INTERVIEW WITH PROFESSOR JOHN MALLARD

I. INTPODUCTION

During 2016 the International Organization for Medical Physics (IOMP) approved a new International Award in Medical Physics named after Professor John Mallard, OBE, FRSE, FIPEM.

The name of Professor John Mallard was selected for this award, as he played a crucial role in the development of two of the world's most important medical technologies – Magnetic Resonance Imaging and Positron Emission Tomography. He is also one of the Founders of IOMP; was the first IOMP Secretary General, later IOMP President and also Founding President of IUPESM.

The IOMP John Mallard Award will honour a medical physicist who has developed an innovation of high scientific quality and who has successfully applied this innovation in clinical practice (e.g. equipment, software, methodology), or who has led a team developing this innovation. This Award will be given triennially at the IOMP International Conference on Medical Physics (ICMP).

The winner of the first John Mallard Award was Professor Paul Marsden, Director of PET Medical Physics at King's College London and Guy's and St Thomas' PET Centre. He was selected to receive the IOMP John Mallard Award for his contribution to the development and clinical application of hybrid imaging using simultaneously PET and MRI. The inaugural John Mallard Award was presented at the 22nd ICMP, December 9 – 12, 2016 in Bangkok, Thailand.

Several months before the award presentation the IOMP Past Secretary General Prof. Peter Smith and the current IOMP President Prof. Slavik Tabakov visited Prof. John Mallard at his home in Aberdeen, where S Tabakov took an interview with him.

II. INTERVIEW

Slavik Tabakov: Dear colleagues, we are here with Professor John Mallard, the first Secretary General of the International Organisation of Medical Physics. In fact, the founder of the organisation together with other distinguished colleagues from the UK, Sweden, Canada and the United States. We are here on the occasion of the International Award in Medical Physics named after Professor John Mallard. It is a privilege to be here with him and his wife Fiöna, to hear some of his advice to all of us and also to share some of his memories. Professor Mallard, could you please tell us how did you decide to begin your career in medical physics?

John Mallard: Well, I had been at what was then University College Nottingham, which was a College of the University of London. My Professor was Professor L.F. Bates who was a magnetism man. He had developed, during WWII, a method to protect iron ships from magnetic mines. Immediately after the war the Atomic Energy Research Establishment at Harwell wanted to know the magnetic properties of Uranium which of course they were using for the first nuclear pile, atomic pile and so on. I had the task of measuring those magnetic properties. Iron was always an impurity. We obtained many samples with different levels of iron in, so that we could measure the magnetic susceptibility and project back to the magnetic susceptibility of the pure Uranium. That was my PhD work. I was appointed as a demonstrator in the Physics Department at University College Nottingham then. But it was clear that I had to move on as the Department was fully staffed. I saw an advertisement in the paper for a job in a hospital in Liverpool which was at the Liverpool Radium Institute. This institute had been given a gram of Radium – I think there were five of them in the country – to use for radiotherapy purposes. I applied for this job and much to my surprise I got it. I must confess that one of the major attractions was that it was a much better salary than any of the other jobs that were being advertised at the time!

So I moved to Liverpool and I was fortunate to work with a Dr T Chalmers (known for the Szilard-Chalmers nuclear reaction). He and his colleagues, particularly Mr Herbert, introduced me to the use of radioactive I-131 for measuring thyroid function. I did a lot of that, measuring thyroid function in patients. Then we started learning how to image the thyroid by moving what, at that time, was a collimated Geiger counter, and eventually became a collimated scintillation counter, over the neck to build an image of the shape and size of the thyroid in the neck. You could find tumours in the thyroid and abnormalities of function, cysts and so on. I worked with many patients at that time. And then a job came up at Hammersmith Hospital in London which is now part of Imperial College. I managed to get that job and I built the first scanner, which started off being used for just the thyroid gland. It was based on a floating-top couch. You put the patient on the floating-top couch and moved it in centimetre steps. You measured the activity at each step so that you could build up an image of the distribution of I-131.

There was also a cyclotron at Hammersmith. The very first medical cyclotron in the world. Dr Constance Wood's Medical Research Council Radiotherapeutic Research Unit had this cyclotron and they were able to make other isotopes which led us to I-132, with a much shorter half life. We could carry out studies on children which you couldn't do with I-131 because the radiation dose would have been too high. I was able to have other isotopes, particularly an isotope of arsenic which localised in brain tumours, because the brain tumour breaks down the myelin sheath on the outside of the nervous fibres. The arsenic is able to penetrate, so that where there is a brain tumour you get an increased concentration of the arsenic. With our scanner we were able to image that and we set up a brain tumour scanning service which I think was the first one in the world. All the patients were sent to us from a neurosurgeon at Atkinson Morley's hospital in South London. They were sent over with a nurse and I was told: "you do your thing and tell me what you think". So I sent the nurse back with a report that said there was a tumour in a certain position in the brain, it was so big and so on. And after about eighteen months he came on the phone and said: "you know, you're doing remarkably well, I'm able to operate on most of your patients and I find the tumour is where you say it is and it helps me a lot". So that was how the first brain tumour scanning series went. I'm running out of steam now, where do we go?

ST: You were also involved in the pioneering of a whole body magnetic resonance scanner and a PET scanner, how did this equipment develop? How did the ideas come through and how were they implemented in practice?

JM: Well, the idea of the Positron Emission Tomography Imager is that you have a pair of scintillation counters on either side of the head or the body. The radioactive arsenic is localised by the two counters being activated at the same time by the positron disintegration, which is within a fraction of a millimetre from the actual radioactive decay. It gave a much more accurate localisation of the tumour than you could get from normal gamma ray imaging. That was the beginning of PET, Positron Emission Tomography. It was more complicated than before of course, you had to have two counters and digital processing, but it was a big improvement.

MRI came much later. I think sub-consciously I had always been looking for a use of magnetism in medicine. Never found one, but then we started getting this idea of possibly being able to localise things with magnetic resonance. I built up a team of physicists led by the brilliant Dr Jim Hutchinson. And the first image we took was of a mouse, which had been killed immediately before it was put into a small MR imager. We killed it by breaking its neck and the first image showed very clearly, exactly where the neck had been broken. So from then on it became a fight to get this technique from looking at a mouse, to looking at a whole human being. And that took 23 years. But once that was achieved, we scanned our first patient on April the 26th 1980. It was a man from Fraserburgh, Scotland, who had a very large malignant growth in his liver which was known about, but what they didn't know was that there was also a secondary deposit in one of his spinal discs. That was picked up on the whole body MRI. So for our very first patient, the MRI showed information that they didn't have before.

ST: It is so important that your innovations were immediately implemented into clinical practice. That is why we decided to award the John Mallard Award to a scientist who not only discovered something, but also actively implemented it into medicine, because this is what we do. We are at the interface between science and medicine.

JM: Yes, well it is not a bit of good doing it in the lab is it? You have got to go out and use it on patients and get some practical results. I am very pleased that it has gone as well as it has. I have got a leaflet somewhere about the latest magnet from Siemens, I think it's 7 Tesla. Good heavens! Our first one was 0.04 of a Tesla, Mark I. Mark II was 0.08 Tesla and now it is 7 Tesla, which gives superb visual resolution compared to our Mark I and Mark II. But at the time that was the highest field strength we could achieve with sufficient uniformity over the body.

ST: Yes, but the important things are the ideas and the methods which are working now and improving constantly. One other thing that you have done amongst the many contributions to medical physics is your work to help other countries to develop their own medical physics programmes. As President of the IOMP, I really want to thank you on behalf of many colleagues around the world, now 84 countries, for the establishment of the International Organisation for Medical Physics. You were there from the very beginning and you were the first Secretary General. What are your memories of this time, back in 1963?

JM: Well, Sweden was always very much to the fore and I remember Dr Sven Benner of Uppsala, who was always very interested in developing Medical Physics. The other interesting thing is that Hungary was always to the fore. I wrote a lot of letters to people in Hungary. At that time they were firmly behind the Iron Curtain, so how they managed to correspond with me, very much in the West, I really don't know, but they did. We were all keen to develop medical physics. Another country that always surprised me was Japan, Japan corresponded a lot. I am not quite sure how many countries I was corresponding with - it was either 34 or 43. I suppose it was 34. If there was more than one centre in the country I tried hard to encourage them to set up a national committee so that they could affiliate that country to the beginning of IOMP.

ST: Yes, and now we have 84 countries with about 24 000 members around the world. This is something that you started. You were also President of the IOMP at the beginning of the 1980's alongside your work with magnetic resonance. What would be your advice to colleagues around the world, young colleagues, for their work in the field of medical physics?

JM: Try hard to improve it, try hard to do something new. Try hard to think of something a bit different and develop that: push it as much as you can. Don't just sit there and accept what is the accepted version because there is always something beyond that if you can think of it or find it.

ST: I have to say that a lot of us have worked in this field, we are here with Prof. Peter Smith who was also Secretary General of the IOMP and he was very much involved in the establishment of Medical Physics as a separate profession. This was an achievement of IUPESM and you were the first president of IUPESM. How do you see the future of this field?

JM: Well, I worry sometimes: has it reached its zenith, will it fade away a bit, with less new things coming along? There is a tendency throughout the world isn't there, for the biologists to take over. And I have always been told, for donkey's years, oh well the biochemists are going to solve everything. And all I can say is that they haven't solved everything yet have they? So I am sure Medical Physics will still have a part to play.

ST: There is a future and we always have to believe that there is more to be discovered. We haven't even scratched the surface of nature, and I think that in the future medicine and medical physics will continue to have a strong link, especially when many countries work together.

JM: I think that probably the next most important development will be nanotechnology. Trying to develop that so that we can direct treatment in whatever form it might be, exactly to the right place. Probably that is the next step. But I am afraid that is a bit beyond me.

ST: There will be others now to go along the road which you have paved. Thank you very much indeed on behalf of all of my colleagues from the International Organisation of Medical Physics, from the UK IPEM, and all of us.

JM: Thank you very much indeed, thank you.

Special gratitude is to be extended to Prof. Peter Smith, Past Secretary General of IOMP, and Past Treasurer of IUPESM, who initiated the renewed link of IOMP with Prof. John Mallard and facilitated the meeting with him and his wife Mrs Fiöna Mallard at their home in Aberdeen.

With Prof. Mallard during the interview (August 2016) – left to right: John Mallard, Slavik Tabakov, Peter Smith

III. VIDEO ADDRESS FROM PROFESSOR JOHN MALLARD TO THE ICMP2016 DELEGATES

I am in my ninetieth year, so these are really the ramblings of a very old man. I know that you're all medical physicists and I think that you are all very fortunate because you are able to use your science to help people. Both your routine work and your research work helps to treat them, and helps to diagnose their illnesses. With research, I think it is very important to persevere and keep going. All advances take a lot of time. MRI was twenty three years from the idea to making it work on the whole body. IOMP is the wonderful organisation which ensures that every advance is made known worldwide, and I am both proud and humbled by the award which IOMP has set up in my name. I'm very grateful. And I hope that it spurs people on to contribute significantly to our very wonderful field of science. Enjoy it and learn as much as you can from your Congress in Bangkok. How I wish I could be with you. Thank you very much for listening. .