Prof.dr. Charles E.H. Berger

Taking the search for truth to a higher level

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Taking the search for truth to a higher level

Inaugural lecture by

Prof.dr. Charles E.H. Berger

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Criminalistics

by special appointment

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Mr. Rector, Dean and Board of the Faculty of Law, members of the Executive Board of the Netherlands Forensic Institute, members of the Board of Trustees of the endowed chair for Criminalistics, dear family, friends and colleagues,

What is criminalistics?

I want to start with the question of what criminalistics really is. Criminalistics is the exact science part of the forensic sciences. It focuses on the scientific examination of evidential material for truth finding in criminal law and on the significance of the results of such examinations for the truth finding process. It does not examine how lawyers handle evidence and search for truth in practice, which is in the domain of legal psychology. It is more about how you should use evidence to reach an optimally informed rational judgment. Real justice is not possible without a good attempt to find the truth. And a good search for the truth requires good criminalistics.
Criminalistics is not criminology. Criminology is a behavioral science that has criminal behavior and the social reaction to it as its object of study. Criminalistics is also not a party game. Nevertheless, I think that knowledge from criminalistics should be shared with as many people as possible. In the first instance with all the players in our criminal justice system. But ultimately with everyone who is interested in finding the truth.
For me, the interpretation of evidence is the core of criminalistics. The interpretation of evidence distinguishes criminalistics from other sciences, and it interconnects the many forensic disciplines. The interpretation methods are also less short-lived than the technological aspects of the examination, and often need improvement.
No matter how advanced an analytical technique is, we must ask ourselves what each examination result means for the questions in the case. This also applies to the observations of lawyers themselves, and the interpretation of evidence is therefore at least as relevant to lawyers.
A few years ago I came up with a much shorter definition of criminalistics: Criminalistics is reasoning backwards.[1] The objective is to reason backwards from consequence to cause. From an observation of a consequence, a trace, we want to reason backwards to its cause. We focus on questions like by whom, when and how was that trace left behind?

The logic of evidence interpretation

I want to show how the logic of the interpretation of evidence follows from three simple principles:

1. tunnel vision must be avoided;
2. an expert does not have all the information and evidence in a case;
3. we want to reason rationally, to arrive at optimal decisions with the information available.

Tunnel vision must be avoided

The first principle is to avoid tunnel vision. Everyone will agree that consistently omitting exculpatory evidence leads to tunnel vision, and does not belong in an honest process of truth-finding. But tunnel vision can also sneak into the examination in more subtle ways. The wish to prevent tunnel vision therefore has a number of consequences.
For example, more than one hypothesis must be considered. Hypotheses are statements that may or may not be true. Examples of hypotheses are:

- "the trace was left by suspect A", or
- "the culprit entered through the window", or
- "the injury was caused by kitchen knife A".

Each of these hypotheses should go together with at least one alternative hypothesis, for example:

- "the trace was left by suspect B", or
- "the perpetrator was let in by the victim", or
- "the injury was caused by some other kitchen knife".

In evaluative forensic examination, the hypotheses are a reflection of the positions taken by the prosecutor and the

defense. If the case is still in the investigative phase, there is no defense yet, and the hypotheses are a reflection of the questions in the investigation.
There must be balance in the considerations. For example, if the forensic expert is asked: "Could the injury have been caused by kitchen knife A?", The answer might be: "Yes, the injury may have been caused by kitchen knife A". But due to the lack of balance this answer seems much more useful than it really is. After all, the answer does not say anything about the alternative hypothesis: "the injury was caused by any other kitchen knife". Suppose the findings of the examination fit equally well with both hypotheses; the findings then make no distinction between the two hypotheses. The evidence then points just as strongly in the direction of kitchen knife A as in the direction of each of the millions of other knives in our country.
It is therefore not sufficient to see how well the results of the forensic examination fit one hypothesis. It is essential to see how well the results fit an alternative hypothesis. In the inquisitorial Dutch legal system too, there is a competition between hypotheses in the mind of everyone who is interested in finding the truth. The convention is that the first hypothesis is that of the prosecutor and the second is that of the defense. In a rational interpretation, the examination results lead to an update of the relative probability of the hypotheses: a change in their odds.

An expert does not have all information
The second principle is that the expert does not have all the information. A forensic expert will receive the following as part of an examination request:

- evidential material;
- some context information; and
- an examination request with the hypotheses to be considered.

When requesting an examination, the requester (usually police and the public prosecution service) selects the evidential material submitted for examination. The requester also selects the context information that is provided to the expert.
Since the expert never possesses all the information, he or she cannot determine the probability of a particular hypothesis. This is because a lot of the case information the expert does not have is relevant for that probability. Only the police and the prosecutor have this information.
If, for example, the hypothesis is: "The trace on the crime scene originates from the suspect", then the probability that this hypothesis is true does not only depend on how strongly the trace resembles the reference material of the suspect. This probability also depends on other information such as motive, alibi, and other traces. The expert does not have the other information and that is proper, because it will usually fall outside his area of expertise.
Experts therefore cannot make any statements of the type: "given these examination results I think it is very likely that hypothesis 1 is true". After all, the probability of hypotheses depends, as discussed, partly on other information and evidence that the expert is not aware of.

We want to reason rationally
The third principle is that we want to reason rationally. In the above we have seen what the expert *cannot* conclude on the basis of logic and the information he has. We will now discuss what he *can* conclude rationally.
An observation is ideal proof when you would always make that observation when one hypothesis is true, and never when the other hypothesis is true. In reality, such evidence does not exist, and evidence is probabilistic because there is always some uncertainty. It is possible to make the observation under both hypotheses, so we must not only look at the possibility but also at the probability.
Bayes' theorem tells us how to adjust our conviction based on an observation.[2] A theorem can be directly proven from the basic laws of, in this case, probability, and there is therefore no doubt about its correctness. By 'our conviction' I refer to the ratio between the probability that hypothesis 1 is true

and the probability that hypothesis 2 is true, the odds. We have to adjust the odds of the hypotheses on the basis of the observation. Bayes' theorem shows that that adjustment is done by multiplying them with the evidential value.
The evidential value is therefore the update factor for our conviction, the update factor for the odds of the hypotheses.
The theorem also tells us how the evidential value is determined. The evidential value is equal to the diagnostic value of the observation, also known as the likelihood ratio. The value of the evidence is the extent to which the observation is more likely under hypothesis 1 than under hypothesis 2. For the evidential value, we must therefore divide the probability of the observation when hypothesis 1 is true, by the probability of the same observation when hypothesis 2 is true.
The analysis of the evidence and the resulting observations are only part of the work of the forensic expert. The final contribution of the expert is the evidential value. To this end, the expert first puts herself in the situation where hypothesis 1 is true, and assigns a value to the probability of her observations, the examination results. How probable are the examination results when the prosecutor's hypothesis is true? The expert then moves to the situation where the hypothesis of the defense is true, and again assigns a value to the probability of the examination results. The ratio of the probability of the examination results under each hypothesis gives the evidential value.
The evidential value indicates the extent to which the observations can distinguish between the hypotheses. The legal practitioner can use the evidential value to see how the odds of the competing hypotheses change through this piece of evidence. The evidential value itself does not say anything about how likely the hypotheses are, but only about how their odds change. The odds depend on all evidence and information in the case, and are up to the tribunal of fact. The expert thus works with the hypotheses of the prosecutor and the defense without knowing the probability of these hypotheses being true.

Now suppose that the defense puts forward a rather far-fetched hypothesis, then the expert will just go to work. It is up to the judge to wonder how probable such an hypothesis is a priori. Thus it is possible that, after we have considered some exculpatory evidence, the probability of the hypothesis of the defense is still smaller than that of the prosecution. Conversely, despite incriminating evidence, the prosecutor's hypothesis may still be less probable. And the most probable hypothesis, of course, does not have to be the hypothesis that is true.
The evidential value is the indication that lies in the examination results. And an indication has a strength and a direction. The same goes for evidence. Neutral evidence has evidential value 1, the odds of the hypotheses do not change by multiplication. For exculpatory evidence, the evidential value is between 1 and zero, and the evidential value goes towards zero as the evidence is stronger. For incriminating evidence, the evidential value is between 1 and infinity, and the evidential value goes towards infinity as the evidence is stronger. The word 'indication' rightly emphasizes that there will also be other indications, and that these indications can point in different directions with different strengths.
In reporting the evidential value, the expert remains within her own area of expertise and does not need all other information. She shows how much weight her results put into the scales when the judge weighs the evidence for the various hypotheses. Thus, the expert does not take over the work of the judge, because the weight of other evidence and information still is up to the judge. The expert says everything she can say logically; nothing more and nothing less.[3]
Around the time of the institute-wide introduction of this logically correct interpretation at the Netherlands Forensic Institute (NFI) I wrote five Dutch articles to introduce this method, in the year prior to my professorship.[1,4-7] Including a triptych that I was fortunate to write together with Diederik Aben from the Supreme Court.[5-7] As a teacher for the training and study center for the judiciary (SSR), I was able to reach many hundreds of legal practitioners in criminal law and police.

Internationally there were a number of workshops, and the Swedish forensic lab invited me to contribute to their introduction of the logically correct interpretation of evidence. In 2015 the European guideline for evaluative forensic reporting, that I contributed to, was published.[8] This European guideline centers on the logical approach to evidence interpretation just discussed. For a number of articles on the logic of evidence interpretation, I had the honor to work with leading international colleagues such as Ian Evett, Christophe Champod, John Buckleton, Graham Jackson, Bernard Robertson and Tony Vignaux.[9-12]

Managing subjectivity and objective methods

The logically correct approach provides a solid basis for forensic casework. But that is a minimum requirement. A second important objective is to better deal with the subjective aspects of forensic examination, and to reduce that subjectivity wherever possible.

Often we think of partiality when we talk about subjectivity, but that is something else. There is nothing wrong with subjectivity in itself. It means that the personal judgment of the expert plays a role, and that is a good thing. But subjective examination does carry with it the risk of undesirable bias. Research in psychology shows that people often use information that should not play a role in their judgment. We can assume that forensic experts too are people who are not immune from being influenced by contextual information. We call such unwanted influence bias. The safest approach is to organize an examination as if the risk of bias is always there. The logical basis that we have just provided for casework makes clear which information should and which information should not play a role.

A confession by the suspect, for example, will influence the odds of the hypotheses, but not the evidential value of the examination's results. The expert therefore has no need for that information, and it is better that she does not have it. We call this kind of information domain-irrelevant.

Determining what information is domain-relevant and which is not, often requires expertise. Selecting the information that the expert should receive cannot be left to the requester. Instead, the responsibility lies with the experts. The best approach is to let a first expert discuss the matter with the requester, and make a selection of the information that a second expert receives. The second expert can then carry out the examination with only the domain-relevant information.

There are more forms of context information that can cause bias. For example, the material submitted to the expert will in many cases lead to incriminating evidence. After all, this material has not been collected randomly. This may lead to an expectation in the expert's mind that the evidence in this case will also be incriminating. Yet this information is not relevant to the examiner and the weight of evidence. Such an expectation can lead to so-called base-rate bias.

But here too there is a solution. It is possible to add fake cases to the incoming cases. These fake cases could be constructed to just yield exculpatory evidence. You cannot expect that these fake cases can compensate in numbers for all real cases with incriminating evidence. Fortunately, that is not needed; it is enough that the experts know that fake cases are coming in. The knowledge that the current case may well be a fake case keeps the expert sharp, because that expert obviously does not want to get caught making a mistakes.

Another form of bias can occur in a comparative examination, for example a fingerprints examination. The questioned finger mark is compared with the inked print of the suspect as reference material. When comparing back and forth between the unclear questioned finger mark and the fingerprint of the suspect, there is a risk that the examiner will see features from the print in the mark; even if those features are not there in reality.

The solution is to first record the observed features in the trace material, and only then look at the reference material. By maintaining this order, the risk of bias by the reference material is easily prevented. This approach is somewhat less straightforward when the relevant features are less easy to describe, such as when comparing shoe traces, but also relevant there.

All these methods can help prevent bias from playing a role in the expert's final conclusion. At the moment we are implementing these solutions - which we call context management - in practice, with a successful start in the field of weapons and ammunition. The collaboration with Reinoud Stoel, Erwin Mattijssen, Wim Kerkhoff and Itiel Dror also produced five publications devoted to subjective comparative examinations and the prevention of bias.[13-17]

In addition to managing subjective examinations properly, it is often also possible to reduce the level of subjectivity. We then speak of 'objective' methods. This involves the automatic analysis of the features of trace and reference material, the comparison of those features, and the assignment of an evidential value to the comparison result.
There is a fixed methodology for such a comparative examination. The hypotheses are that trace and reference material come from the same source, or that they come from different sources. The question is what the observations can say about these hypotheses. In order to make these observations, first the features that will be examined have to be chosen. For this type of choice, subjectivity still plays a role but it will not differ from case to case. The evidential value again follows from the probability of the observations under each hypothesis.
Next, the features of the trace and reference material will be related to each other for the comparison. Here too there is a subjective choice for e.g. a measure of similarity or difference. The chosen comparison algorithm thus summarizes the result of a comparison in one number, a comparison score.
Now that the choices have been made for the features to be observed and the comparison algorithm, a large number of experiments will have to be done. A large number of traces coming from the same source are compared to each other, with each comparison yielding a comparison score. The resulting distribution of these scores informs the probability of a score observed in a case when the same-source hypothesis is true. In order to arrive at the evidential value, we must also look at the probability of that comparison score when the different-source hypothesis is true. To this end, a large number of traces from different sources are compared. The scores found in these experiments inform the probability of an observed score when the different-source hypothesis is true. Now that we can evaluate the probability of a comparison score observed in a case for each hypothesis, the division of these probabilities leads us to the evidential value of the comparison in the case. This means that the comparison can, in an objective way, update our odds for whether trace and reference material come from the same or different sources. Using this method removes the risk of the aforementioned forms of bias. As a former document examiner I have developed objective methods for the comparison of inks, and the comparison of paper structure.[18-21] I also had the pleasure to work on the objective comparison of signatures, fire accelerants and fingerprints with fellow scientists Didier Meuwly, Peter Vergeer, Daniel Ramos, Rudolf Haraksim, Marcus Liwicki and Imran Malik.[22-26] I will continue to work on this theme in the coming years, with two outstanding PhD students. Wouter Karst's PhD project is about "the evidential value of medical findings when examining prepubertal children in suspected sexual abuse cases", and Erwin Mattijssen's PhD project is about improving forensic assessments of evidence.[27]

Hypotheses and activity level interpretation
Now back to the hypotheses in a case. The formulation of the hypotheses is of great importance because it determines the question that is being addressed. The hypotheses often describe the positions that the prosecutor and the defense take in the case. The expert can advise on their formulation, but the ultimate responsibility for the hypotheses must always lie with the requester. It is therefore important that this requester also has a basic knowledge of the interpretation of evidence.
Logic and criminalistics make a number of demands on the hypotheses. First of all, the hypotheses must be relevant. That seems to be obvious, but what is relevant is up to the judge and not up to the examiner. In the case of DNA traces, the

hypotheses are often that the suspect was the donor of the DNA, or that some other person was the donor. Nevertheless, some years ago a number of forensic scientists in the United States and Germany used the hypotheses that the donor of the DNA trace was in the DNA database or not. But it is the suspect who is on trial, and not the database. That the expert uses a database is nice, but that does not change the underlying question in the case. This database is not relevant for the formulation of the lawyer's question, and therefore does not belong in the hypotheses.

Another requirement was mentioned earlier. We use more than one hypothesis, and we use hypotheses in pairs. We saw that we can only speak of evidential value if we consider at least two hypotheses. These hypotheses must exclude each other, they cannot both be true at the same time. It makes no sense to compare the hypothesis that the trace came from a man against the hypothesis that the trace came from someone with red hair. You can talk about a man versus a woman, or someone with red hair versus someone with blond hair.

Hypotheses do not have to be exhaustive; they do not have to consider all possibilities. This fits in with the forensic setting, which is not about absolute truth-finding, but is specifically aimed at the issues that are disputed by prosecution and defense. The hypotheses may of course be exhaustive, but this is not a requirement. In the preceding example of man versus woman, the hypotheses can be seen as exhaustive, but not in the example of red hair versus blond hair. In practice, the positions taken by the parties and the circumstances of the case will usually make the hypotheses exhaustive. Where the court sees a relevant third possibility, it can of course still be investigated, but in first instance forensic truth finding is conflict-resolving, and not absolute.

Couples of hypotheses can easily be made exclusive and exhaustive by choosing the alternative hypothesis as the denial of the prosecution's hypothesis. So for example: 'this bullet was fired with this firearm' versus 'this bullet was not fired with this firearm'. But such an alternative hypothesis is not specific and can mean several things. It could mean that the bullet was fired with another firearm, but also that the bullet was not fired at all. Alternative hypotheses should therefore not be formulated as a negation. They must be formulated positively and specifically so that the expert can consider the probability of her observations when the alternative hypothesis is true.

Another mistake that is made is to use an alternative hypothesis that aims to explain the observation. This often means that the probability of the observation given such a hypothesis becomes 100%. As an extreme example, in case of a speech comparison, the defense suggested as an alternative hypothesis that it was someone else with the same voice. The probability of the observations is then the same under both hypotheses and the evidential value disappears. The probability that a random person has the same voice, the rarity of that voice, then moves from the evidential value to the prior odds of the hypotheses. This is undesirable because then the expert cannot contribute with her expertise and the trier of fact would have to estimate how rare it is to encounter such a voice.

Formulating the alternative hypothesis is crucial in another aspect. So far, we have mainly looked at hypotheses about the origin of a trace. That is actually quite strange, because it is not punishable by law to be the source of a trace. Some actions or activities *are* punishable. With the increased sensitivity of trace examination, ever smaller traces can be found, and there are more and more ways in which these traces can be transferred. Partly because of the enormous weight of evidence of a DNA profile for the origin of a DNA trace, we increasingly see the question move from who is the source of the trace, to through which activity the trace was transferred. The suspect might not deny that it is his DNA, but dispute the activity through which the trace was transferred.

We speak of a hierarchy of hypotheses. At the lowest level there is the origin of a trace, that is the source level. Above this comes the level of activity which concerns the activity through which the trace was transferred. At the top we have

the crime level and the question is whether the activity is also a crime. That question is very close to the ultimate issue, and is generally left to the trier of fact. Note that in almost every case the issues will move up through these levels. In the past, the forensic expert interpreted evidence at source level, mostly leaving the activity level issues to the trier of fact.

What does it take to say more about the activity through which a trace was transferred? And can the trier of fact be deemed capable of doing so? Let's take a DNA trace as an example. Where at the source level only the DNA profile is important, many more factors now play a role. For example, we now also want to see how much DNA was found, where it was found, how it is distributed, and what type of cell it is. To be able to consider the probability of these observations for different activities, we want to gather knowledge about the probability of transfer for different activities. We must also consider the probability that that DNA will still be found after time has elapsed, the probability of persistence.

In order to speak about these probabilities with expertise, more knowledge is required than for the source level. This knowledge comes partly from transfer experiments and partly from the experience of the DNA expert. The probability of transfer of detectable quantities of DNA in different activities is therefore an active subject of research. This also applies to the probability of persistence. This is not only about the course of time, but also about what happens during that time. That is why not only more expertise is required, but also more knowledge about the circumstances in the specific case. Precisely because interpretation of evidence is more difficult at activity level than at source level, this almost always requires the contribution of an expert. By addressing questions at activity level and not leaving this to the lawyers, the contribution of the expert can be of greater added value. Addressing questions at a higher level means addressing more relevant questions. But it also offers more possibilities for combining evidence. After all, one activity can produce multiple traces and evidence that can be interpreted and combined under the same hypotheses. More generally, a so-called Bayesian network can be used for combining evidence.[28] In it, the conditional dependencies of the probabilities of evidence and hypotheses are represented graphically, and the odds are calculated numerically. It goes too far to go into this further here, but it is certainly an important theme of research for the future. I am fortunate to work on this with Marjan Sjerps, Jan de Koeijer, Bas Kokshoorn, Bart Aarts and Bart Blankers.[29-31]

Unlike this mathematical side of the work, the psychological side is easier to explain. I was talking about contextual bias before, and that is even more important for activity level interpretation. Activity level interpretation requires even more expertise, insight and judgment, but is also more subjective. This requires an approach that takes into account the risks of contextual bias. All the more because a lot more information about the case circumstances will have to be exchanged. I mentioned earlier the approach whereby a first expert filters the information that goes to a second expert who carries out the examination and interpretation on the basis of only the domain-relevant information.

But the interpretation itself also offers possibilities to prevent undesired influence. The English Forensic Science Service (FSS) developed a casework approach known as Case Assessment and Interpretation.[32] Communication with the requester plays an important role in it, in order to discover the actual needs and underlying questions of the requester, as well as the necessary case information. Another essential element is the so-called pre-assessment, in which interpretation starts prior to the observations. In pre-assessment, a limited number of categories of observations are defined. For each possible future observation, a value is then assigned to the probability of this observation under both hypotheses. Because the examiner does not yet know what is or will be observed, he or she can not consciously or unconsciously control it to make the evidence seem more incriminating or more exculpatory. Pre-assessment thus forms a powerful tool to prevent bias in the interpretation of the observations.

Conclusion

I have talked about three main themes in criminalistics. The first theme is to comply with logic, with the basic laws of probability. The second theme is about managing and reducing subjectivity. By means of context management and the use of more objective methods, the risks of bias can be greatly reduced. The third and newest theme is that of activity level interpretation and combining evidence, in which more relevant questions about activities are addressed. These themes have become main themes in criminalistics and in my work, and will remain so in the coming years.

In addition, I continue to contribute with great pleasure to the Honors Class "Body of Evidence", an interdisciplinary course with the Leiden faculties of Law and of Archeology, and the course for forensic archaeology. With Mike Groen from the Faculty of Archeology, I can also explore what examiners from crime scenes can learn from examination methods of archeology.[33] And together with Roosje de Leeuwe, also from the Faculty of Archeology, we are working on a study of patterns in the choice of location for the clandestine burial of victims, to which graduate student Lieke Dix also contributed.[34] I will collaborate with Cor Veenman of the Leiden Institute of Advanced Computer Science in the area of mathematical methods for the interpretation of forensic evidence.

Scientific progress has been made on all the main themes mentioned, and this progress should also be reflected in forensic practice. With newly developed courses and discussion groups, things are moving in the right direction, and progress on all themes is therefore noticeable on three levels: the level of publishable scientific research, the level of forensic examinations at the NFI, and the level of readers of the forensic reports. In the coming years I want to continue helping achieve that progress, at all those levels.

Often the influence of this progress is also international. This obviously applies to published scientific research, since serious scientific publications are international. The NFI is at the forefront of international forensic research and one of the institutes with the most publications. This is of course not only because of the NFI, but also because of all those other institutes that publish less often. The NFI, together with the University of Lausanne, plays an important pioneering role in criminalistics and must continue to do so, because criminalistics as a science is vulnerable.

Just how fragile became clear a few years ago when the Forensic Science Service (FSS) went bankrupt in England after a botched attempt at privatization.[35] Up to that time, the FSS was the leading forensic institute worldwide. The NFI has taken over that role since then, but the progress of criminalistics has been delayed for a number of years.

In terms of case work there are plenty of international aspects. For example, the forensic institutes from Ireland and Sweden cooperate with us in implementing scientific progress in the practice of case work. This mainly involves activity level interpretation, and the implementation of Case Assessment and Interpretation, an approach that was developed at the FSS much earlier. The aforementioned European guideline is another example of international cooperation aimed at progress at the level of case work.

Even so, the implementation of new scientific developments in forensic case work has little impact if readers of forensic reports cannot understand them. That is why I have put a lot of effort into transferring knowledge to police and lawyers, especially concerning the introduction of logically correct reporting. They must be fully enabled to gain more knowledge to make optimal use of the forensic reports. Practicing lawyers have thus received education in truth-finding that they had to miss during their legal education. In addition, there is not only 'one-way communication' but also a dialogue, as in the so-called user panels with readers of the reports.

Practicing lawyers in our country deserve compliments for their progressiveness and eagerness to learn. This eagerness is explained in part by the fact that knowledge about the interpretation of evidence is not only important for the understanding of expert reports. It is even more important for

the weighing of the observations of the lawyers themselves. Lawyers also reason backwards for truth-finding, from what they observe to what happened in the past. It is remarkable that practicing lawyers now receive more education about truth-finding than the law students at the university. But in a few months' time I will be able to reach law students at this university, with a contribution to the course criminal evidence law, thanks to Marieke Dubelaar.

A few months ago the second edition of the book "Interpreting Evidence" appeared. I worked on it for a number of years with Bernard Robertson and Tony Vignaux from New Zealand. This book makes the interpretation of evidence an accessible subject for lawyers and forensic scientists worldwide. Hopefully this book can contribute internationally to a more scientific way of dealing with evidence. That there is still a long way to go internationally in that area was clear from the recent report of the President's Council of Advisors on Science and Technology in the United States. The writers of that report have little knowledge of the current state of affairs in criminalistics and the interpretation of evidence. They propose a method in which the expert can give only two answers to the forensic question. This approach reduces the expert to a kind of scent dog that can only give a binary conclusion.

I have said it before: justice cannot do without a good attempt at truth-finding, and good truth-finding cannot happen without good criminalistics. Lawyers need more knowledge about what science can offer them for the interpretation of evidence. Justice and trust in our legal system are important pillars for our society. Everyone should be aware of the importance of punishing as few innocents as possible, and letting as few guilty as possible go undetected. But it is not self-evident that everyone is aware of the societal importance of an independent, high-level Netherlands Forensic Institute and with sufficient capacity to serve our society with a normal workload. Since the end of the second world war, the NFI has functioned as a forensic center of excellence. I sincerely hope that society and the government will allow us to continue to do so, and allow us to continue to improve ourselves.

Word of thanks

I would like to express my gratitude to a number of people. I would like to thank the board of the NFI, the Curatorium of the Chair of Criminalistics, the Executive Board, the board of the Faculty of Law and the Institute for Criminal Law and Criminology for my appointment and the trust they have placed in me. It is a great honor to be part of this beautiful university. Previously, together with Marjan Sjerps, I was able to organize the successful International Conference for Forensic Inference and Statistics at this university. With colleagues from the institute such as Jan de Keijser, Paul Nieuwbeerta and Tineke Cleiren, we are delighted to explore the intersections of the legal, social and natural sciences in the Criminal Justice research program and the research theme of evidence and truth-finding.

With my lectures in Criminalistics I contribute to the master in forensic criminology, and the international law students get their turn in the English language criminalistics course. Fortunately, my enthusiasm for criminalistics and that of the students is mutual, even though it is probably the so-called CSI effect and I cannot take credit for that. I thank Simone, Nicolet and Elianne for the support of the secretariat.

Above all, I thank my wife Magda and my family.

I have spoken.

Notes

1 Berger, C.E.H. Criminalistiek is terugredeneren, Nederlands Juristenblad 2010, 85, 784-789.

2 How do people come to knowledge on the basis of observations? How do people adjust their beliefs by what they perceive? Or how should they do that for an optimal result? That is a fundamental scientific question, perhaps the most fundamental question of science. At the same time, it is a very concrete question for lawyers. A question that they encounter almost every day. But it also applies to everyone else: what do our observations mean for the decisions we make throughout the day, whether in a criminal case or when crossing the street.

3 If no number is given for the value of evidence, an NFI expert uses a verbal conclusion scale. The chosen wording for representing the evidential value is: The findings of the examination are ... about as probable; somewhat more probable; more probable; much more probable; very much more probable; extremely much more probable ... when hypothesis 1 is true, than when hypothesis 2 is true.

4 Berger, C.E.H. Het juiste gewicht in de schaal, Ars Aequi 2010, 499-501.

5 Berger, C.E.H.; Aben, D. Bewijs en overtuiging: Rationeel redeneren sinds Aristoteles, Expertise en Recht 2010, 2, 52-56.

6 Berger, C.E.H.; Aben, D. Bewijs en overtuiging: Redeneren in de rechtszaal, Expertise en Recht 2010, 3, 86-90.

7 Berger, C.E.H.; Aben, D. Bewijs en overtuiging: Een helder zicht op valkuilen, Expertise en Recht 2010, 5/6, 159-165.

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