I told him: "Form a cosmology group. You're a mathematician really, you think about airy-fairy things: cosmology's for you! Do that and I'll find you a senior demonstrator." He said OK and we appointed Richard Ellis, later a distinguished astrophysicist and good friend.

We had John Major, who had worked at CERN on bubble chamber photos. I said: "We're too small a place to be doing research at CERN where we're lost among 300 authors on a paper. Found a group where we've got a chance of making a mark." This led on to active optics and the success we've had there. We needed a statistician and I recruited Tom Shanks, who had done the MSc at IC and came here for the PhD, and then there was George Efstathiou and others from Cambridge. I'm not really a devious fellow, but I am willing take a chance. Once I learned that they were good, I made them an offer. I told them that if they accepted my offer, then I'd take them, whatever class of degree they achieved. Martin Rees, who was also after these very promising young researchers, went ballistic, but I wanted them for Durham.

"I got many of my colleagues to move into astronomy ... probably my biggest contribution to the subject."

As time went on, we shut down the experimental particle physics work here, but the theoretical particle work went from strength to strength. We boosted the numbers, too. I convinced the VC that we needed a chair of astronomy, and it was funded partly by a university anniversary appeal and partly by SERC (the Science and Engineering Research Council) for five years. Astronomy was certainly a boost to numbers; once we added astronomy to physics, our intake went up. We never changed the name of the department to "Physics and Astronomy", as so many places did, because I didn't think names matter. Physics includes the applied work that is so vital for industry, and astronomy is pure as the driven snow, with the strengths and weaknesses that implies. I certainly pushed the astronomy, but think we kept a good balance in the department.

The future

I think the art in research is in knowing where to stop; when the cream is off, do something else. I do like to keep an open mind, and there are a few areas that I worry about. It looks as though contemporary models of the origin of the universe are too good to be true, for example. They fit too well. I have a problem with the cosmic microwave background from WMAP and the extent of the contribution from our galaxy. I think it would be weird if we could see evidence of the really early universe without worrying about what's in between. I see interesting correlations between features in the halo of the galaxy and cosmic-ray physics that are not accepted by most scientists. They are taking the map of the sky and correcting for effects of cosmic-ray synchrotron radiation, but the people doing that are often not specialists in that field. One man's noise is another man's signal.

It wouldn't surprise me if there were surprises. There are exciting things coming up in other areas, too. Terry Sloan and I are looking at the links between cosmic rays and global warming. I was surprised that *A&G* published Svensmark's work on cosmic rays and clouds. It's a stimulating idea, but it stands or falls on the evidence, and the evidence isn't there.

"It looks like contemporary models of the origin of the universe are too good to be true ... they fit too well."

I was surprised to become President of the RAS. I had never thought of it and when Mike Seaton rang and asked me if I would be interested, I said yes. An even bigger surprise was my appointment as 14th Astronomer Royal [1991–95]. A letter came from the Prime Minister, John Major, suggesting that my name be put forward to the Queen. It was a great honour, especially as I had not been at Oxford or Cambridge. It was particularly useful being Astronomer Royal in dealing with government and other bodies – and not just for astronomy. I used to rant and rave about ineptitudes in all sorts of areas, and particularly in the area of funds for science. I felt I was doing something for the community and on a certain level I felt I owed it to people.

John Harrison

Part of my career I'm very proud of is the work I've done over John Harrison. I came across him in Dava Sobel's book *Longitude* and thought: "That's interesting, I wonder how Harrison is honoured in Britain?" The answer was "not at all", so I set about changing it. I'm a member of the Worshipful Company of Clockmakers and I had them institute a medal, the Harrison Medal, which was not a trivial task. Dava Sobel was awarded the second such Medal and when we were chatting I wondered about a memorial for John Harrison in Westminster Abbey. She said "we tried and failed" and I realized that this was a cause for me. I got the historical good and great on-side, the Dean of Westminster Abbey agreed, and we had exhibitions and published a little book, and raised the £30 000 we needed. I think the memorial is in a good position – next to the grave of Livingstone and that shared by Tompion and Graham.

I certainly never dreamt about this sort of success early in my career. I did what I could and enjoyed myself in research. The pleasure of research for me lies in finding something new. There are good questions there that I could answer, and get other people involved in the questions. It certainly was not money that motivated me. Academic freedom is still there, although people often seem too timid to take the route I did. I found that, in universities, vice-chancellors will take action if pressed hard enough by people with fire in their bellies. When we were short of money for astronomy, I'd go and see politicians and argue the toss with financiers and committees. I used to enjoy it. Some of our leaders at the moment seem a bit timid. ●