The Story of the Right Measurement that Caused Injustice and the Wrong Measurement that Did Justice; How to Explain the Importance of Metrology to Lawyers and Judges

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Peter Neil Hamkin is a peaceful bartender in Litherland, a small village north of Liverpool, in UK. On February 13, 2003, Scotland Yard collared him under indictment for murdering a 24 year-old lady named Annalisa Vincentini during a robbery attempt in Castiglioncello, a small village on the Tuscany coast, not far from Florence, Italy, on the previous August 19. His DNA nailed him. The police found it in the abundant trail of blood left on the crime scene: Annalisa's boyfriend reacted to the robbery attempt and hit the mugger's face with a stone, causing him to bleed freely.

DNA profiling cannot be doubted. Peter is guilty and risks a life sentence. However, he claims his innocence. He says he has never been in Italy. He's lucky. The regular customers of the pub where he works all gave evidence that they saw him behind the bar on August 19. Even more luckily, on August 19, the pub owner was at the funeral ceremony of a relative. The pub was open, Peter is the only employee, so he was the person behind the bar, without any possible doubt. He is cleared from the charge. But, what could have happened to any John Doe, student, or unemployed or retired person, without so many people to give evidence for him?

Because DNA does not lie. Everybody knows this! Or, maybe not?

No, DNA does not lie. If the peaks of the alleles in the organic traces found on the crime scene that the instrument measured correspond to those of the suspect's DNA, that DNA is his own DNA with a high level of probability. There is practically no doubt left.

However, there is a "liar." Better, there is an inveterate liar: the instrument employed to detect the allele peaks. Indeed, all instruments "lie," not only the one that was nailing our poor Peter. This is well known to metrologists, those who practice measurement science.

Metrology tells us very clearly and very humbly that, due to the inaccuracy with which we can describe the measurand – that is the quantity we want to measure – and the unavoidable imperfection of the employed measurement methods and systems, even the most accurate and expensive ones, the value we obtain is only an approximation, more or less accurate, of the measurand value we would like to know.

Well, to cut it short: the "true" measurement result does not exist. And if we take for granted the measured value, thinking it is correct, as did the detectives working on the murder of poor Annalisa, we may risk charging an innocent.

What shall we do, then? Kick all scientific evidence out of the courts of justice? Go back to the 19th century and throw away everything Sherlock Holmes showed us?

Obviously not! Science means progress, and forensic science means progress, too, a progress that we should not throw away. However, science must be understood and mastered, to get useful results instead of gross mistakes. An important branch of science is metrology, and it has become an important part of forensic science too.

Luckily, metrology does not only tell us that the instruments we use are liars. Indeed, it does not say this. Sometimes scientists double-talk, we know, and say "the result of a measurement can provide only incomplete knowledge about the measurand." Indeed, were this all they could say, they would be of little utility, these metrologists! But they aren't. They say – and this is the most important part – that it is possible to understand how close the measurand value is to the measured value. They instruct us on how to evaluate an attribute of the measurement result – that they call "measurement uncertainty" – that is used to obtain an interval of values, about the measured value, in which the value of the measurand is expected to lie with a specified probability.

Do you find it difficult? Well, it's not immediate. Everybody is capable of using an instrument. Actually, we all use them in our everyday life, from our watches (that measure time), to the speedometers in our cars, that measure the speed we are driving. On the other hand, evaluating measurement uncertainty is not a piece of cake. We need expert people to do this. But when they tell us the value, then we can understand its meaning rather easily.

The meaning is that the result of a measurement is not a single value, but rather a set of values, into which the value

of the measurand is supposed to lie with a given probability. And what do we associate with probability? Doubts, of course, don't we? If the weather forecast says that tomorrow we have a 20% probability of sun, the reasonable doubt that, if we leave our umbrella at home, we will arrive at home totally soaked crosses our minds. On the other hand, if the weather forecast says that it will be sunny tomorrow, without specifying any probability, we leave the umbrella at home, and at the first shower, we'll start cursing the weather service (and with some reason, after all!).

The same thing happens with DNA profiling and every other measurement. If an expert witness provides the measurement result as a single value, the trier of facts takes it for granted and no doubt crosses his or her mind. And makes a decision accordingly. On the contrary, if the expert witness states that the value of the measured quantities lies in a given interval with 95% probability, he or she is also correctly warning the trier of facts that there is a 5% probability (that is a doubt) that the value of the measured quantity lies outside that interval. The trier of facts can hence ask himself or herself, in all conscience, if that doubt is reasonable or not and, consequently, render a decision "beyond any reasonable doubt."

This is what metrology tells us. The little, humble wrong measurement, child of a lying instrument, who is aware of this and discloses it to the trier of facts, thereby, does true justice. While her haughty sibling who believes to be always right, denies her untruthful father and makes great injustice!

So, fellow metrologists, don't stop explaining that measurement uncertainty helps the trier of fact to be more certain of his or her decisions. And you, fellow lawyers, do not be pleased by those expert witnesses who do always believe that their instruments are always right: question them about measurement uncertainty and grill them if they can't answer: you will contribute to clarify the facts!