RESUMED **[4.00 pm]**

COMMISSIONER: We reconvene on topic 11, Effects and Threats of Nuclear Radiation and we welcome from Berlin, Professor Geraldine Thomas from the Imperial College, London. Thank you very much for joining us professor.

PROFESSOR THOMAS: Pleasure.

MR JACOBI: Professor Geraldine Thomas is a Professor of Molecular Pathology at the Imperial College, London. She received her degree in pharmacology from the University of Bath in 1982 and completed a PhD at the University of Wales College of Medicine in 1988. Professor Thomas established the Chernobyl Tissue Bank which we will come to in evidence, which provides infrastructural support for thyroid cancer diagnosis and research in to the molecular mechanisms that underpin the increases in thyroid cancer seen after the Chernobyl accident. She has published extensively on the molecular pathology of thyroid cancer and is the author of a number of reviews of the health effects of radiation exposure following nuclear accidents. She was invited to speak at expert meetings on the health effects of radiation following Fukushima in September 2011 and was invited by the UK Chief Scientist Office to join the UK/Japan dialogue on nuclear energy in 2012. The Commission calls Professor Geraldine Thomas.

COMMISSIONER: Professor, if I might start, who do you consider the credible – what are the credible sources of information concerning the radiation effects from both Chernobyl and Fukushima and perhaps you might want to deal with them separately?

PROFESSOR THOMAS: Yes. I think that major organisations like UNSCEAR and WHO when they set up reports, they get people literally from around the world who are experts in their field to give their opinion. I have served on some of their committees and it is very much more opinion, you’re not expected to toe a party line. We draw all of the evidence from the scientific media, so from journals and things like that. And you have to remember, when you read scientific journals, that not all journals are equal, there are some that are much more reputable, therefore much more difficult. They require scientists to put an awful lot more input and facts and consider the options when they're writing the papers and their discussion. So those are the places that we really go for scientific results. We look at the scientific design, our rate of control and things like that. So it is quite a detailed dissection of what's been put in in the scientific publications, by a number of people with different disciplines. So you get an all round approach to the subject. So I would say probably UNSCEAR and WHO are the major sources of the real scientific (indistinct) that's gone in to this.

COMMISSIONER: It's been put to us that those organisations are populated with pro-nuclear individuals, clearly - - -

PROFESSOR THOMAS: Yes.

COMMISSIONER: - - - you have a different perspective?

PROFESSOR THOMAS: I don't think that's true. I think unfortunately the problem that you have is – I mean I'll be quite honest, I was anti-nuclear until I started working on Chernobyl and I was forced to look at the results coming out of the Chernobyl accident and actually say, you know this is not what we really thought. Everybody thought we were going to see far more cancers and things like that arising from Chernobyl and it – you have to start questioning where you get that information from and were you right to have thought that way. So I would say actually it's likely that most of the people around those tables started off as being broadly anti-nuclear but they've had to look at the scientific facts and say, our assumptions weren't right. Our hypothesis aren't right, and that's what a scientist does. You have a hypothesis, you look at the facts and then you question the hypothesis again and say, does that hypothesis fit the facts. And if it doesn't, you have to change your viewpoint. So I would not say that they were predominantly pro-nuclear or anti-nuclear, they're just scientists doing their job.

COMMISSIONER: All right. We might unpick some of that then.

MR JACOBI: Can I just ask, in terms of your involvement and participation in the constitution of those sorts of committees and special projects undertaken by UNSCEAR, were they constituted of people that also include people with medical science experience as well?

PROFESSOR THOMAS: Yes. I mean you get a broad range of physicists, people who are experts in medical radiation and things like that, so a really broad field of people.

MR JACOBI: And in terms of the information gathering, in terms of the data collection, did you also interact with people that had medical science or particular medical qualifications within hospitals or other institutions?

PROFESSOR THOMAS: Absolutely. I mean you have to remember, actually the doses that comes from medical radiation are quite a lot higher than the environmental doses and often you will find doctors are even more cautious than the environmental based scientists simply because they've been taught all the way through their careers that radiation is quite dangerous and you have to be careful how you use it. So yes, I mean there were – there are epidemiologists but there were also medical doctors on those panels.

MR JACOBI: Perhaps if we can just come to some just very basic fundamentals and we will hopefully move through this quite quickly. I am just interested to understand whether or not there are particular radioisotopes that we need to be particularly alert to. We have heard much about caesium and iodine with respect to - - -

PROFESSOR THOMAS: Yes.

MR JACOBI: - - - their consequences for human health?

PROFESSOR THOMAS: Yes. Isotopes are different, you know you can't sort of use a broad brush and describe them. The effects on health really depend on whether they have a long physical half-life and depend on whether they are taken up in to the body and bound so can release the radiation while they are inside your body. What you have to remember is we tend to think our bodies stay the same the whole time but they don't, we are continually losing stuff from it and taking stuff in, that's why we eat. And so the balance of the biological half-life, i.e., how long that particular dose of isotope you've taken in, stays in your body before it's replaced by the more widely available stable isotopes, because all of these things exist as (indistinct) radioactive isotope phase. So the actual – the health effects depends on the balance between the biological effect and the physical half-life.

So use iodine and caesium as an example, iodine 131 which is the one that we talk about in terms of health effects from Chernobyl for example, has a short half-life of about eight days, physical half-life. But your thyroid needs iodine to make its hormones. If you don't make thyroid hormones you have all sorts of problems with brain function and it generally control the whole of your metabolism. So that hormone is very important. Iodine is normally very scarce in the environment, so the thyroid over our evolution has developed a way of taking up the iodine in to the thyroid and binding it to make the hormones. Now that means that it remains in your body is much longer than it would be if it just went in and came out again. So because it's got a short physical half-life and the long biological half-life of about 100 days in most people, that means it's got a chance to release all of its radiation while it's inside you. Whereas caesium is the opposite way around. Caesium doesn't concentrate in any particular tissue. There's no mechanism that we have that makes caesium stay particularly long in any of our tissues in our body. And it has a long physical half-life of about 30 years and a relatively short physical half-life, like 70 days. So it comes in and goes out and very little radiation is released. The dose from caesium is an awful lot less than the dose from iodine.

It's a complicated thing, which is not surprising why a lot of people find it really difficult to get their heads around because you have to understand the physics, the chemistry and the biology. So it makes it really difficult.

MR JACOBI: The Commission has also heard something about strontium and I know we've concentrated on iodine and caesium, could you address strontium in the same way that you've just addressed those last two?

PROFESSOR THOMAS: A few things to remember is things are different weights, so you have heavy elements like strontium and you have the volatile isotopes like iodine and caesium. Because they're volatile, when you have an accident, they get – go in to the atmosphere and they'll drift around on the air circulation round the planet. Whereas, things like strontium because they're quite heavy actually don't go very far form the site at which they're released. So you do get some strontium release. If you look at the atomic bombs for example, because these were above ground tests, they were dispersed – strontium was dispersed a bit more than it would have been if that explosion had occurred on the ground because it's a much heavier thing than the caesium and the iodine. So it does depend on the weight of the isotopes, their atomic mass, as to where they're likely to end up and whether they're volatile or as in strontium's case, not volatile that much. So you will get a small amount of strontium but it is relatively much, much smaller amounts of strontium from something like a nuclear plant having a problem. And the other thing is we do tend to equate atomic bombs with nuclear power plants and they're not the same things at all. They release different things and the kinetic energy released into the environment is very, very different, because it depends on whether it's an aboveground explosion or whether it's an explosion based on the ground as to where those things get distributed.

MR JACOBI: I'll come back to those differences later, because I think we might work our way through each of the three different - the Hiroshima, Nagasaki circumstances, Fukushima and Chernobyl. But I just wanted to come to another fundamental, and that is the issue of background radiation and I just wonder whether you could give us some insight into your views as to the averages or the average ordinary exposure that humans receive to radiation. I think we might have a slide that picks this up. Do you have that available to you?

PROFESSOR THOMAS: Yes. Yes, it varies around the world, so it really depends on which country and even which region you're in. A lot of the background comes from radon that seeps up from the ground. So places like Cornwall, for example, in the UK have much more granite, and Edinburgh, have much more granite and therefore have a slightly higher radon dose. So that's affected the background radiation that you have. And there are areas of the world, like the (indistinct) which has thorium in the towns where they have a much higher dose of background radiation because the rocks are quite different. So it's the geology that really affects the background radiation.

And also in places in America actually, it's much higher. It's 6 millisievert compared with around about 2 in the UK. So it does vary. And also different societies obviously use medical radiation differently. So that has a slight effect on the dose. So if you're in somewhere that doesn't use CT scanning, of course your dose is going to be slightly lower on average than somewhere else where they use an awful lot of medical intervention and things like that. There are lots of things that affect the background dose.

And some of us will get more dose than other people because some of us fly a lot. Every time I go to Tokyo on a return flight I get 0.14 millisieverts of radiation from cosmic radiation. So your habits as a human also can affect that. And of course there's radiation in food, things like potassium-40. Bananas are really good source of potassium, very good for you, but also contain a bit more radiation than other things because they have a lot of potassium-40 in them because they take it up from the soil as the plants are growing.

MR JACOBI: Just coming to the pie chart that's there, for which particular population group is that? Is that the UK?

PROFESSOR THOMAS: That's the UK, yes, but I mean, that's actually fairly average for most people. So, you know, in some areas you might get a bit more radon from background rocks, but in most places that's about average. There's probably about the same in Australia as well.

MR JACOBI: Yes. We've just seen a chart from Australia that shows a greater proportion for artificial sources, about 1.7 millisieverts for CT and medical uses. So I think it's a bit more than 50 per cent.

PROFESSOR THOMAS: Yes. I mean, it might well be that, you know, in Australia you're going to use that an awful lot more than, say, in the middle of

Africa, for example.

MR JACOBI: Yes. Now, I just wanted to deal with the issue of LNT. We received in the submissions significant amounts of information about views about the LNT hypothesis or assumption, and I'm wondering perhaps, first of all, whether you could offer some insight into that particular discussion or debate and where there's consensus or not consensus with respect to that issue.

PROFESSOR THOMAS: Yes. LNT is a good example of, as a scientist, you could never have a hypothesis that you can't really test, and that's the problem we have with the LNT. We've got lots of information about radiation effects at high doses. The trouble is, as we've just been talking about, we're all exposed to radiation. So if I said that there was an average dose of 2 millisieverts, which is probably a bit on the low side, per year for each human life year spent on the planet and you die at 70, you're exposed to 140 millisieverts over your lifetime.

So when you get down to the really low doses you have a problem in being able to design the study to decide whether it's due to the radiation because you have that background effect, and so when you get below about 100 millisieverts we know the effect is very small. There's quite a steep slope on that line. We know the effect is very, very small, and it becomes incredibly difficult to actually show an effect because of all the other things that affect our health. So if you like- and the noise - it's like looking for the needle in the haystack when you get down to those low levels that you find what is due to the radiation are not due to everything else that affects our lives, which of course is complicated because over a lifetime, how we live changes markedly. I mean, we didn't have the Internet and things when I was young child.

Everything changes in life, so you're eating habits or (indistinct) so trying to define over a lifetime the effect of a very low dose of radiation, it gets lost in everything else that affects our health, and that's why there's so much argument about the lower dose range. We don't have many studies in that area because we can't do the study. We don't routinely expose people to a little bit extra radiation. It's quite difficult to get that data, and it's just sort of a noisy area when you're looking at it to define things statistically, and that's our issue with it, though some people believe that if you have a little dose of radiation it will actually pep up your DNA repair which is what keeps our bodies going.

MR JACOBI: Is that the so-called hormiotic view or - - -

PROFESSOR THOMAS: It is hormiosis. Yes, hormesis, sorry. Hormesis.

MR JACOBI: Yes.

PROFESSOR THOMAS: I mean, a lot of people like sitting in spas, for example. Interestingly, the German and Japanese are probably the two countries that really go in for spa treatment. You're actually exposing yourself to a little bit more radiation in those places and people think it's healthy. They don't think about the radiation. They just think it's healthy. But some people have taken that and think, well, you know, a bit of radiation does you good, whereas other people believe that we're far more sensitive to low doses of radiation.

I think that's more difficult to say that's correct because if a little bit of radiation was even more dangerous, we'd be seeing so many more effects from things like atomic bomb exposure and atomic bomb testing that we did in the 1960s where the doses around the world literally spread most - I think they didn't quite reach Australia, but they were virtually over the northern hemisphere where we had actually quite a bit more radiation around in the atmosphere than what would be normally from background, but we don't see huge increases of cancer. The increase in cancer we see because we're living too long, so people are getting cancer as a natural thing of aging which we can't really stop.

MR JACOBI: I'm just interested in your view as to the appropriate uses that can be put to the linear threshold. We've heard some evidence that it's appropriate to place store in it for the purposes of radiation protection. Is that your view?

PROFESSOR THOMAS: I find it really difficult because again, we will never ever have the evidence to say we shouldn't do it. So as a scientist, you tend to err on the side of caution and say, well, if I can't find the evidence, I have to assume the hypothesis was correct. I think we're actually getting to a stage now where all the other things that affect our health are becoming more important than very low doses of radiation. So to give you an example, there's a good piece of work done by the BEIR VII report which tries to put some of this into context. So they used American statistics and the Americans do have an awful lot of data on health outcomes, something called the (indistinct) database.

They're a good source of good, hard scientific data, and they reckon that if you exposed 100 Americans, given all of the normal health patterns that we would see in America, to 100 millisieverts, at that low level which we start to have problems defining what the effect is, one of those would get cancer due to the exposure at 100 millisieverts, 42 others will get cancers from other causes. Now, to me, that really put it into sort of context and (indistinct) well, actually I'm a bit more worried about the other 42 cases than the one case and the radiation at that level.

And you can never remove all risk from life. It's impossible. So when you start making one risk really decide things where actually it pales into insignificance compared with the other risk, I think we have a problem getting our heads round what's safe and unsafe when you get to that sort of level. And we could be making other things more risky by trying to protect ourselves from radiation at low levels, for example, and you see that and the psychological effects of Chernobyl and Fukushima. We're too worried about the radiation and it starts to actually have health effects. The worrying has health effects more than the radiation itself (indistinct)

MR JACOBI: Yes. I'm just interested in understanding with respect to LNT its utility in reaching conclusions about the causation of radiation-induced cancer, and that is, I'm just interested in your view as to whether it's appropriate to multiply these predictions from very low doses by large population cohorts to predict outcomes.

PROFESSOR THOMAS: Absolutely not. That does not help at all. To give you another way of trying to look at that, it's a bit like saying that as a man you wet shave and if you cut yourself you're going to lose a small amount of blood. So if lots of men wet shave and lose a small amount of blood, if you add the blood up, that means somebody is going to die from blood loss. That doesn't make sense. That doesn't help you protect men from cutting themselves shaving at all to suggest that it's so dangerous that if you multiply it up by the number of people who wet shave, somebody somewhere is going to die because they've lost so much blood.

MR JACOBI: Perhaps we can move away from LNT and I think we can just - we've got a slide that I think picks up some of the discussion that we've just had in terms of the relationship between dose and effect. I think this is headed Dose and Effect. Do you have that in front of you?

PROFESSOR THOMAS: No, I don't. Hang on a second. Yes, I've got them.

MR JACOBI: Whilst we've talked very low and low dose, are you able to speak to the issues of moderate dose and high dose, just so that we can round out the viewing of that table.

PROFESSOR THOMAS: At moderate dosage you're getting to the area where you - you mean the sort of upper half of the table?

MR JACOBI: Yes.

PROFESSOR THOMAS: A moderate dose is you're getting to the levels of more than a hundred millisieverts, so you're likely to see an effect in a very small number of people but you will see the effects specifically in epidemiological studies. At high dose you're actually getting to the areas where you start to see direct tissue effects. So if you expose somebody to high doses of radiation for cancer treatment, for example, often the skin will go red, they'll start to feel sick and those are what we call sort of the direct effect of radiation, where you actually get tissue injury. Now, you only need to expose a very small number of people to those high doses to see those direct effects.

When you come down the dose range and you get to the medium dose levels, you're then starting to see fewer people affected. So to get a statistical answer you need to expose many more people but you will see an effect at those doses but the population needs to be significantly larger than at the very high dose.

MR JACOBI: We've seen similar information today expressed in terms of effective dose in terms of millisieverts and I notice that this particular tab was expressed in terms of absorbed dose or grays.

PROFESSOR THOMAS: Yes.

MR JACOBI: I'm just wondering what the relevant translation is here, just so that we're clear on that.

PROFESSOR THOMAS: It depends on the type of radiation. So things like an alpha particle are a bit like a juggernaut running into your DNA. It's very heavy, a helium nucleus. So it's physically going to do an awful lot more damage. So we apply weighting factors for gamma radiation. It isn't a direct translation but for most beta radiation it is a direct translation. You can translate grays into millisieverts. This is part of the problem that we have with radiation, is it's complicated. It's not a straightforward thing. It's not like taking a chemical that you can say, "This dose causes this effect." You have to take into account the type of radiation that's involved as well.

So to be correct, when you talk about doses to tissue, you should give effect in gray. It's much easier when you're looking at different types of radiation and most of it is exposed to multiple different types of radiation. So in order to sum those individual doses together, you have to take account of those weighting effects. We tend to refer to it as sieverts to give us one figure.

MR JACOBI: Just to pick up on some evidence that was given this morning, I just don't know whether you're - are you aware of a statement to the effect - and I hope I've got this right - that about 30 per cent of cancers are produced from natural background radiation and that a further 70 per cent are produced from anthropogenic cause? Are you aware of any such statement to that effect within the medical or scientific literature?

PROFESSOR THOMAS: Yes, it's basically very difficult to be certain.

Again, you've got the problem of so many things cause and effect, like cancer, that it's actually very difficult to tease out which effect is causing what percentage of cases. It depends on the study you read what people will say but it's very difficult to get hard scientific facts. I would suspect actually smoking obesity - sitting here as somebody who should not be the size she is - is probably far more deleterious to your health than exposure to background radiation. You can't avoid that exposure but you can avoid doing some of the things that we know are much more dangerous to health, like smoking and being overweight.

MR JACOBI: Earlier in your evidence we began to refer to some of the distinctions in the kinds of radiation exposure you got in particular events. I indicated that we'd come back and deal with each of the particular significant population radiation exposure events in sequence.

PROFESSOR THOMAS: Yes.

MR JACOBI: I'm happy to first come to the circumstances of the atomic bombs that were detonated over Hiroshima and Nagasaki and I'm just interested - perhaps we will deal with sources as well as we go - but I'm just interested, first of all, to understand what's the consensus of scientific evidence about what are the radiation-related effects associated with the Hiroshima and Nagasaki detonations.

PROFESSOR THOMAS: Yes, there's no doubt about it, the higher the dose the more likely you are to have had cancer as a result of exposure. People tend to think that there was an awful lot of people affected by radiation. Yes, there was. But actually most of the deaths that occurred - and there are about 140,000 casualties in those two atomic bombings, short-term casualties - about 120,000 of that was actually caused by blast injury. I mean this was a massive heat release and that basically caused blasts and it caused a heat surge which killed the majority of the population. About 20,000 of the people who survived that and lived in the very, very centre of the explosion died subsequently, as in a few months, from radiation poisoning, which is the top end of that table I showed you. So those are the very high doses that give you direct tissue effects.

MR JACOBI: This was acute radiation sickness, as I understand it's called.

PROFESSOR THOMAS: Yes. You see the effects immediately. People who have radiotherapy, they will know that a large dose of radiation that we use to cure many cancers, which is targeted to the cancer, does cause some systemic effects as well. So that gives you an idea of what that really is. But then you come down to the people who did not die from the immediate effects but were exposed to fairly large doses, around about - they give it in weighted colon dose. It's the way it is referred to by the Radiation Effects Research Foundation. So some of them have large doses: four gray, three gray. Then you start coming down into the milligray. For most of the population it's a five. Those exposures had lower-end doses. So there was quite a lot of low dose exposure. But it was exposure to gamma radiation predominantly, not to the particulate radiation of iodine-131. There was some but not as much. It was mainly gamma exposure.

It was quite different to a scenario than an accident in a nuclear plant, for example. There is a clear dose response, in that the high doses result in more cancers. The low doses, there's a slight inflection of the curve at the bottom suggesting that the low doses are not quite as bad, according to the LNT, as you might expect. But it's actually very difficult because once you get down to that hundred millisievert level you're looking at a very small increase in cancer over the background rate. I mean they did very large studies. 86,000 people were in the studies that they looked at and they followed them over their lifetime. Many of those people are now in their 70s and 80s.

We know there's an effect on - if you were much younger at exposure, the effect might even be greater. So you're more sensitive to the lower doses than if you're an older person, for example.

MR JACOBI: I was going to come to the sources of the information upon which you relied for the answers that you've just given in terms of effects.

PROFESSOR THOMAS: Yes.

MR JACOBI: You referred to a number of 86,000 people studied. What's the source of that study and what's the nature of that study?

PROFESSOR THOMAS: That's the lifespan study and that was a very big cohort study that was set up as quickly as they could, given the effects of war in that area, to look at the effects long-term on the population that was exposed. That was run from the Radiation Effects Research Foundation in Japan. It was a very major undertaking to follow that number of people throughout their lifetime and it's a good source of well-collected data that's been collected in a regimented fashion. So you know that the data is not changing over time because of the way you're looking at the data, for example, and collecting that data. Those sort of studies need to be set up from the word go and set up very strictly to make sure that you don't introduce bias into them. So it's a well-conducted scientific study with appropriate controls.

MR JACOBI: Has that study itself been the subject of peer review and analysis?

PROFESSOR THOMAS: God, yes. You don't get any of that published without it going through peer review. People will tear papers apart. Peer review is not an easy process. People tend to think it is, but real peer review and the journals that that sort of information is published in are really rigorous journals. So that's been subject to great peer review. I know there's a lot of people who think it's easy. It's not if conducted properly. But I'm afraid it is pretty rigorous in the way it's been conducted and those are the facts and I'm sorry, but that's what the facts are.

MR JACOBI: You drew a distinction in your evidence earlier between the nature of the radiation exposure from an atomic weapons detonation and the consequences of a nuclear power plant accident. I wonder whether you might expand on what you see is the key distinctions.

PROFESSOR THOMAS: I mean for a start off the atomic bombs are exploded above ground, okay, so the atmospheric conditions are quite different and the way the material is distributed is quite different. What is released is quite different. Yes, you do get T3 and iodine released as well. For example, the iodine will stay up in the atmosphere for longer before it comes down to the ground in rain. So because it's got a short half-life there's going to be less of it than what was actually released by the time it hits the ground and we get exposed to it. It's interesting actually that people tend to think that - sorry, I've lost my train of thought.

MR JACOBI: We're drawing a distinction between what follows from atomic weapons testing and from nuclear power plants.

PROFESSOR THOMAS: People tend to think that there's been more exposure from a nuclear power plant accident but if you actually look at the figures for what was released from the atomic bomb tests - not the bombs themselves but the tests that carried on in the 1960s in America and Kazakhstan and places like that. We actually released far more caesium and iodine into our atmosphere and stratium as a result of those tests than at - - -

MR JACOBI: I think we've got a slide that picks that up and it contains a table.

PROFESSOR THOMAS: Yes. I was quite surprised when I saw that.

MR JACOBI: It would be helpful I think to the Commission if you might unpack the information that's contained there. It uses a particular - as I understand, it's a petabecquerel and I'm just wondering whether you can explain what a petabecquerel is.

PROFESSOR THOMAS: A becquerel is a measure of radioactivity, so it's the amount of radiation. It's the radioactivity. A petabecquerel is 10 to the 15 becquerel. An individual becquerel is very, very small. It's disintegration per second. So if you're looking at very, very large releases then in actual fact it's nearly tenfold what came from the above-ground tests in the 1960s compared with something like Chernobyl. So it was 85 I think it is petabecquerels from Chernobyl and there's nearly 10 times that much from the above-ground tests.

So we worry about nuclear accidents but far more was released in the 1960s. There's a lovely graph where you get the original raw data from the (indistinct) web sites is you can actually plot the amount of strontium and caesium in milk in the UK from the above-ground tests and in the 1960s that was substantially higher than from the Chernobyl accident. There was virtually no strontium in our milk from the Chernobyl accident in the 1980s but you could caesium in that. So it's interesting, we tend to forget about the above-ground tests and concentrate on the two nuclear accidents, but actually more radiation was released in those tests than either of the two nuclear accidents that we've had more recently.

MR JACOBI: Again I understand that the source of this information is one of the UNSCEAR reports. Is that right?

PROFESSOR THOMAS: Yes, there's two reports. There's the UNSCEAR report from Chernobyl which references that table, and then the Fukushima data comes from the latest Fukushima - - -

MR JACOBI: All right.

PROFESSOR THOMAS: They're all public documents, so it's perfectly - anybody can look at these online if they want to.

MR JACOBI: Perhaps with that point, if we can come to the particular circumstances of the Chernobyl accident and I'm just wondering whether there's anything particular about the circumstances of that incident that has had a particular consequence in terms of the release of the radiation from that particular accident that distinguishes it from Fukushima.

PROFESSOR THOMAS: I mean the plant for that was quite a different design and now when we build nuclear power plants we always put containment facility around the core, which means that if something happens to the core and there's a release of radiation there's another shield, like a firewall around your computer. There's another shield so that you don't get it released straight into the atmosphere. It gives you time to do things like move the population away or get them to close their windows and doors and things like that. So it gives you a bit more time to deal with the situation and keep that radiation inside the plant rather than releasing it to the atmosphere.

Chernobyl didn't have that. The power station there, what they believe happened was this was an incident where they were doing a safety demonstration and they were trying an experiment with the reactor. I've been told and I think it's probably true, that the train from Moscow - because you have to remember this was Soviet Russia at the time - was late and there was a crew that went off duty who had been trained how to do this specific procedure and then a naive crew came on, and you didn't do those things in Soviet days without the people from Moscow coming to watch you and it was basically human error that caused the accident. What happened was, they removed the rod that would normally moderate the reactor, the safety features were disabled. It went out of control. They couldn't do anything to save it and there was a massive steam explosion, not a nuclear explosion. People confuse the two. This was a steam explosion which basically blew the roof off the building and ejected part of the core. It was a very big explosion.

But in Fukushima it was very, very different. I know the whole world saw an explosion but actually that was the outer containment breaching. That wasn't the reactor core going up. So the amount that was released in the two accidents are very different because the core was exposed following Chernobyl. So much, much more was released in the Chernobyl accident than was released in Fukushima because all the safety systems kicked in in Fukushima, where there weren't any safety systems working at Chernobyl; they'd turned them off to do the experiment.

MR JACOBI: I'm just interested to understand with respect to the exposure of the core at Chernobyl, did that have a particular consequence in terms of the radioisotopes to which Soviet Russia and the remainder of Europe were exposed?

PROFESSOR THOMAS: Yes. I mean the problem you have when a nuclear power plant explodes is you get releases of volatile isotopes. Things like strontium, because they're heavier, don't get ejected as far so they stay in the vicinity of the reactor. So when you have an explosion like that, the iodine and the caesium go up into the atmosphere and get driven around circulation of the wind. That's exactly what we saw. If you map where that contamination went, you can tell which way the winds were blowing. Originally the winds went north. There was also a fire in the reactor as well and that burned for seven days. It took them seven days to extinguish that, which is the pictures that some of us remember of seeing helicopters flying over and dropping things down; it was trying to turn that fire off. But that took about seven days.

So for seven days it was leaking radiation into the atmosphere. It was quite different from the scenario of Fukushima where it was under control fairly quickly. There it burnt for some time. It carried on releasing radiation. In fact, we didn't know anything about it in Europe because we didn't have all the fancy satellites and things that we have now. We didn't know anything until an alarm went off at a power station in Sweden and the Swedes thought they had a release and got really worried, but in actual fact that was the air travelling across, carrying the radiation from Soviet Russia and it hit the detectors at the Swedish power station. That was the first inkling we had that something was wrong, and that was a week later.

So it took a whole week for that cloud to pass across Soviet Russia and hit the Swedish border. Of course during that week half of the radiation from the iodine would have gone because its physical half-life was so short. It was pretty obvious we were detecting something that was a major release in that area of Russia. If the wind had been going the other way, we may never have known about it because of course the wind would have taken it to the east and over Russian territory.

MR JACOBI: I'm just interested to understand - we'll come in a minute I think to - I want to address what you understand the key health effects have been following the exposure at Chernobyl, but I'm just interested in understanding about the evidence collection and to the extent to which there was evidence collection associated with affects on human health and what's been undertaken in terms of those studies.

PROFESSOR THOMAS: There were a number of large studies set up fairly quickly. The Japanese actually were the first to really respond with that and they set up large-scale screening for – they literally sent vans, that were able to screen children, to Russia and went around the local community. So there was a lot of evidence gathering within that. That was probably in the early nineties and we have to remember that when it happened in 1986 it really was Soviet Russia, it was not easy to get in to that country. But there were people who were allowed in fairly soon after the accident. So you have some people from EU for example were allowed in to just see what was happening to gather some evidence and actually, to put together packages to actually help recovery. So from the very early times, there were people evidence gathering in there, but the real major studies of the effects on health, because we know the effects on health are going to be slightly longer term, didn’t really get going until the early nineties.

But the Japanese (indistinct) foundation started running large screening programmes, the Americans started putting a lot of money in to cohorts, similar to the lifespan cohort but really intended not to be probably as long as the lifespan cohort. But those are still ongoing. They’re still obtaining data and what they do there is they collect people who have got thyroid cancer, have had a diagnosis of thyroid cancer and pair them up with people who have a similar exposure and live in a similar area and then follow them through the rest of their life to see what the effects are. So there were – it would have been nicer to have had much more data, not many people have direct thyroid measurements for example, but there were some. And not many people undertook detailed questionnaires and it's important to know what people were doing, were they inside at the time of the accident? What foods they were eating? Were they eating lots of milk containing food for example, which we know gets more heavily contaminated in the iodine fallout? So it would've been nice to have more data but actually we got quite a lot of data that tells us the doses that individual people have. And if you're going to relate cause and effect, you need those (indistinct)

So there is a lot of data and it's well constructed, that had been conducted – it's the protocols that most scientists would accept are the best that we could do at the time.

MR JACOBI: Now I think you've indicated that there were a number of studies and I'm just interested to understand, we're aware that there was a major report produced by UNSCEAR, this is in the decade after the nineties, so this is, as I understand it - - -

PROFESSOR THOMAS: Yes.

MR JACOBI: - - - a major report released in 2008. I'm just interested to understand, are you aware of the sort - - -

PROFESSOR THOMAS: There was one before from about 2000 as well, so there's been two major UNSCEAR reports.

MR JACOBI: Yes.

PROFESSOR THOMAS: The most recent one was 2008 which actually wasn't released publicly until 2011, just before Fukushima. But it was 2000 was the first report and that really – we were still actually getting data at that point. So that was a sort of preliminary report and with the 2008 we got far more data, so we have been able to assess the health and consequences much, much better with the longer period of follow up.

MR JACOBI: Did those reports include information concerning these medical data sets from these cohort studies? Did it consider those studies?

PROFESSOR THOMAS: Yes. They were starting to give early results at that stage, so yes they were included. More importantly, was understanding the doses and the amounts of release and trying to get that right because actually you're reconstructing doses because people weren't physically there measuring things at the time. So that was important to get right as well. But yes, you were starting to see some – certainly some of the cases of thyroid cancer were definitely a problem in 1992. There was no two ways about it, this was not detection (indistinct) screening, this was definitely arising in childhood thyroid cancer, and only childhood thyroid cancer. So you had about eight years worth of data form those screenings in to that first report in 2000 but obviously you'd have more in 2008.

MR JACOBI: And I know this may seem obvious but did that involve people that were medically trained?

PROFESSOR THOMAS: Yes, absolutely. Absolutely. I mean that was one of the reasons that I got interested in this, my boss at the time was probably the most (indistinct) pathologist and he and a gentleman who's (indistinct) both went out in 1992 and actually sat in clinics with the medics in Belarus, seeing these patients as they came in through the door. So no, these were people who were really at the top of their game, experts in their field who went out to conduct these surveys.

MR JACOBI: Okay. Now I just want to turn, we mentioned in introducing you, the concept of the Chernobyl Tissue Bank and I'm just wondering whether you might explain what the Chernobyl Tissue Bank is and what its purpose is?

PROFESSOR THOMAS: Yes. It became fairly obvious, in about the mid-1990's that the people in Ukraine and Belarus were very keen to understand what was happening. They wanted to be involved in a lot of the science and they had a tendency to be giving researcher's material from the same patients, which means when you come to do the meta analysis, you're actually looking at the same patients and you don't know it. So we thought a better way of helping them to do this and a better way of giving research scientists good material to work on was to actually develop a tissue bank where we collated all of the information about the pathology and about the types of tumours that were coming and collected biological specimens so we could try and understand whether there was something different about the way radiation induces cancer or are we looking actually at the same cancers but just more of them. Because if there's something different about the way the cancer's been developed, we might need to change the way we're treating people.

So it was really to try and understand how radiation affects the molecular biology and how it induces these cancers. But it was to do it in a programmed way, so that all researchers around the world could get access to this material, so the best science could be done on the material, to make sure it was collected ethically because the rules in Ukraine and Belarus are not quite – at the time, they've strengthened since, but at the time were not quite what we would accept in the west. So it was to encourage them to do this in a proper way, in a standardised way and in a way that we could follow over time. A bit like setting up the cohort study but this time with tissue because we wanted to know what radiation actually does to the tissue which causes these cancers?

MR JACOBI: Did that involve cancers other than thyroid cancers?

PROFESSOR THOMAS: There weren't any. That was the problem. I mean people keep thinking we're going to find other cancers other than thyroid cancer. There has been no increase in any other cancer in the populations at large. I'm not talking about the cohort with the liquidators; I'm talking about the population at large. There has been no other increase in any form of cancer, other than thyroid cancer. And there's a really good reason for that. The reason is there was an awful lot of iodine released; this is the first time we've ever exposed 10 million children to iodine. We don't see effects on the adult population; we only see it on the children. So this increase in thyroid cancer is restricted to only those who were young children at the time of the accident and the reason for that is that is a) they probably drank more milk than their parents, so their dose was higher because the milk was contaminated. But also, the thyroid in the child continues to grow, it has to reach adult size and that added growth increases the ability to – for the cells to become cancerous.

So it was important that we collected that and of course it's a particularly sensitive group when you deal with children, it's sensitive where – whichever country you're in. And people expected there to be other cancers. I thought there might be breast cancer for example because the breast has an iodine (indistinct) but it doesn't keep the iodine within the tissue. So it takes it up, especially when you're lactating but then it releases it again very quickly. So the actual dose to the tissue is much smaller than it would be to the thyroid where it takes it up, hangs on to it, and it releases its iodine while it's inside. And it really brought it home to me, when I actually saw the figures from the epidemiologist about doses of caesium. Now the caesium, some of it was skimmed, they took the (indistinct) off and disposed of it but a lot of it stayed on the ground and that mass that we were talking about at the beginning shows you where that caesium deposition was. And of course (indistinct) this is a rural economy where people grow their own food and they eat their own food.

So people were exposed to caesium and I was expecting to see something from that because that's the way we always thought about radiation, low doses can be very, very dangerous. But when you work out how much the dose is to people, just carrying on their normal lives, eating the crop they grow in the garden, over 20 years about nine million people – sorry, six million people got the equivalent of nine millisieverts each. That's the equivalent of one CT scan, whole body CT scan for example.

MR JACOBI: Now could I just - - -

PROFESSOR THOMAS: Because caesiums long lived physically, short lived biologically, the dose is much lower than you would expect. So all of a sudden you start to realise, well hang on, that's why we don't get any other cancers because the two principle isotopes, the iodine yes does cause thyroid cancer but the caesium dose that you get from that is so small that we just don't see the cancers because we wouldn't be able to pick them out from the noise of the (indistinct) cancer in that particular area.

MR JACOBI: Can I just go back through that answer and I'm just interested in the question of sources of the information that we've just discussed. And that is, I think we started with a statement about there not being cancers other than the thyroid cancers.

PROFESSOR THOMAS: Yes.

MR JACOBI: What studies you rely on to express that particular conclusion?

PROFESSOR THOMAS: Those are the large epidemiology studies that have been. I mean, if you're looking for something that - you want to look at the mechanism for how something is caused, first of all, you have to see that there is something causing it. So you can't do studies on the molecular biology unless you can see an increase in that cancer and then look at the excess rate. So you can only study an increase in cancer if you do proper cohort epidemiological studies, and all the cohort studies have shown us that thyroid cancer is the only one that has increased.

There is lots of noise in the scientific - not quite so reputable ranks - that give you anecdotal things of, "Somebody has got this cancer from that," but there's actually no studies that show that is the case, and you have to do this in a scientific way because cancer is caused by so many other things. So unless you do the right design studies, you're going to end up picking up cancer from other causes and think it's due to the radiation. You have to design very carefully in order to find out exactly what is causing it.

MR JACOBI: Can I just come to the thyroid cancers, and you expressed a view about the increased risk, particularly with respect to children, but not in the adult population and their exposure.

PROFESSOR THOMAS: Yes.

MR JACOBI: Again, what are the studies? What's the source of the information that you refer to with respect to those conclusions?

PROFESSOR THOMAS: Again, it's the epidemiology. So there has been less done in the adult population because thyroid cancer becomes so much more common in the old population, so you'd have to do massive studies in order to look at that. Childhood thyroid cancer is very, very rare, so you can see an increase very quickly, and this is a large increase. There's 100-fold increases in some places. As you move into adulthood, thyroid cancer becomes a lot more common even though it's still a rare cancer in terms of cancer terms.

But in order to see an increase with the population that you've got, you'd have to do very large studies and because we knew children were more sensitive, we did concentrate more on the children, because we knew that's what we could see, and of course you have to remember we had to get somebody to do these studies as well. So you have to come up with a proper design that everybody is going to believe the result, otherwise nobody is going to fund the study too. So there has been more concentration on the younger people because we knew they were much more at risk and we could define the population.

The adult population has not been so well studied, but there have been some studies in that population as well, and we just can't see an increase. And the simple way to do this is just to plot cancer rate over time and you can see that there's a cohort effect, so the youngest ones carry that risk with them. So there's no doubt about it. It is the youngest who are most at risk from this with all the studies that have been done.

COMMISSIONER: Professor, there has been evidence also this morning about genetic disease caused by the Chernobyl accident. Is there any evidence - - -

PROFESSOR THOMAS: Absolutely none. You have to remember that to have genetic disease you have to get a radiation dose to the germ cells. Your germ cells are pretty well protected. So to get a large dose to the germ cells is actually quite difficult. The studies that were carried out after the atomic bombs, where the doses were much larger you would've expected to see much more effect, and still have shown absolutely nothing in the next generation. So there's no generational effect at all from the atomic bombs because the individual doses - not the collective dose, which is the totally wrong way to look at it - the individual doses are so much lower.

It would’ve been amazing to see that, because you would then assume that anybody you had put under a CT scan, would it affect their children in the future. It just doesn't work scientifically to even suggest that at those doses. A lot of people did have abortions because they were scared, and we saw that after Fukushima as well. Some of the people were so scared that their children would be affected they had abortions, but the doses - there was just no scientific evidence to suggest that they would be at risk.

But people are scared and they do react in different ways, and it's very easy to blame something like radiation (indistinct) why something isn't right in your life, and I've seen that with people I know should know better. It's still an automatic response to try and find something to blame if you have a problem with your health or your children's health, but there's no scientific evidence for it whatsoever.

MR JACOBI: Coming back again to the answer from earlier, you expressed, I think, a generalised statement or an average with respect to an average exposure in terms of about 9 millisieverts for the general population that was other than the localised emergency workers at Chernobyl, and I'm just interested to see what's the basis for that estimate, how that was calculated, and where does one go to find that as a piece of material?

PROFESSOR THOMAS: Yes. That's using data from the map that we've been discussing first so we know what the - - -

MR JACOBI: Actually we'll pull that map up if we've got it. We don't. Sorry.

PROFESSOR THOMAS: Yes, so that you'll know what the pool contamination is, you can take questionnaire data to work out how much people were eating during the time, and you can also use whole-body scanning. They are doing that in Japan at the moment. People are being whole-body scanned to look at the caesium burden they have and in most cases they can't find any caesium at all in them. But there's a variety of different ways you can look at it, but most of them will use sort of environmental measurements and give you an estimation of the dose, because it's actually quite difficult to go and scan that number of people in an area like Belarus and Ukraine so you can work out from all of that data what the estimated dose would be.

MR JACOBI: I just want to then come to the question of outcomes, and that is in terms of deaths and other reported losses. Perhaps we can deal first with the localised workers, that is, as a result of the Chernobyl accident. What's your view of the state of the evidence with respect to the number of people who were in fact killed by radiation exposure from the Chernobyl accident?

PROFESSOR THOMAS: Yes. I mean, there are three people who were killed as a result of the explosion, nothing to do with the radiation, just got hit by flying debris and things like that. There are 28 firemen - and these were the guys who were hovering over the reactor core and were exposed to very large doses of radiation. 28 of those have died within a few months as a result of acute radiation sickness. There were a total of 134 people who actually have acute radiation sickness. They had very large doses and 28 of those have died. 14 of them went on within, I think, about five years of the accident to have children who were perfectly okay. So even those who had high doses, their children were perfectly okay.

There have been around about - again, you have to keep taking account (indistinct) lifetime. So what was reported in a 2008 report from UNSCEAR was 6,000 cases of thyroid cancer. They're going up by about a few hundred each year. Now, of those we know of 90 who have actually died from their disease. Okay? So these were people who unfortunately came to the clinics late and had metastatic disease and we were unable to treat effectively, and over about 50 years, so up to about 20, 25, we would expect, based on the data that we have at the moment, we'll probably have about 16,000 thyroid cancer cases as a result of the radiation. Okay? So more than we would have with normal incident of thyroid cancer.

Thyroid cancer is one of those things that we can cure very effectively, ironically by giving very high doses or radio iodine because the thyroid themselves take up the iodine and they get a large dose of radiation and that kills them. But even so, we would expect about 1 per cent of the people who get thyroid cancer to eventually die of their disease, and that could be many years after they have their first primary cancer. So that would be 160 deaths, for example. About 30 per cent of them we would expect to come back with thyroid cancer deposited elsewhere in their body, but again, most of those we would treat very effectively with radio iodine.

So if you sum all that up, you've got 28 who definitely died from acute radiation syndrome, very high doses, their bone marrow packed up; you've got 160 predicted deaths. That gives you something like just under 200. Then you've got (indistinct) in a fudge factor because until you have a complete dataset you will never know the exact figure, but two to 300 probably maximum. The assumption that they're in paper (indistinct) with a card (indistinct) which reviewed all this on the 20th anniversary of the accident suggested there might be about 25,000 other cancers, but the evidence doesn't seem to say that that's necessarily going to be correct, because the doses to elsewhere in the body were so low because they come from caesium.

We base that data on what we would predict if we use the models that were used for the atomic bombs on that population. That may not be the correct model to be using. So at the moment there are estimates, but what we do know is about 19 of the children who have thyroid cancer have died from their thyroid cancer and 28 workers have died from acute radiation syndrome. The others, although they have acute radiation syndrome, they have sort of lesser forms of it, are still alive and well, apart from the few who died from smoking-related illnesses, alcoholism and (indistinct) which you really can't put down to the radiation because of course as our population ages they're going to die. We can't avoid death, unfortunately. Well, not yet. That population will die but it won't necessarily die of anything to do with radiation.

MR JACOBI: You gave a number from I think an analysis that had been done. I think the surname was Cardis.

PROFESOR THOMAS: Yes.

MR JACOBI: Of 25,000. Was that 25,000 cancers or fatalities?

PROFESOR THOMAS: Cancers. Interestingly, as we get better at treating cancer of course they may not result in deaths from cancer because in medicine if you cure somebody, it just means they die from something else, not from the cure.

MR JACOBI: I just wonder, based on your involvement and work, whether you think that there are any particular key lessons that have emerged from our understanding now of the Chernobyl accident in terms of the cancer risks.

PROFESOR THOMAS: Yes, I think if you'd asked me when it happened I think everybody was scared there was going to be lots of leukaemia and different sorts of cancer. Now the evidence - and it is very good, hard evidence, and that's part of the reason I think people did not speak out quite as - particularly don't speak out without data. We don't like giving false information. So now we have the data and we can see that actually the major cancer was - in fact the only cancer was thyroid cancer, which we would not have predicted from the beginning. But interestingly, if you go back with hindsight and you look at the animal models, the animal models predicted exactly that: it would be young children who would be most at risk and they would get thyroid cancer and nothing else. Even we treat with radioiodine, very high doses of radioiodine, that does get elsewhere in the body - that's why we're giving it, to get rid of the thyroid cancer - you do find you get a small number of secondary malignancies as a result of that radiation exposure but at much higher level.

So my guess is that thyroid cancer will remain the only thing that we actually can prove was due to the radiation. It's very difficult to disprove that anything else went up because of all the other effects that give us cancer. That's partly part of the scientific conundrum we find ourselves in: you can't disprove something but you can prove it; and you can't disprove there was ever any other type of cancer, if we're totally honest scientifically. But the chances are that the vast majority of all the other cancers in that population were not caused by the radiation at all; were caused by alcohol, smoking, all the other common factors that we know about. But pinning the exact amount down to radiation in our population, as I've said before, at low doses is very difficult and I would say almost impossible. But we keep trying to do it, and that's part of the reason that people are still worried about radiation, is we can't give them a definitive answer, if we're really brutally honest.

But what I can say is, I would be more worried about living with somebody who smoked than being exposed even as a liquidator - to the lower dose liquidators to the radiation from Chernobyl. Smoking is far more dangerous. In fact, smoking also has radiation in it because you have polonium-210, which is now thrown into - so a smoker who smokes on average one pack of cigarettes a day over a year will get the same dose as if they had a CT scan.

MR JACOBI: That's additional?

PROFESOR THOMAS: That's additional.

MR JACOBI: Can I move to Fukushima. I think we've already dealt in part with the differences in causation and I'm just interested in terms of the key isotopes we need to be concerned about in terms of emission from the Fukushima incident and then move on to dealing with the health effects from that.

PROFESOR THOMAS: I mean it's the same two isotopes. It's iodine-131 and caesium-137, the longer lived version of caesium. Those are the two isotopes that we're concerned about. Those are the ones that were released at highest quantities and dropped into the general population rather than just being in the reactor plant itself. So those are the ones that are cause the health effects, if any, on the population.

MR JACOBI: Perhaps if we can deal with - because we've dealt with iodine and thyroid cancer with respect to Chernobyl, are there relevant difference with respect to the Fukushima incident?

PROFESOR THOMAS: I mean the doses at Fukushima were much, much lower. They were about a hundredfold lower, even to those who were evacuated. There are reasons for that: (a) there was much less release; (b) the Japanese did exactly what they should have done, which was to move the population away. The Japanese don't drink much milk and things like that. It was cold, it was snowing. The cows were inside so they weren't eating contaminated grass for those who do have milk in their diet. So there's lots of reasons why their iodine intake would be lower. Also, the Japanese eat a lot of iodine-containing seaweed and things like that. So your thyroid is a bit like a sponge. If you put a dry sponge into water, it soaks up the water and once it's got all of the water contained in the sponge, it can't take up any more. The thyroid is like that.

If you've got lots of stable iodine around, you're actually going to have all of your iodine being sucked in by the thyroid will be taken up by stable iodine. So the radioactive ones don't go in. There are lots of reasons why that dosage was lower but primarily it's a lot less was released and the Japanese authorities did the right things in terms of moving the population away and cutting the food chain. There's no doubt about it that the food chain and what you consume is the most important component of the dose. So you will inhale some iodine if you're standing outside but cutting that food chain restricts the dose of iodine and caesium very, very effectively.

In Japan they can do that. They can call in food from other areas of Japan. In Belarus you can. In Russia, because it's ruled economy, you really couldn't do that. So if they said, "Don't eat the food," if the people had actually done what they were told - and people notoriously don't do what they're told - you know, they had problems feeding the people who lived in that area as well. So the two accidents are quite different, both in terms of the amount released and in terms of response by the authorities (indistinct)

MR JACOBI: You expressed the exposure as being a hundredfold less. Is that capable of being expressed in terms of either grays or middle sieverts?

PROFESOR THOMAS: Millisieverts. So the average exposure to evacuees and (indistinct) was to the thyroid about 500 milligrays. Because it's a beta emitter, you can equate that to the 500 millisieverts. The exposure to the thyroid for the people that were actually physically measured - there's no assumption in the dose; this was actually measured in the thyroid - from Fukushima was about 4.2 milligray millisievert. So we now the doses were that much lower. In the original reports that came out from WHO there were an awful lot of assumptions about how people would behave, so those assumptions went into the dose estimates. So those estimates at about 80 millisieverts, for example. When they actually measured the doses, the doses were an awful lot lower because people had been moved away, they'd shut their windows and doors, they'd not eaten contaminated food. So it's pretty obvious that the measures were pretty effect in reducing the dose, which is the most important thing. No dose, no effect; it's that simple.

MR JACOBI: I'm interested in understanding the extent to which there's been health monitoring of both the general population and those particularly in the Fukushima prefecture following the incident.

PROFESOR THOMAS: There's a huge study going on where they are monitoring the health of the population. That might actually not be helping the population because if you're having your health monitored you immediately think, "I'm going to be ill, that's why they're looking at me," which actually psychologically doesn't help them that much. But there's a massive health survey that's going on looking at different aspects. There's a big ultrasound study that's looking at the 360,000 children who were exposed under the age of 18. That is actually a survey. So all of these kids will be invited to participate in having their thyroids screened by ultrasound, which is an extremely sensitive technique, every two years until they're 20. I think it then goes to every five years after that. Just the long-term effects on the thyroid.

But there are also other studies looking at women's health, looking at pregnant women's health, looking at the psychological effects as well. So there's massive amounts of data being gathered about that. That's actually got a problem because if you release that data without explaining where the data has come from, you can actually worry the population far more. So interpretation of that data for the public, who aren't experts in whatever health field we're looking at, actually requires quite a lot of skill and quite a bit of interpretation. Otherwise you just get facts which don't mean anything to anybody.

MR JACOBI: I think we've referred to an analysis of caesium and iodine. Is there analysis of other particular radionuclides and their release and their health effects on the population?

PROFESSOR THOMAS: There are huge amounts of people monitoring the environment around there, loads of studies being done. There’s some people wandering around with caesium detectors just to see what the levels are on the ground because you get very patchy fall out and of course if you’re inside a house you’re not going to get contamination unless you walk through a contaminated patch and bring contamination in with you. So there’s huge differences in exposure levels depending on where people are at the time and where it rained for example, so – and on to the soil that (indistinct) There were lots of studies going on about that but really and truly, we know that the isotopes they’re going to cause a problem not the caesium and the (indistinct) because they’re released in to the environment whereas most of the (indistinct) are very, very close to the power plant themselves. It’s the volatile isotopes that cause the problem for general health. So there’s massive amounts of data that are coming out of those studies as well.

MR JACOBI: Are you aware – and we have heard some evidence that suggested that there were some reports of illnesses consistent with some forms of radiation sickness following the - - -

PROFESSOR THOMAS: No.

MR JACOBI: - - - Fukushima incident?

PROFESSOR THOMAS: No, not true at all. I mean you can feel sick for a number of reasons and that’s one of the first signs of radiation sickness but it doesn’t mean you’ve been exposed to radiation. The doses at the plant were very much lower than the doses at Chernobyl; nobody got a dose of a sievert, which is the sort of (indistinct) acute radiation syndrome as 1,000 millisieverts. So the doses were much, much lower, even within the plant and that’s down to really good radiation protection and making sure that you monitor your workers effectively as well. And that was very important. That’s why so many people were involved because they were changing the workforce to make sure that individual's levels were kept as low as they possibly could, but to give them (indistinct) they were working in.

MR JACOBI: We have also heard some evidence that suggested that there would be an epidemic of cancers that would be created as a result of the Fukushima accident. Do you have a view with respect to that?

PROFESSOR THOMAS: Absolutely not. I mean I worked on the recent IAEA report and we went through every piece of evidence and we were able to talk to the Japanese, really drill down in to what was known, what was unknown and the levels of radiation that were – that came out of the plant and the doses to which the population were exposed, there will be absolutely no discernible risk in cancer increase. I have to say something though, there was a recent report about a gentleman who had leukaemia who’d been working at the plant, the problem is the law is not our friend here. The law says that if you cannot disprove that it was due to an industrial cause then you pay compensation. So because they were unable to prove that it wasn’t due to the radiation because we just can’t do that. We can’t prove a negative, he was given compensation but I’m really worried about that because if you look at the dose he had, he had AML which is reasonably common in his age group. If you look at the figures from what we have from the atomic bomb studies, actually 30 to 40 year olds and this gentleman was I think 40, that section of the population is actually more resistant than younger people and older people to leukaemia development from radiation. His dose was, I think, 15 millisievert or 19 millisieverts, certainly under 20 millisieverts but his lifetime dose from other radiation sources throughout his life and background would’ve been 80 millisieverts by the time he was 40.

So why – to me, he’s much more likely to have had the leukaemia from things other than radiation and unfortunately people in that age group do get AML and that’s a fact of like. I see people like that all the time in the hospitals who have got AML around about that age group, doesn’t mean they’re exposed to radiation. But unfortunately as soon as you pay compensation it becomes fixed in the public’s mind and the media’s mind that it was caused by the radiation. That is something totally different and there’s certainly not enough evidence to say that. But unfortunately that’s the way the compensation rules work in terms of industrial exposure to things that might damage your health. And also, I should also say that smoking causes 17 per cent of AML and if you've been to Japan, the majority of Japanese men smoke.

COMMISSIONER: Professor, thank you very much. That was very useful for us and - - -

PROFESSOR THOMAS: Thank you.

COMMISSIONER: - - - I thank you for spending some time with us on that evidence. We'll now - - -

PROFESSOR THOMAS: Thank you very much.

COMMISSIONER: - - - adjourn.

MATTER ADJOURNED AT 5.15 PM ACCORDINGLY