

## Science of Forensic Investigation – part one

**Peter Brabazon:** “My name is Peter Brabazon. I’m the programme director for Discover Science & Engineering and we’re responsible for Science Week. I’m very pleased that you could all be here today on such a lovely day outside and in such a lovely building, of course, here as well. The National Museum is very much associated with science and indeed when this site opened back in the 1800s, this was known as the Museum of Science and Art. And we’re glad to say that science has returned here today. We’re very happy, of course, to be working with the Women in Technology and Science, particularly with Sadhbh McCarthy who has been organising quite a lot of this today with my own colleagues in Discover Science & Engineering.

“I think we’re on for a truly interesting time, a bit like the forums of the past in this great building. We’re going to hear science forensics, forensic science, a very interesting and topical subject these days, and indeed helping to solve quite a lot of problems and ensuring that we have a good, safe democracy, which is so important.

“And of course, certain people like OJ Simpson today may regret in fact that there is forensic science. I just heard that as I came out of the taxi. He looks like he might be in a bit of trouble because of forensics.

“We’re very fortunate today to have Dr Sheila Willis, who is Director of the Forensic Science Laboratory, a key part of our national institution. She’s going to really talk to us, I understand, about the real world of forensic science, because, obviously, probably most of us have seen CSI. I guess there’s other aspects to it as well and I’m looking forward to hearing that myself.

“We’re also very fortunate to have as your MC today David Harvey. David, of course, has a very strong and personal interest in the topic as well because he was the man that used to front Crimeline on RTE. Subsequently, he’s kept up his interest, but he’s been setting up television stations and he’s now the CEO of City Channel and it’s growing rapidly around the country with a presence not only in Dublin, but also now, I believe, in Waterford and Galway. He tells me he’s

going to capture the rest of the world as well. So he's after your minds as well. But I'm going to hand over now to David and enjoy the presentation, I'm sure you'll be fascinated. Thank you very much for your time."

**David Harvey:** "Well, good afternoon everybody. It's great to be here. This used to be the ceramics room, well it still is known as the Ceramics Room of the National Museum. They've moved the ceramics out so it makes a wonderful room to have a meeting like this in and it's great to be here today.

"Thank you Peter for that nice introduction and I suppose Peter's already said in what context I'm here. I was involved as the producer and also the co-presenter of RTE's Crimeline show for eleven years. We did one hundred and thirteen programmes before we decided we'd had enough of it but I was also involved in making a series for RTE on the subject of crime solving, or not solving as the case may be, called 'Solved and Unsolved'. And in that particular programme we had a lot of access to forensic information and subjects like murder and rape and so on, subjects where there had been a huge intervention from the new science of crime solving. That is what Dr Willis is going to bring to us today.

"The whole change, the radical change there's been, in what was originally a non-scientific, yet scientific in its own way, method of solving crime, the art of deduction, elimination, the plod, if you like, of the local detective. And in this country, I think, a huge part of the crime solving was down to the fact that we are a small country so the word got round when something happened. But one had to build a case based on evidence, a case based on interview and so on, so that little tiny piece of the jigsaw, which has now become such a huge piece of the jigsaw, was left out. That is what Dr Willis is going to talk about today.

"One of the particular crimes I came across in my tenure was that of Marilyn Rynn and maybe Dr Willis would enlighten me but I believe that it was the first criminal trial in this country which was solved with the aid of DNA evidence. You may remember, this was a civil servant lady who was murdered in 1996, and her body was found after Christmas in the Liffey Valley Park/Tolka Valley

Park area and it was the DNA evidence that convicted the killer in that particular case. So it's a relatively new science but one which, I think, has revolutionised the whole area of crime fighting.

"Just to tell you a little bit about our distinguished speaker. Dr Willis is the director of the Forensic Science Laboratory. Prior to that she was deputy director and head of the chemistry section. She went to UCD and she also carried out PhD research on organo-metallic chemistry, under the supervision of Professor Manning there. She was recently chair of the European Academy of Forensic Sciences and has been active in the European Network of Forensic Science Institutes since its inception.

"Now she's going to deliver a lecture we're told today, but I know it's more than that, it's an insight into this terrific subject. She's going to use PowerPoint but I think what we'll have afterwards is hopefully a very interesting and informative strong exchange of views in our question and answer session. I've talked enough. Let's get on with the real business of today. Please put your hands together and welcome Dr Sheila Willis."

**Sheila Willis:** "Thank you very much David and good afternoon ladies and gentlemen. I'm very pleased to be here in this venue and hope I can one quarter live up to the expectation of that introduction I've just had. I'm going to talk to you about forensic science and how it's involved in the investigation of crime.

"One of the interesting things about forensic science is that it has been, for a long, long time, inextricably linked up with the world of fiction. I have often said in previous presentations that we're still trying to play catch-up with Conan Doyle's invention, which was back in the late nineteenth century. That, at that time, was really the work of science fiction, although I'm sure it wasn't called that at the time. And today, although people may not have much to do with Sherlock Holmes, very many people are familiar with CSI. And I say that with a bit of a tone of 'Oh my goodness' in my voice because it has both positives and negatives from my perspective. Lots of people know about forensic science and therefore that's good to some extent. But it also has created huge expectations of what we in the world of real forensic science can deliver. And what I'm hoping to

do now in the next thirty minutes or so, is give you some sense of what it's like in the real world as opposed to what it's like on the forty-nine minutes or so that we get on the CSI slot.

"My laboratory, the Forensic Science Laboratory, has the mission of assisting in the investigation of crime and helping the administration of justice by our staff carrying out analytical work and also delivering expert evidence. That's a bit of a mouthful, but I put it there to give you some idea of the breadth of what forensic science is about. And the realisation that, and this is something that I feel passionately about, it's not about a black box solution in a corner. Forensic science is about a process and it begins at the scene and it finishes when the evidence is actually delivered in court. Obviously the piece in the middle where the analytical work is done is critically important, but in a way that's easier to control than the other bits.

"And I put that bit in at the end because I was preparing this clip art the other day and I thought, I'd love if I could get a hydra because the difference between the real world and CSI is that in CSI virtually every role is performed by these trendy, beautiful looking people who are able to do the investigation, the analysis, the interpretation and all the whole thing in one. Whereas in our world you find that different people are involved in different parts of the process.

"So let's look at the lab end first. We are involved to some extent in all parts of the system, in that occasionally we attend scenes. This would happen in certain instances where – obviously, we're a relatively small number of people, by the way, in comparison to the investigative force of the Gardaí – but occasionally there would be scenes where there is a value in the forensic scientist attending the scene, either because they may be able to prioritise what work they'll do when they go back to the laboratory, or they might be able to advise on the best samples to be taken. We also are involved in court although you would be surprised, I think, to find that a relatively small number of cases that go through the laboratory end up in contested court cases, but it is an important aspect of the work. We provide a helpline and a lot of training to the Gardaí as well. But the core work of the laboratory is the analytical work and I will talk about that in a bit more detail.

"There is some work that would be considered to be forensic science work that's not part of the functions of our laboratory, but is performed by technical sections of the Garda Síochána. The

present Technical Bureau was established in 1937, I think, and it provided a technical service to the Gardaí in all ranges of materials until the Forensic Science Laboratory was established in 1975. So there's a bit of overlap of our functions but the more analytical, biological, chemical things are dealt with in the laboratory whereas the Gardaí, they do crime scene investigations, fingerprint detection, firearm examination, photography and they also do document and handwriting examinations. Now in some countries, that range of activities would be in an isolated laboratory, in some countries different so there's no real ideal model for the delivery, I suppose, of forensic science.

"Let's get back to the actual analytical work in the laboratory. The laboratory is divided into four functional areas and the biggest one, which is reflected in the number of times you hear it in the news, is in the analysis of materials that are thought to contravene the Misuse of Drugs Act. It's maybe the less glamorous end of forensic science, it's not the bit that you hear about in fictional detection work, but approximately nine thousand cases come through our laboratory every year in which the main purpose is to find out if there is a controlled drug present. The range of drugs varies in different eras, at different times. Cannabis resin has remained the most popular throughout the time but in the past sometimes the second most popular would have been heroin, or ecstasy or whatever. The list on the slide there reflects the present order of popularity, if you want to say that, in terms of materials being submitted at the moment.

"The chemistry section is almost a misnomer. It's a section dealing with a very broad range of crime types and analyses. And both biology and chemistry fit into the category of looking to make links. The forensic scientist has two possible ways of operating. And one is the actual analysis of material which we saw in relation to the drugs case, where the significance is that something is actually identified as being heroin or cocaine or whatever. The second area, which I'm going to talk about in more detail, is one where the analysis and comparison is carried out in order to check whether or not there's a link or not between places and people or between victims or suspects, for example.

"So, in that context, in the chemistry section, case types such as armed robberies, burglaries, traffic accidents, fires, explosions and so on are examined. And in order to help with those investigations, materials such as paint, glass, soil, firearm residue, fire accelerants, explosives, are some of the materials that are analysed on a routine basis. The cases in chemistry tend primarily

to be cases against property, while in the biology section – these divides, by the way are a little bit artificial, it's just how we're separated – in the biology section it's primarily offences against people. By its nature we're talking about biological materials so we're talking about the detection of blood, semen, saliva. In this section the staff are involved in, first of all actually locating such samples, because high sophisticated analytical techniques are not really possible unless you can say where you should start. It's like, you know, a haystack and a needle, you've got to be able to locate where you're going to look. Sometimes, in fact a lot of times, the positioning of something is actually more significant than the comparison or discrimination later on.

"The forth section is the newest one in the laboratory, and that's the section dealing with DNA profiling and samples are submitted from all the other sections into DNA. I have on the PowerPoint there a brief resumé of the development in the technology in DNA over a relatively short period of time. David mentioned earlier on that it is a relatively new area and I'll talk about it later on in the presentation. But if you look at the slide, the sample on the – that went without my touching anything folks – well, the bigger sample was the size that we needed when the technology was first introduced and nowadays DNA can be carried out on samples where you can't see it with the naked eye. So the sensitivity of it as a technique has continued with time, which causes its own problems, maybe we'll talk about that again.

"I've said that forensic science is an end-to-end process. It involves using science in a context, and again David said in the beginning that crime investigation was carried out by traditional investigative police activity. I would make a strong point that that skill is still absolutely vital if forensic science is to be used properly. Forensic science doesn't have magic answers that can be plucked out of the air and plugged in to give you a solution. Forensic science has to be used by people who understand both the potential and the limitations and know where and when it's going to be useful. That's, I think, one of the reasons that it's critical, that we as a society in general and that the police and the people involved in the criminal justice system have an understanding of how to use it. It's not a science of absolute solutions and even when there's very high discrimination, by which I mean that you can separate samples to a great degree, it's still not associated with certainty. Because all science, if you like, is growing on the back of predecessors.

"This may seem a trivial point but I put in some slides to the presentation to remind me of the tension and frustration that is sometimes there when science and the law meet, which they do in

forensic science. My perception is that, when I present evidence in court, there is a need, by the court of me, to give yes and no answers and black and white solutions and, of course, science is full of grey and it's changing, it changes all the time and that has all sorts of problems associated with it. And you use the literature, and just as a little anecdote to prove the point I'm making about the difference between science and the law: I can remember being in a situation where the judge would not allow me to give an opinion because it was based on literature references and I hadn't carried out the work that the literature was based on. I mean, that would just be such a crazy world for a scientist and yet that seemed to make sense for that particular lawyer.

"I said we're not into the realm of black and white, yes and no answers, so where do we get our answers? Statistics are used quite a lot to evaluate findings and for that reason, I know there's a lot of students in the audience, I would encourage students who are interested in science to concentrate and focus on mathematics as a key skill, regardless of what branch of science that you're interested in. I think traditionally there may have been – I'm deviating now from forensic science – but there may have been an interest in thinking that if you're doing physics, chemistry, you should have the maths but I think it's very much the world of biology as well. All measurements in science have uncertainty associated with them, and that's something else we need to be conscious of if we are doing our analysis in the laboratory.

"There's very little real academic work associated with, purely with forensic science. Forensic science tends to be an application of other scientific techniques and I'm going to come to that in a bit more detail. The exception to that is work by Evett and co-workers in the UK and I put it here because it's emphasised the point I think I'm trying to make, that the interpretation of scientific evidence is carried out within a framework of circumstances. It's not an isolated fact.

"Interpretation, if it's meaningful, has to look at two competing hypotheses, at least two competing hypotheses, and the scientist should be in a position where they're commenting on the probability of the evidence, rather than the probability of the hypotheses, and CSI is a bit different in that. CSI is always able to look in, and you know the way they have these flashbacks and they can see the thing being relived, well science is never in that realm, not today in this world anyway."