



**ISSSES 2016**

**2<sup>nd</sup> International Symposium on Sino Swiss  
Evidence Science**

Exploring Scientific Evidence and Judicial Proof  
in an International Perspective

**Symposium Programme and Abstracts**  
**Opening keynote address**

*Unil*

UNIL | Université de Lausanne

University of Lausanne, Faculty of Law, Criminal Justice and Public Administration  
School of Criminal Justice



China University of Political Science and Law  
Institute of Evidence Law and Forensic Science  
中国政法大学证据科学研究院



# Symposium Statement

Welcome to Lausanne! The **2<sup>nd</sup> International Symposium on Sino Swiss Evidence Science 2016** (2nd ISSSES) will be held at the School of Criminal Justice (Faculty of Law, Criminal Justice and Public Administration) of the University of Lausanne (UNIL) from September 6<sup>th</sup> to 9<sup>th</sup> 2016.

The symposium provides a forum for discussions on the current breakthroughs and new directions in the field of evidence science. The symposium is jointly organized by the School of Criminal Justice and the Sino Swiss Evidence Science Research Center (SSESRC), chaired by Professor Baosheng Zhang, who is currently chairman of the Collaborative Innovation Center of Judicial Civilization, China.

The 2<sup>nd</sup> ISSSES scientific organizing committee is composed of Professors Christophe Champod and Alex Biedermann, in Lausanne (UNIL), and Professors Baosheng Zhang and Yuanfeng Wang, in Beijing (China University of Political Science and Law, CUPL).

The Symposium topic is **Scientific evidence and judicial proof** and will promote the interchange of ideas between Chinese and Swiss lawyers, scientists, academics and their foreign counterparts. The symposium will provide a platform where prestigious scholars from China as well as other overseas countries will share their experience and expertise in the field of evidence law. Their perspective on the advancement of the administration of justice in an interdisciplinary perspective will be of interest to scholars and researchers from both forensic science and evidence law.

The 2<sup>nd</sup> ISSSES is supported by:

- 2011计划”司法文明协同创新中心 : The “2011 Plan” of China – Collaborative Innovation Center of Judicial Civilization
- 111计划”证据科学创新引智基地 : The “111 Plan” of China – Evidence Science Innovation and Talent Base
- The Swiss National Science Foundation (SNSF)
- The University of Lausanne (UNIL) with its School of Criminal Justice ([www.unil.ch/esc](http://www.unil.ch/esc), SCJ)
- 中国政法大学证据科学研究院: China University of Political Science and Law (CUPL) with its Institute of Evidence Law and Forensic Science

In addition to scholars from Switzerland and China, we are delighted to welcome delegates from the United States, Australia and New Zealand, in particular:

- Ronald J. Allen, John Henry Wigmore Professor of Law, Northwestern University, Pritzker School of Law, Chicago (USA);
- David Caruso, Director of the Litigation Law Unit, The University of Adelaide Law School, Adelaide (AUS);
- Edward J. Imwinkelried, Edward L. Barrett, Jr., Professor of Law Emeritus, School of Law, University of California, Davis (USA);
- Thomas Man, Professor from Practice, School of Transnational Law, Peking University; Adjunct Professor of Law, Institute of Evidence Law and Forensic Science, Chinese University of Political Science and Law;
- Bernard Robertson, barrister and visiting lecturer at Auckland University of Technology, Wellington (NZ).

On behalf of the Hosts and Sponsors, we are delighted you are joining us for the 2<sup>nd</sup> International Symposium on Sino Swiss Evidence Science 2016 (2nd ISSSES) at University of Lausanne. We are looking forward to fruitful exchanges on evidence and proof for the administration of justice through an interdisciplinary and international exchange.

Christophe Champod and Alex Biedermann  
University of Lausanne

Baosheng Zhang and Yuanfeng Wang  
China University of Political Science and Law

# Symposium Programme

Symposium venue: University of Lausanne, “Génopode” Building, Auditorium C

Monday September 5th 2016	
10:00-12:00	<b>History of forensic science in Lausanne (museum of the School of Criminal Justice) with Professor Pierre Margot for early arriving Chinese delegates</b>
12:00-13:30	Lunch (University canteen)
13:30-16:00	Pre-symposium meeting between members of the School of Criminal Justice (UNIL) and early arriving Chinese delegates
17:30-19h30	Evening Pizza-Pasta party at the University of Lausanne (University canteen)
Tuesday September 6th 2016	
08:30-09:00	Registration
09:00-10:00	<b>Pre-symposium workshop</b>
10:00-10:30	Morning coffee break
10:30-12:00	<b>Pre-symposium workshop (continued)</b>
12:00-13:30	Lunch (University canteen)
13:30-17:30	Visit and presentation of the Canton of Vaud Forensic Science Laboratory Hosts: Alexandre GIROD, head of criminal police and Nicola ALBERTINI, head of forensic services Address: Route de la Blécherette 101, 1014 Lausanne Private group transfer with historic postal car ("Retrobuss")
18:00-19:30	<b>Symposium Welcome Reception</b> Aperitif-Dinner at the University of Lausanne Restaurant "Restaurant de Dorigny"
Wednesday September 7th	
08:00-08:30	Registration
<b>08:30-09:15</b>	<b>Welcome ceremony</b> Chair: Christophe CHAMPOD
08:30-08:40	Professor Laurent MOREILLON, Dean of the Faculty of Law, Criminal Justice and Public Administration (UNIL)
08:40-08:50	Professor Olivier RIBAUX, Vice-Dean and Director of the School of Criminal Justice
08:50-09:00	Professor Baosheng ZHANG (CUPL)
<b>09:00-09:45</b>	<b>Opening keynote address and discussion</b> Chair: Christophe CHAMPOD
09:00-09:30	<b>The conceptual difficulties of specialised evidence</b> Ronald J. ALLEN
09:30-09:45	Discussion
09:45-10:15	Morning coffee break

<b>10:15-12:00</b>	<b>Morning session: Current issues in scientific evidence and proof</b> Chair: Alex BIEDERMANN
10:15-10:45	<b>Scientific evidence and the right to a fair trial under Article 6 ECHR</b> Joëlle VUILLE, Luca LUPARIA, Franco TARONI
10:45-11:15	<b>Computer source code: a source of the growing controversy over the reliability of automated forensic techniques</b> Edward J. IMWINKELRIED
11:15-11:45	<b>Understanding Chinese forensic examination</b> Thomas MAN
11:45-12:00	Discussion on morning session
12:00-13:30	Lunch (university canteen)
<b>13:30-15:10</b>	<b>Afternoon session: Current issues in scientific evidence and proof (continued)</b> Chair: Edward J. IMWINKELRIED
13:30-13:55	<b>Reflecting on the past to envisage future perspectives</b> Pierre MARGOT
13:55-14:20	<b>On the testimonial triangle: speech act perspective</b> Luping ZHANG
14:20-14:45	<b>What is the evidence?</b> Bernard ROBERTSON
14:45-15:10	<b>"Voluntary" false confessions as a source of wrongful convictions</b> Marcelo F. AEBI, Claudia CAMPISTOL
15:10-15:30	Afternoon coffee break
<b>15:30-17:10</b>	<b>Afternoon session (continued): Forensic microtraces</b> Chair: Pierre MARGOT
15:30-15:55	<b>Evaluation and examination of a possible shoe-polish trace in a hold-up case</b> Line GUEISSAZ, Tacha HICKS, Cyril MUEHLETHALER, Geneviève MASSONNET
15:55-16:20	<b>Evaluation and interpretation of handlebar grip residue evidence in hit and run cases</b> Yuanfeng WANG, Zeyu LIN, Ran DU, Ziwei WEI
16:20-16:45	<b>Application of scanning electron microscopy with energy dispersive X-ray spectroscopy and Clustering Analysis in vehicle paint identification</b> Yahong ZHOU, Tian ZHENG, Jin CHEN, Lijun ZHANG
16:45-17:10	<b>Which vehicle is the source of the tire trace?</b> Line GUEISSAZ, Geneviève MASSONNET
17:10-17:30	Discussion and closing
18:00-20:00	Dinner at the University of Lausanne Restaurant "Restaurant de Dorigny"

#### Thursday September 8th

<b>08:30-09:45</b>	<b>Morning session: Fingermarks and forensic imagery</b> Chair: Yuanfeng WANG
08:30-08:55	<b>The shifting landscape of latent print testimony: An American perspective</b> Heidi ELDRIDGE



08:55-09:20	<b>Research and realization of ten-print-data quality control techniques for imperial scale AFIS</b> Qian WANG, Wei WANG, Wei ZHANG, Tong ZHAO, Guangnv JING
09:20-09:45	<b>Image fusion to increase the spatial information in three-dimensional forensic reconstruction</b> Quentin MILLIET, Eric G. SAPIN
09:45-10:15	Morning coffee break
<b>10:15-12:00</b>	<b>Morning session (continued): Forensic DNA</b> Chair: Bernard ROBERTSON
10:15-10:40	<b>Study of autosomal STR loci with IBS method in full sibling identification</b> Li YUAN, Xu XU, Dong ZHAO, He REN, Chaohui HU, Wen CHEN, Shicheng HAO, Di LU, Lin ZHANG
10:40-11:05	<b>Evaluation of forensic DNA traces when propositions of interest relate to activities: analysis and discussion of recurrent concerns</b> Alex BIEDERMANN, Christophe CHAMPOD, Graham JACKSON, Peter GILL, Duncan TAYLOR, John BUTLER, Niels MORLING, Tacha HICKS, Joëlle VUILLE, Franco TARONI
11:05-11:30	<b>Allelic dropout at D8S1179 locus : A case report</b> Zeying TANG, Zhihua MA, Zhou LYU
11:30-11:55	<b>Quality control of low copy number DNA analysis with short tandem repeat typing</b> Tian ZHENG, Guoping WU, Xing MENG, Yingqiu QIAN, Yahong ZHOU
12:00-13:00	Lunch (University canteen)
13:00-22:30	<b>Excursion to Berne</b> Visit of Parliament Building (The Federal Assembly - The Swiss Parliament) Dinner in local restaurant (City of Berne)

### Friday September 9th

<b>08:30-09:45</b>	<b>Morning session: Forensic investigation and the legal process</b> Chair: Thomas MAN
08:30-08:55	<b>“Trust v Truth”: the case for reform of expert witness obligations regarding crime scene investigation and pre-trial forensic procedures</b> David CARUSO
08:55-09:20	<b>Is there a Chinese darknet market? Studying the role of Chinese vendors in the online trafficking</b> Julian BROSEUS, Damien RHUMORBARBE, Ludovic STAEHLI, Quentin ROSSY
09:20-09:45	<b>Forensic science in a large-scale investigation</b> Đurđica HAZARD
09:45-10:10	<b>Mandatory appearance of authenticators to be cross-examined in court and related system improvement under criminal procedure</b> Jianye QU, Min GUO
10:10-10:35	Morning coffee break

<b>10:35-12:40</b>	<b>Morning session (continued): Forensic document examination</b> Chair: Bing LI
10:35-11:00	<b>Ink dating: interpretation of the results in a legal perspective</b> Agnes KOENIG, Céline WEYERMANN
11:00-11:25	<b>Study on the relationship of continuous laser printing and the distance of trace on the OPC</b> Xingzhou HAN, Yuanli HAN, Xiaoguang WANG, Zihan GUO, Da QIN, Haiqian YAN, Hongguang HAO
11:25-11:50	<b>Fundamental problems in questioned signature examinations</b> Lorenzo GABORINI, Alex BIEDERMANN, Franco TARONI
11:50-12:15	<b>Chemical imaging research on 100 yuan currency authenticity identification in 2005 edition</b> Yuanyuan LIAN, Xiaolei ZHANG
12:15-12:40	<b>Closing remarks and announcement of ISSSES prizes for the two best presentations (provided by John Wiley &amp; Sons)</b>
12:40-14:00	Lunch (University canteen)
14:30-17:00	Walk in historical centre of Lausanne (Cathedral and former building of the forensic science institute (School of Criminal Justice)), guided by Professor Pierre MARGOT Visit of museums of the Palais de Rumine (City of Lausanne, Place de la Riponne)

## Symposium participants and affiliations

Marcelo	AEBI	University of Lausanne, School of Criminal Justice	Switzerland
Ronald	ALLEN	Northwestern University, Pritzker School of Law	USA
Alex	BIEDERMANN	University of Lausanne, School of Criminal Justice	Switzerland
Julian	BROSEUS	University of Lausanne, School of Criminal Justice	Switzerland
David	CARUSO	University of Adelaide	Australia
Christophe	CHAMPOD	University of Lausanne, School of Criminal Justice	Switzerland
Heidi	ELDRIDGE	RTI International	USA
Pierre	ESSEIVA	University of Lausanne, School of Criminal Justice	Switzerland
Lorenzo	GABORINI	University of Lausanne, School of Criminal Justice	Switzerland
Line	GUEISSAZ	University of Lausanne, School of Criminal Justice	Switzerland
Min	GUO	Changzhou Intermediate People's Court, Jiangsu Province	China
Xingzhou	HAN	Institute of Forensic Science, Ministry of Public Security	China
Durdica	HAZARD	University of Lausanne, School of Criminal Justice	Switzerland
Tacha	HICKS	University of Lausanne, School of Criminal Justice	Switzerland
Edward	IMWINKELRIED	University of California, Davis	USA
Agnès	KOENIG	University of Lausanne, School of Criminal Justice	Switzerland
Bing	LI	China University of Political Science and Law	China
Yuanyuan	LIAN	China University of Political Science and Law	China
Zhihua	MA	Southwest University of Political Science & Law	China
Thomas Yunlong	MAN	Peking University, School of Transnational Law	China
Pierre	MARGOT	University of Lausanne, School of Criminal Justice	Switzerland
Geneviève	MASSONNET	University of Lausanne, School of Criminal Justice	Switzerland
Quentin	MILLIET	University of Lausanne, School of Criminal Justice	Switzerland
Damien	RHUMORBARBE	University of Lausanne, School of Criminal Justice	Switzerland
Olivier	RIBAUX	University of Lausanne, School of Criminal Justice	Switzerland
Bernard	ROBERTSON	Wellington, New Zealand	New Zealand
Eric	SAPIN	University of Lausanne, School of Criminal Justice	Switzerland
Ludovic	STAEHLI	University of Lausanne, School of Criminal Justice	Switzerland
Zeying	TANG	Southwest University of Political Science & Law	China
Franco	TARONI	University of Lausanne, School of Criminal Justice	Switzerland
Joëlle	VUILLE	University of Neuchâtel, Faculty of Law	Switzerland
Yuanfeng	WANG	China University of Political Science and Law	China
Wei	WANG	Liaoning Province Public Security Bureau	China
Céline	WEYERMANN	University of Lausanne, School of Criminal Justice	Switzerland
Guoping	WU	Jiangsu Police Institute	China
Li	YUAN	China University of Political Science and Law	China
Luping	ZHANG	China University of Political Science and Law	China
Baosheng	ZHANG	China University of Political Science and Law	China
Tian	ZHENG	Jiangsu Police Institute	China
Yahong	ZHOU	Jiangsu Police Institute	China



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## Abstracts

### **"Voluntary" false confessions as a source of wrongful convictions**

Marcelo F. AEBI, Claudia CAMPISTOL

The vast majority of the scientific literature on wrongful convictions focuses on innocents convicted against their will. In this article, on the contrary, we will concentrate on persons who are wrongfully convicted by their own will.

### **The conceptual difficulties of specialised evidence (Keynote opening address)**

Ronald J. ALLEN

*See full keynote address reproduced in this programme.*

### **Evaluation of forensic DNA traces when propositions of interest relate to activities: analysis and discussion of recurrent concerns**

Alex BIEDERMANN, Christophe CHAMPOD, Graham JACKSON, Peter GILL, Duncan TAYLOR, John BUTLER, Niels MORLING, Tacha HICKS, Joëlle VUILLE, Franco TARONI

When forensic scientists evaluate and report on the probative strength of single DNA traces, they commonly rely on only one number, expressing the rarity of the DNA profile in the population of interest. This is so because the focus is on propositions regarding the source of the recovered trace material, such as ‘the person of interest is the source of the crime stain’. In particular, when the alternative proposition is ‘an unknown person is the source of the crime stain’, one is directed to think about the rarity of the profile. However, in the era of DNA profiling technology capable of producing results from small quantities of trace material (i.e., non-visible staining) that is subject to easy and ubiquitous modes of transfer, the issue of source is becoming less central, to the point that it is often not contested. There is now a shift from the question ‘whose DNA is this?’ to the question ‘how did it get there?’. As a consequence, recipients of expert information are now very much in need of assistance with the evaluation of the meaning and probative strength of DNA profiling results when the competing propositions of interest refer to different activities. This need is widely demonstrated in day-to-day forensic practice and is also voiced in specialized literature. Yet many forensic scientists remain reluctant to assess their results given propositions that relate to different activities. Some scientists consider evaluations beyond the issue of source as being overly speculative, because of the lack of relevant data and knowledge regarding phenomena and mechanisms of transfer, persistence and background of DNA. Similarly, encouragements to deal with these activity issues, expressed in a recently released European guideline on evaluative reporting [42], which highlights the need for rethinking current practice, are sometimes viewed skeptically or are not considered feasible. In this discussion paper, we select and discuss recurrent skeptical views brought to our attention, as well as some of the alternative solutions that have been suggested. We will argue that the way forward is to address now, rather than later, the challenges associated with the evaluation of DNA results (from small quantities of trace material) in light of different activities to prevent them being misrepresented in court.

### **Is there a Chinese darknet market? Studying the role of Chinese vendors in the online trafficking**

Julian BROSEÚS, Damien RHUMORBARBE, Ludovic STAEHLI, Quentin ROSSY

Cryptomarkets are online marketplaces, located on the Darknet, that facilitate the trading of a variety of illegal goods, mostly illicit drugs. Cryptomarkets share many structural features with popular marketplaces such as eBay or Amazon, with searchable listings of products for sale. Each listing contains data (vendor name, type of product, quantity, price, shipping country and destination(s), etc.) that may inform on the extent, the structure and the organisation of the trafficking on such online platforms.

Through the analysis of relevant data collected on a very popular marketplace in 2014, Evolution, our research seeks to better describe the entirety of this illicit online market. It also aims at highlighting

geographical patterns in the trafficking of specific types of illicit products. In particular, we investigate the magnitude and the specificities of the vendors claiming to send products from China.

From a global dataset containing information on 4171 vendors and 92980 listings, we found that 51 vendors (about 1% of the total number of vendors) managed 3361 listings (almost 4% of the total number of listings) where China or Hong Kong SAR China was mentioned as the shipping country. Nevertheless, while the number of Chinese vendors may reveal a minor position considering the worldwide market, China and Hong Kong SAR China are at the forefront of the distribution of specific categories of illicit products. Indeed, they lead the trafficking of luxury goods forgeries and can be considered as major actors of New Psychoactive Substances (NPS) trafficking.

This research presents a general methodology to take advantage of online data to analyse the structure of trafficking on Darknet marketplaces. In particular, data mining highlights spatial patterns that tend to reflect the structure of the traditional illicit market. Indeed, results show that online data may strengthen assumptions deriving from other sources of information (e.g. from customs or law enforcement seizures). Moreover, it guides the development of new approaches not only to evaluate the strategic role of a country in products trafficking but also to mitigate such trafficking. This study, carried out from a Chinese point of view, will serve as a basis for the exploration of Darknet marketplaces from other perspectives.

### **“Trust v Truth”: the case for reform of expert witness obligations regarding crime scene investigation and pre-trial forensic procedures**

David CARUSO

Decisions made by Crime Scene Investigators and forensic specialists involved in crime scene investigation and pre-trial forensic analysis affect the forensic evidence available to police investigators and courts. CSIs and forensic specialists continually make decisions on whether pieces of forensic material are relevant and of probative value and therefore to be processed. These decisions are made in the context of scientific accuracy and time and resource limitations and allocations. This paper discusses the role of the CSI and forensic laboratories in crime scene investigation and pre-trial processes with a view to explaining the basis for discretionary decision making in these investigations. Decisions made to not collect or not test certain materials are reviewed in the context of the explanation for these decisions that must be given in any subsequent criminal proceedings according to current rules and practice of disclosure and reporting governing expert witnesses for the Crown. These decisions raise legal and ethical issues regarding the transparency of the prosecution case and the information provided to the Court and defence parties.

This paper reviews the rules and practices of Australian Courts for receiving expert forensic scientific evidence in support of the prosecution case. This paper proposes methods by which to create efficiencies in CSI and pre-trial forensic examination in a manner that requires modification to existing court practices but nevertheless adheres to a transparent trial processes. The proposals are critically assessed from the position of the defendant so as to explain their effect on the full and proper presentation of the defence case.

The revised approach for Australian Courts advanced in this paper is argued to save resources whilst maintaining the fundamental obligation of professional and scientific integrity informing the administration of criminal justice. The aim of this paper is to find a balance between “trust” in discretionary forensic decisions and “truth” by scrutiny of those decisions so as to improve efficiency without sacrificing rectitude in criminal justice.

### **The shifting landscape of latent print testimony: An American perspective**

Heidi ELDRDGE

Friction ridge comparison testimony in the United States has long been characterized by speaking in absolutes: fingerprints are unique, the ACE-V methodology has a zero error rate, and the testimony presented by the expert should be regarded as an incontrovertible fact. Once the National Research Council released their watershed report in 2009, questioning and criticizing these clear overstatements of the strength of the evidence, many commentators and professional organizations recommended that the friction ridge community rethink the way their evidence was presented in reports and in court. Yet change has been slow to come. While some agencies have begun a shift in the way they present their findings, many others still testify the same way they always have. This paper presents the historical context of where American friction ridge testimony has been, lays out the arguments for why it needs to change, describes

some recent efforts to improve, and highlights some likely directions for the future of friction ridge reporting and testimony in the United States.

### **Fundamental problems in questioned signature examinations**

Lorenzo GABORINI, Alex BIEDERMANN, Franco TARONI

In this work we show the initial stages of the construction of a framework for supporting experts in questioned signature examinations. Through the use of Bayesian networks, we envision to quantify the probative value of well-defined measurements performed on questioned signatures, in a way that is both formalised and in agreement with the laws of probability. At the current stage, our project is explorative, focusing on the broad range of aspects that relate to comparative signature examinations. The goal is to identify writing features which are both highly discriminant, and easy for forensic examiners to detect. We also seek for a balance between case-specific features and characteristics which can be measured in the vast majority of signatures. Care is also taken at preserving the interpretability at every step of the reasoning process. This paves the way for future work, which will aim at merging the different contributions to a single probabilistic measure of strength of evidence using Bayesian networks.

### **Evaluation and examination of a possible shoe-polish trace in a hold-up case**

Line GUEISSAZ, Tacha HICKS, Cyril MUEHLETHALER, Geneviève MASSONNET

Forensic investigations dealing with shoe polish smears generally concern aggression cases when victims received kicks. The case we investigated was therefore very uncommon.

During an armed hold-up, the offender pushed a customer in the back with his gun. A black trace was observed on the left shoulder of the customer's jacket which could have been left by the coating of the gun. One month later, a suspect was arrested and a fake weapon apparently black sprayed with paint was confiscated. The traces recovered on the jacket were compared to the coating applied on the weapon. Preliminary results suggested that black waxy material had been used to cover the gun (not paint). This was confirmed by the suspect who declared to have covered his fake gun using black shoe-polish. The trace and the comparison items were analysed according to an analytical sequence commonly applied to paint. This sequence includes the physical recovery of the particles with micro tweezers on glass slides, microscopic examinations and infrared spectroscopy. It is completely different from sequences proposed in the literature that are first based on the extraction of traces with a solvent. The insoluble part is then observed by microscopy while the liquid part is used for thin-layer chromatography or capillary gas chromatography [1-5]. Generally, shoe polish traces are encountered on textile. Therefore, the extraction of the traces using solvent can lead to the simultaneous extraction of the dyes of the substrate. Our methodology, based on a dry extraction, help to avoid this problem. In our case, the traces and the gun covering could not be differentiated using the applied analytical sequence. The case and the methodology from sample preparation to interpretation of results will be presented.

1. M.D. Cole, J.W. Thorpe, *The analysis of black shoe polish marks on clothing*, Journal of the Forensic Science Society 32 (1992) 237-244.
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### **Which vehicle is the source of the tire trace?**

Line GUEISSAZ, Geneviève MASSONNET

For the 1<sup>st</sup> ISSSES conference meeting between CUPL and UNIL at Hainan, a methodology was presented for the statistical comparison of tire traces and tires based on chemical profiles. For this 2<sup>nd</sup> meeting, this methodology was implemented on a real traffic accident case.

This traffic accident involves several vehicles. Among the different traces detected, a tire trace was observed in the middle of the street. This trace was important for the reconstruction of the events. In the opinion of the investigators, this tire trace could be left by two vehicles: a Ford Fiesta and a Peugeot 3008, both involved in the accident. The tire trace was collected with white gelatin and sent for analysis. Several specimens were also sampled on tire treads of the two vehicles. The aim was to compare the tire trace with the specimens of the tire treads in order to help determine if either of these tires was the source of the tire trace. Macroscopic observations of the white gelatin showed that numerous dark, elongated and rough particles were located at the surface of the gelatin. These particles look like small rubber rolls and were optically not differentiated from tire trace particles [1,2]. These were thus removed from the gelatin and analyzed by Py-GC/MS. Tire tread specimens were cut into small particles and analyzed according to the same analytical procedure. Chemical profiles were extracted and statistically compared according to the developed methodology [3]. One of the two vehicles could be excluded as the source of the tire trace. For the second vehicle, the chemical profile of its tires was not differentiated from the chemical profile of the trace. To evaluate the strength of these findings, a likelihood ratio approach was followed. A database of tire chemical profiles created by the authors was used in order to evaluate the rarity of the chemical profile of the trace in a relevant population. Finally the authors could assign probabilities of the findings given the prosecution's proposition on one hand, and given the defense's proposition on the other hand, to provide the strength of the evidence in support of a proposition over the other.

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### **Mandatory appearance of authenticators to be cross-examined in court and related system improvement under criminal procedure**

Jianye QU, Min GUO

The press published the opinions of authenticators on the case of “traffic accident by a BMW on June 20<sup>th</sup>, 2015 happened in Nanjing” about the criminal liability of the suspect Wang Jijin. “The suspect has acute and transient psychotic disorders, who limits the ability to attribute blame”. The citizens were upset about the conclusion. With the legal system improving and development of scientific technology, judicial authentication conclusion is extremely prominent on the effect and efficacy in the fact-finding of the case, conviction and sentence under criminal proceeding. Currently, there is no mandatory request for authenticator to appear in court for cross-examination. The right to cross-examine witnesses is the basic consensus, however, under the Chinese judicial practice, it is common phenomenon to read out the authentication conclusion without examining the witness. The cross-examination of the conclusion is formalism, which damage the lawful rights and interests of the parties and injure the objectiveness and impartiality of the judgment, especially in the cases which have to judge whether the accused is guilty or the sentence shall be a death penalty.

### **Study on the relationship of continuous laser printing and the distance of trace on the OPC**

Xingzhou HAN, Yuanli HAN, Xiaoguang WANG, Zihan GUO, Da QIN, Haiqian YAN, Hongguang HAO

This thesis aims to seek the relationship between photosensitive drum cyclical trace distance of two pages (shorted for L') and continuity printing of laser printers. Characteristics quantification, statistics are chosen to evaluate the data and results. It is indicated that the regularity is existed between L' and continuity



printing, and regular performance between different models of HP and Canon printers are consistent. According to the data, L' of continuous printing are summed up, the probability of replacing the front page and the middle page which can meet the continuity regularity are analyzed. The numerical interval is given of non-continuous printing. The study can enhance the scientificity of printing document examination, and have innovation and practical significance in civil disputes, criminal cases and social community.

### **Forensic science in a large-scale investigation**

Đurđica HAZARD

On February 14<sup>th</sup> 2005, the former Lebanese Prime Minister, Rafic Hariri, was killed in a bombing attack in the capital city of Beirut. This is an example among many other cases in the history, where many priorities of different nature merge (political, economic, humanitarian, seeking the truth about the events) and where an investigation will take place in non-standards dimensions. In reality, conducting an investigation in such geopolitical situation can be jeopardized at many levels. From a forensic standpoint, the challenges start right at the crime scene, causing logistical and pragmatic issues as the protection and collect of trace material for instance. But the difficulties lie all along the chain of evidence and require a sound coordination of all information provided and gathered in order to support the inquiry efficiently and provide strong judicial proof for court. Using this case as an illustration, the presentation intends to draw the attention to difficulties met in such an inquiry and to think about key stages of investigation process and challenges to deal with. Ultimately, the objective is to question general forensic science practices applied to more reasonable sized cases through difficulties and experiences met in such large-scale affairs, aiming at providing reliable judicial proof and intelligence at the end of the process.

### **Computer source code: a source of the growing controversy over the reliability of automated forensic techniques**

Edward J. IMWINKELRIED

There is a growing trend to automate forensic analyses. The analyses are controlled by programs which, in turn, are controlled by the source code of the program. In the United States, there have been two waves of cases dealing with source code: cases involving infrared breath testing devices and cases involving the TrueAllele program for analyzing mixed DNA samples. The cases have addressed two questions: (1) whether the government can lay an adequate foundation for admitting the results of automated analyses without presenting any testimony about the accuracy of the source code; and (2) whether the defense has a right to access to the source code to evaluate the validity of the program logic. All the American cases have answered the first question Yes, and most of the cases have answered the second question No.

The purpose of this paper is to critically evaluate the judicial responses to those two questions. The paper argues that the courts have correctly concluded that the prosecution may introduce evidence of the results of an automated analysis without presenting any testimony about the source code. However, the paper also contends that at least in some circumstances the defense should either have access to the source code or be granted access to the hardware and software to conduct another validity test of the source code. Analogizing to the concept of a calibration range in metrology, the article proposes the concept of a validation range to help judges determine when to grant the defense access.

### **Ink dating: interpretation of the results in a legal perspective**

Agnes KOENIG, Céline WEYERMANN

Ink dating remains a particularly challenging forensic task. Despite almost a century of research on the matter, only few methods have been reported as being used in practical work. This can be explained by the complexity of the ageing processes and the amount of experiments needed to implement a method in practical caseworks. Three steps can be described as minimum requirements to reliably estimate the age of an ink entry: (1) method development and validation, (2) definition of reliable ageing parameters and (3) development of an adequate interpretation model to estimate the age of a questioned ink entry in a legal perspective. This presentation will focus on the last step. Data was collected on 28 ballpoint pen inks provided by the LKA Munich as representative of the European market. These were analysed using gas

chromatography coupled to mass spectrometry (GC/MS) and several ageing parameters were calculated and used to develop an interpretation model based on the calculation of likelihood ratios. The results will be discussed in comparison to actual interpretation based on decision threshold values. The advantage of a probabilistic approach lies in the facts that the results are evaluated in view of two alternatives hypotheses (generally given by the two parties involved in the questioned document issue). Moreover, it explicitly takes into account uncertainties concerning the questioned and reference data.

### **Chemical imaging research on 100 yuan currency authenticity identification in 2005 edition**

Yuanyuan LIAN, Xiaolei ZHANG

In this paper, chemical image set of 70 pairs of real currency (100 YUAN in 2005 edition), 12 pairs of real and forged currency (100 YUAN in 2005 edition) and 10 pairs of forged currency (100 YUAN in 2005 edition) were acquired by chemical imaging technology. Afterwards, different parts of the currency were defined as different colors by the software in order to get the resulting image. The experimental results show that for the 100 YUAN in 2005 edition, we can identify the currency authenticity in 8 stable spots and 2 relatively reference spots.

### **Understanding Chinese forensic examination**

Thomas MAN

Forensic examination plays a very important role in the fact-finding process in China. As the only statutorily recognized process to obtain and produce scientific evidence, forensic examination is increasingly used by all the players in the Chinese judicial process, including judges, law enforcement agencies, and litigants in criminal, civil, administrative as well as arbitration proceedings. This paper focuses on forensic examination in its narrow definition within the more confined context of formal judicial litigation proceedings. It introduces the statutory basis for forensic examination as an evidentiary tool in judicial proceedings and describes the institutional framework, the unique Chinese “judiciary,” of which forensic examination is an integral component. It traces the evolution of forensic examination system in the PRC history and gives a statistical overview of the institutions and personnel comprising the forensic examination system and the scope of services offered by this system. Finally, it provides a brief account of the procedures under which forensic examination is initiated, performed and used in judicial proceedings. Taken together, this paper aims to serve the limited purpose of providing a descriptive sketch of the Chinese forensic examination system in order to set the stage for interpretative analysis of the functions and future development of forensic examination in the Chinese judicial fact-finding process.

### **Reflecting on the past to envisage future perspectives**

Pierre MARGOT

Criminalistics was seen as multifaceted by pioneers at the turn of the 20th Century. The focus was tiny details, trace material that could provide clues to a hidden and uncertain past, inaccessible otherwise. This has been highlighted by the historian Carlo Ginzburg who noticed the change of paradigm that occurred with Freud’s psychoanalysis, Morelli’s art studies...and Sherlock Holmes, who exemplified the study of signs or semeiology. A philosophical and historical movement was underpinning the views of pioneers who saw the perspectives offered and opened by the study of « signs » . Whereas some like Gross saw the tactical aspects offered in the form of an investigative science (which he incidentally called « criminalistics ») as well as the value of these signs in the form of evidence, others like Bertillon, saw their value in classifying, identifying and creating databases, leading to police files or like Locard as a form of clinical science with laboratory support. These categories were not rigid, even if they reflected each pioneers background and knowledge. Unfortunately, during the 20th Century this was taken up by practitioners with little vision, or power, to develop the astonishing potential of this new « science » and it is only now that science is, hopefully, reclaiming its ground over test providers and other administrative organisations to offer new perspectives in detecting crime phenomena, through detection, intelligence and databasing (strategic and tactical dimension) as well as support for evidential purposes. The future, in that perspective, may not be what law enforcement administrators want or what the legal profession perceives. It has to be defined in

science and only science (as perceived by pioneers) will prevail in the future of criminalistics if it is to make the impact it is capable of.

### **Image fusion to increase the spatial information in three-dimensional forensic reconstruction**

Quentin MILLIET, Eric G. SAPIN

Crimes, accidents or unusual events are often recorded by public or private surveillance cameras, cars equipped with cameras, bystanders, witnesses, journalists or first responders. Such records are trace images of past events and represent a rich source of information in many investigations. The quality of these images might be limited or poor but they still convey key information.

Image processing techniques help getting the most out of these traces. Deblurring, sharpening, contrast adjustment and many other operations are combined to enhance the content of images. This article focuses on image fusion techniques to increase the informative potential of images. Emphasis is put on spatial information obtained from witness images. The first part of the method is to maximise the spatial information from images. Camera movements are examined to select and extract images that increase the field of observation of the scene in all directions. Modifications of the viewpoint, camera movements and settings are exposed to discuss their effect on the fusion process. A casework example presents the effects of these parameters on the fusion results and how to ensure the quality of the spatial information obtained.

The spatial information is integrated in a three-dimensional reconstruction of the event. Photogrammetry is used to measure the quality of this new piece of spatial information against a three-dimensional model of the scene. The viewpoint and camera parameters are adjusted in the photogrammetric project to match the real viewpoint. Format, focal length and distortions are considered in the adjustment process. Then observations from the panoramic image are integrated in the model.

The second part of the method emphasises the coherent use of spatial and temporal information according to the circumstances of a case. Merged images represent different snapshots of the event. Temporal information is preserved in order to maintain the chronology of observations on the event. Clues are presented in a logical and clear manner without modifying the understanding of the event in terms of the number of persons or objects and their movements.

### **What is the evidence?**

Bernard ROBERTSON

In a recent High Court of Australia case, the court divided over whether a judge was required to take into account the credibility of a witness when deciding whether evidence had "heightened probative value" or whether the judge should assume that the evidence would be accepted by the jury. "Relevance" in the Australian Evidence Act is defined differently from "probative value". Bayesian analysis reveals that the members of the court were interpreting "evidence" to mean different things: the fact that the witness made a statement on the one hand and the content of the statement on the other. Analysis of these theoretical questions casts light on how to deal with expert evidence given in conclusory form.

### **Allelic dropout at D8S1179 locus : A case report**

Zeying TANG, Zhihua MA, Zhou LYU

The short tandem repeats (STR) is a method applied most widely in paternity identification at present. However, mutation of STR locus would make the relationship between parents and offspring disobey the genetic principle. With the increase of genetic markers used in identification, the risk of mutation of STR locus is rising. It should be more pay attention in paternity identification especially when the allelic was dropout. Here we report a case with allelic dropout at D8S1179 locus. In the present case, Goldeneye® DNA identification system 20A and STRtyper-21G\_PLUS Identification System were applied for DNA amplification and recording. The result of D8S1179 locus: mother 15/15, child 10/10, suspected father 10/13. The gene phenotypes of mother and child disobey the Mendel's law of inheritance, while the rest STR alleles do follow this law. The locus mutation occurred at the site of primer binding would result in fail to amplify allele, and lead to allelic dropout. Therefore, the heterozygous individuals only have one amplification product of allelic genes. This miss examined gene was called null allele in previous studies. According to the technique

standard of paternity identification of China, the genetic relationship could be excluded if there were more than three locus running against the Mendelian inheritance law. As there was only one allele disobeyed the genetic principle, the paternity relation was still not eliminated. According to the mutation rate of D8S1179 locus, the paternity index (PI) was calculated as  $3.3776e-5$ , and the combined paternity index (CPI) was 146239.32233, and the W value was 0.99999. The result had already reached the standard of paternity assertion.

### **Research and realization of ten-print-data quality control techniques for imperial scale AFIS**

Qian WANG, Wei WANG, Wei ZHANG, Tong ZHAO, Guangnv JING

As the first individualization-information processing equipment put into practical service worldwide, AFIS has always been regarded as the first choice in individualization of criminal suspects or those who died in mass disasters. By integrating data within the existing regional large scale AFIS database, many countries are constructing an ultra large state of the art AFIS (or Imperial Scale AFIS, ISA) system. Therefore, it is very important to develop a series of ten-print data quality controlling process for this system of this type, which would insure a substantial matching efficiency as the pouring data comes into this Imperial Scale being. As the image quality of ten-print data is closely relevant to AFIS matching proficiency, a lot of police departments have allocated huge amount of human and financial resources over this issue by carrying out manual verification works for years. Unfortunately, the manual work methods above are always proved to be inadequate, because it's an astronomical task involved, in which has always been problematic and less affiant for potential errors. So we will implement quality control in the above procedure with supplementary - acquisition effect caused by the delay of feedback instructions sent from the human verification teams. In this article, a series of fingerprint image quality supervising techniques based on the RSR (rank sum ratio) model has been put forward, which has made it possible for computer programs to supervise the ten-print image quality in a real-time and more accurate manner as a substitute for the traditional manual verifications. Besides it's prominent advantages in the human and financial expenditures, the new technique has also been proved to obviously improve the image quality of the AFIS ten-print database, which leads up to a dramatic improvement in the AFIS matching-accuracy. And the optimization of the target print's candidate-list order, by the new-tech also makes it easier for the fingerprint experts to get a Hit, and helps them to reduce the Miss-out rate of latent fingerprint matching.

### **Evaluation and interpretation of handlebar grip residue evidence in hit and run cases**

Yuanfeng WANG, Zeyu LIN, Ran DU, Ziwei WEI

Introduction. In this report, the authors presented a study on the analysis and evaluation of handlebar grip residues from the suspect vehicles in hit and run traffic cases in China. As we all know, China is a developing country where the bicycle, the electric bike and the motor play important roles in the modern transport. The three common means of transport in China are practical and economical. However, more and more bicycle/electric bike/motor have been involved in traffic cases. Meanwhile, serious injuries have frequently happened to the rider, because most of them did not wear helmet. Sometimes, there was indeed collision between the perpetrator and accident victim or their vehicles. In this case, the handlebar grip residue from the bicycle/electric bike/motor always transferred to the surface of suspect vehicle. Whereas, there was sometime no collision between the two parts and the accident victim fell down because he/she changed the direction suddenly during the accident in order to avoid collision. In this case, the grip material contamination from daily life might confuse the fact finder. Different facts will lead to different judgements in the courtroom. Thus, it is necessary to set up a scientific method for tracing the fact in hit and run cases. Especially, we need to be qualified enough to distinguish the situation with slight collision from the situation without collision. Methods. 50 samples of bicycle handlebar grip, 50 samples of electric bike handlebar grip and 100 samples of motor handlebar grip have been collected randomly by the local police. Scanning electron microscope / Energy dispersive X-ray spectroscopy (SEM/EDX) and Fourier transform infrared microspectroscopy were utilized as analytical technology. First, samples were grouped by the typical elements shown in their EDX spectrum. Second, samples from the same group were differentiated further by the statistic data of their FTIR spectrum. Meanwhile, the contamination of grip material on vehicle surface has been investigated as well. Likelihood ratio and Bayesian network have been utilized to achieve

the evaluation and interpretation of handlebar grip residue evidence. Results. It is possible to explore the evidential value of handlebar grip residue evidence through instrumental analysis and statistical method.

### **Scientific evidence and the right to a fair trial under Article 6 ECHR**

Joëlle VUILLE, Luca LUPARIA, Franco TARONI

The European Convention on Human Rights (ECHR) does not mandate any particular form when forensic science findings are reported to the instructing magistrate or to the fact-finder. In the limits posed by Article 6 ECHR (right to a fair trial), national authorities are thus free to set their own rules in the matter. However, even if the scientific techniques on which they base their analyses are similar across jurisdictions and disciplines, not all forensic practitioners report their results in the same standardized way, and there is a vigorous debate in the relevant communities as to the (scientifically) most appropriate way to express the probative value of one's findings. After setting the general framework posed by the right to a fair trial, this paper will endeavor to present the (few) constraints set by the ECHR in matters relative to scientific/expert evidence. We will then explain why the current situation is unsatisfactory and what the risks are to the procedural rights of the parties when certain conclusion formats are used. Finally, we will make recommendations to expand current legal requirements, both at a formal and substantive level, to make the guarantees of the Convention concrete and effective when scientific evidence is adduced.

### **Study of autosomal STR loci with IBS method in full sibling identification**

Li YUAN, Xu XU, Dong ZHAO, He REN, Chaohui HU, Wen CHEN, Shicheng HAO, Di LU, Lin ZHANG

**Objective** We investigated the application of autosomal short tandem repeat (STR) loci with the identity by state (IBS) method and a discriminant function algorithm in full-sib identification. **Methods** A total of 342 pairs of full sibs (FSs) and 3900 pairs of unrelated individuals (UIs) were genotyped for 51 STR loci. Groups were formed in accordance with discrimination power (DP) values and the number of loci, and IBS scores of FSs and UIs were analyzed and compared. The discriminant functions of FS-UI were determined by using the Fisher discriminant with SPSS software. **Results** All IBS in FSs and UIs groups showed normal distributions and there were significant differences between the two pairs. Receiver operating characteristic curves revealed that the detection efficiency of full-sib identification was affected by both the locus polymorphism and the number of loci detected. Comparing the rate of false positive and false negative of discriminant function between groups, a higher average DP value and larger number of loci detected were associated with a lower rate of miscarriage of justice and were more helpful for full-sib identification. **Conclusion** The more loci detected and the higher DP values lead to the more conducive application for FS test. Discriminant analysis with the IBS method is highly applicable for the FS-UI test.

### **On the testimonial triangle: speech act perspective**

Luping ZHANG

Since the *Beweisverbote* (prohibitions on adducing certain sorts of evidence)(Morawski 465) being introduced, arguments about that never end. But what is the essence to testify and define a hearsay? And how the Testimonial Triangle justifying the hearsay rules and questioning the exception rules about it? How to use the speech-act theory as a means to improve it? This paper attempts to find a way to review and improve the Testimonial Triangle.

### **Quality control of low copy number DNA analysis with short tandem repeat typing**

Tian ZHENG, Guoping WU, Xing MENG, Yingqiu QIAN, Yahong ZHOU

The amounts of the template DNA and different reaction systems used in the polymerase chain reaction (PCR) were the important factors of the reliability of forensic DNA analyses. The samples were amplified using the AmpFISTR Identifiler Plus PCR Amplification Kit. With short tandem repeat (STR) typing, low copy number (LCN) DNA samples can present exaggerated stochastic effects during the PCR cycles. The volumes of the reaction system and the amounts of template DNA were discussed and the effects of the different PCR

reaction system and different actual starting DNA amounts were assessed by evaluating STR typing results. To the LCN DNA samples, the robustness of the amplification was improved and the sensitivity was reduced by increasing the volume of reaction system. Consequently, when the volume of the reaction system was 15  $\mu$ L and the amount of template DNA was 0.03ng, the amplification efficiency of LCN DNA samples from crime scenes was stable and the cost of the experiments was more economical.

### **Application of scanning electron microscopy with energy dispersive X-ray spectroscopy and Clustering Analysis in vehicle paint identification**

Yahong ZHOU, Tian ZHENG, Jin CHEN, Lijun ZHANG

Nineteen kinds of automobile paints were characterized in terms of their inorganic elements compositions and relative contents by scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM/EDS). The optimal SEM/EDS method was designed to analysis the contents of inorganic elements and its accuracy and precision were determined. The standard deviation was calculated based on the relative content of elements contained in the different layers of paint and the minimum sample similarity was about 92.3%, and the maximum was up to 99.4%. Then the characterized inorganic elements of multilayered paint fragments were analyzed by clustering analysis used SPSS. The method also could be used in the discrimination of the samples with the same color. Furthermore, according to the results of clustering analysis, the different paints with the same color could be identified.



## OPENING KEYNOTE ADDRESS

### THE TWO CONCEPTUAL DIFFICULTIES OF SPECIALIZED EVIDENCE

Ronald J. Allen\*

I am distinctively honored to be asked to deliver this address. My admiration for many of the people in this room is overflowing. Among the Chinese are those who are, literally, responsible for facilitating the long march of China to the rule of law.<sup>1</sup> This is no easy task, given the insanity of the Anti-Rightist Movement and the Cultural Revolution that together destroyed any semblance of a rational legal system and as a by-product extirpated, again literally, legal knowledge from China; law schools were closed and books were burned. Over the last few years, I have also come to deeply admire the efforts of the Swiss forensic scientists to establish their various fields on sound conceptual and empirical foundations and who are struggling with the very topic of this address, the conceptual difficulties specialized evidence poses for the legal resolution of disputes. The European Network of Forensic Science Institutes' Guideline for Evaluative Reporting in Forensic Science is both a clear statement of these difficulties and offers very helpful recommendations that if implemented would ameliorate some of them.

The last time I spoke with you, I focused on the role of evidence law in the effort to resolve the complex optimization problems that any legal system faces. Although the law of evidence is often thought of as a set of discrete rules motivated largely by epistemological issues, we saw that in fact it must deal with a number of other important social matters as well. With regard to the epistemological issue, which I will focus on today, I emphasized the critical fact that the construction of knowledge is discipline dependent. Perhaps the most critical epistemological difference between the law and forensic disciplines is that, in any form of "science," decision as to what is likely true can be postponed in the absence of satisfactory evidence, but the law lacks this luxury. Legal systems rarely exercise choice over the problems to be solved and even less choice over the evidence that exists to solve those problems, yet a legal system cannot simply choose not to decide. Doing so is a de facto decision on the merits that preserves the status quo. Your epistemologies are thus created to facilitate ongoing research on concentrated and discrete problems that can be solved; the law's epistemology is created to provide a general matrix to resolve whatever happens to come along at the moment with whatever evidence is available. You have the luxury of studying what can fruitfully be studied through controlled methodologies. It is impossible to study in the same way most questions that will emerge in litigation. No one has any idea what might emerge in litigation tomorrow, and whatever does will be highly idiosyncratic and not amenable to controlled studies. You also have the luxury of changing your mind in the light of new evidence that may be subsequently developed, whereas for many fundamental reasons the law of most civilized countries prizes repose.

But the law also prizes accuracy, and thus the law of most countries allows the judicial process to reach out to specialized branches of knowledge when there is good reason to believe that such knowledge will assist in the accurate resolution of disputes. In some countries, like the United States and most western democracies, there is more or less a free market in expertise—parties can proffer any form of knowledge that can be demonstrated to be reliable, whereas in others, like China, the forms of permissible testimony are more tightly regulated. Notwithstanding such stark differences on the surface of the varying regulatory regimes, underlying all forms and regulation of specialized evidence are two conceptual difficulties. The first and more significant of the two is that the use of specialized knowledge at trial can be quite inconsistent with the deepest aspirations of trials in the liberal tradition. The second and very much derivative issue is how to regulate testimony at trial in Anglo-American systems and in reports to judges in continental legal systems.

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\* John Henry Wigmore Professor of Law, Northwestern University; President, Board of Foreign Advisors, Evidence Law

<sup>1</sup> See Randall Peerenboom, *China's Long March toward Rule of Law* (2002).

First, the deep aspiration for trials. Rights are glorified in the western world in particular (and with some good reason), but facts are as if not more important, for every conception of a right of which I am aware is utterly parasitic on facts. Property is a good example. A property right gives a person the right to possess, consume, control, and dispose of something. But if those rights are challenged, the resolution of who gets to possess, consume, control, or dispose of something will be determined by the facts of the matter, in particular whether one party or the other can show the party found, made, purchased, or was given the item in question (these are the ways a “property right” comes into being). A “property right” is thus completely determined by the fact finder’s reconstruction of the actual state of the universe at a particular time. Determining those facts will virtually never be done in an algorithmic manner akin to a DNA test or trace evidence analysis, or any other forensic science. Rather, it will typically involve the vagaries of time, place, and human testimonial capacities. The manner in which one could establish a property right, for example, ranges over an essentially infinite domain of human interaction that usually generates an entirely unpredictable body of evidence.

Given the unpredictability and unruliness of juridical problems, western law does not prescribe the type of evidence that must be proffered (I treat China’s form of regulation below) but instead permits the parties to proceed any way that they like. They can offer virtually any credible evidence and employ inductive, deductive, or abductive arguments; they can search for evidence wherever it may be found and however it is constituted and virtually always offer it (the limit is a few social policies favored over truth determination). There is no formal edict on the meaning of “rationality”; all the cognitive tools in the tool chest, all the forms of organized thinking that have garnered the label “rational,”<sup>2</sup> may be employed. The central aspiration of western trials does not involve adopting any of the contested meanings of “rational” or constraining the cognitive tools or forms of evidence that may be used, but instead to liberate the process to whatever plausibly rational forms of proof the parties choose to present in order to facilitate the accurate and efficient resolution of disputes. This sounds like a recipe for chaos, but it is the opposite. It is the solution to how to construct a dispute resolution system that is on the one hand fair and on the other makes no *a priori* judgments about cases that may arise. As the legal system ranges over the entire human condition, one cannot know in advance what disputes may arise and thus what tools to resolve them may be needed. Thus, the central aspiration of liberal legal systems reduces to providing the conditions under which unbiased fact finders hear, understand, process and deliberate upon the evidence and arguments offered by the parties and by doing so hopefully to reach accurate results.<sup>3</sup>

The solution to this problem of taming complexity is thus essentially procedural—decision is by competent, disinterested individuals able to comprehend, process, and deliberate upon the evidence to reach a rational judgment as to what occurred—and thus rationally decide as to the rights and obligations of the parties. The facts are to be found by the disinterested application of common sense by members of the community (whether judge or juror). After determining the most plausible account of what actually happened, liability is determined consistent with the formalities of substantive law.<sup>4</sup>

All of this is accomplished by exploiting common sense and general experience. Everyone at trial—judges, jurors, witnesses—is presumed to have enough in common so that effective communication and comprehension are possible. Fact finders come to trial with a vast storehouse of knowledge, beliefs, and modes of reasoning that permit communication to occur simply and efficiently. Conventional beliefs about the nature of reality and the existence of causal relationships are just assumed to be held by all participants, and virtually never are the subject of evidence. Everyone is just assumed to engage in orderly reasoning, employing all the necessary forms—deductive, inductive, abductive, statistical—as necessary or appropriate. The ability to comprehend the testimony of witnesses is just assumed, as is the ability to perceive the connection between the evidence and the trial. Everyone is assumed to know about the foibles of human testimony and the perverse effects of potential biases, and thus to be able to judge the credibility of the testimony. Less well known, everyone is expected to be able to fill in the evidentiary gaps at trial that result from many factors (including that individual witnesses always know more than they can express) by

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<sup>2</sup> Ronald J. Allen, Taming Complexity: Rationality, the Law Of Evidence, and the Nature of the Legal System, 12 Law, Probability & Risk 99-113 (2013), reprinted in Maksymilian Del Mar & Burkhard Schafer, Legal Theory and Natural Sciences (2014).

<sup>3</sup> This articulation makes immediately clear why expert testimony is a problem. Ronald J. Allen & Joe S. Miller, The Common Law Theory of Experts: Deference or Education?, 87 Northwestern Law Review 1131-1147 (1993). Reprinted in J.F. Nijboer, C.R. Callen & N. Kwak (eds.), Forensic Expertise and the Law of Evidence (1993).

<sup>4</sup> Ronald J. Allen, The Nature of Juridical Proof, 13 Cardozo Law Review 373-422 (1991), reprinted in 19 Evidence Science, 751-760 (English), 761-767 (Chinese) (2011); Ronald J. Allen & Michael Pardo, Juridical Proof and the Best Explanation, 27 Law & Philosophy 223-268 (2008); reprinted in Spanish 27 Derecho y Filosofía, No. 3 (2008). pp. 223-268.

drawing inferences based on one's own experience. Indeed, one of the arguments for juries and multi-member courts is that the probability of all this being done well increases with the size of the body deciding a case, because each person added to the group brings a lifetime of experience and knowledge to judge the evidence.

But now a problem looms. Those who construct and operate the legal system are fully aware that there are organized bodies of knowledge that are not commonly known and yet can be critical to reaching correct trial verdicts (oncology, metallurgy, epidemiology, biology . . .the list is long). At least sometimes, we know what we do not know, and herein lies the informational vulnerability of the law. Legal decision makers need to exploit knowledge that they do not possess. The dilemma is obvious: What if testimony can only be understood with knowledge or experience that the fact finder lacks, which makes it virtually impossible that the fact finder will comprehend what lies behind the spoken words or be able to intelligently appraise the truth of what is spoken? This is the single most critical conceptual problem posed by expert testimony for legal systems, and there are only two possible solutions to it. Either the necessary background information must be provided or fact finders must defer to the judgment of others, not because of comprehension and agreement, but because the fact finder is simply delegating that decision to someone else. Virtually always when faced with this dilemma, the Anglo-American legal system, and most other liberal systems of which I am aware, has chosen to require that information be provided in a comprehensible fashion to the fact finder. If a witness speaks a foreign language, translations will be provided. When routine business practices or conventions matter, evidence is adduced on the topic so that the fact finder may judge what the actual routine practices or conventions are. Expert testimony at trial is often inconsistent with this normal conception of a trial. Experts often engage in years of specialized training, which can make it difficult to educate the fact finder about the relevant issues at trial. Although the controversies over expert testimony explicitly are typically about such things as knowledge, they in fact are controversies over supplanting the norm of education by deference when someone qualified as an expert speaks, and thus can only be resolved by addressing that issue.

The rules governing expert evidence in the United States permit, and to some extent encourage, a deferential mode of proceeding. Although there are complexities here, especially the complex cost/benefit analysis involved of alternatives, the use of a deferential mode of proceeding is a reproach to the deep aspirations for trials that we hold. Fact finders cannot make rational decisions, but instead defer to others. Moreover, the choice to defer cannot be rational either. The only way to defer rationally is through a comprehension of the field, which is what is lacking (and if it were not lacking, deference would not be necessary). Fact finders operating in a deferential mode are essentially just guessing as to what the right answer is. In my opinion, this should not be allowed and trials should be educational not deferential events.

What then of those legal systems that formally prescribe the types of expert evidence that may be adduced and in some instances mandate that experts be certified in some manner? Or the German system that seems to encourage the judicial appointment of experts? The problem should be obvious, for it is a corollary of the informational vulnerability of the law previously discussed. Such formal approval mechanisms will advance rational outcomes only if those doing the certifying or appointing understand the underlying problems, in which case, again, expertise to defer to it not needed (testimony about facts from an informed perspective, by comparison, might be needed or useful).

It is easy to state the solution to this problem: All testimony at trial should be presented in a form that permits it, and its implications, to be understood. The testimony should be educational rather than provide an opinion to which to defer. If certain issues that would otherwise arise in litigation defy this prescription, then those issues should not be the subject matter of trials. Legislative or administrative resolution of the particular issue should be pursued instead. Of course, this prescription, like many prescriptions about improving legal systems, is wildly idealistic. By articulating it, I do not mean to suggest that one should expect to see its adoption, but it remains nonetheless a commendable aspiration.

There is considerably more to say about this,<sup>5</sup> but I need to move on to the second conceptual problem—the manner of presenting expert testimony. Here again I want to praise the European efforts to improve the quality of forensic testimony. The previously mentioned Guideline for Evaluative Reporting in Forensic Science are a big step forward. Moreover, as I read the Guideline, it is implicitly quite sympathetic to the concern about trials being educational events. Although the education/deference divide is not discussed in the Guideline, one of its major goals is to increase the communicative content of forensic

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<sup>5</sup> See Allen & Miller, *supra*.

testimony. The greater the communicative content of testimony, the more likely it can be understood and processed, which advances the educational goal of trials.

I identified the second problem as “the manner of presenting expert testimony,” but in reality it is the problem, again ubiquitous in legal systems, of the relationship between quantified and non-quantified evidence. Let me state the central dilemma. Legal systems are constructed to optimize accurate decision making under cost and a few policy constraints. If experts have useful knowledge to share, it will be exploited. However, there are often gaps in expert knowledge; how precisely a result is to be interpreted or how it integrates with non-expert trial testimony can be ambiguous. Various efforts to resolve this problem have been identified. Indeed, my discussion above can be construed as just one effort that would require the expert to explain what the expert knows, and does not know, in sufficient detail to be understood by the decision maker. For reasons that will become clear, I suspect that is the only rational solution. Another solution that has been offered is to conceive of the trial as an exercise in subjective probabilities, and to solve the problem of computational complexity through invoking Bayes nets. There is a common difficulty to both and that is that legal systems require reliable data not subjective opinions as the grist for their mills. I have previously discussed Bayes nets,<sup>6</sup> and in any event the Guideline does not mention them, and so I will concentrate on subjective probability. Before doing so, I will just note that the difficulty with Bayes nets as a juridical solution is that one must actually know what the conditional probabilities are and not simply make them up.

First, what is quite positive about the Guideline. Guidance Note 3 is for the most part a wonderful description of what an expert should do, which is to explain the basis of an opinion, and implies that all testimony should be based on “a body of knowledge that should be available for auditing and disclosure.” Right on, as we used to say in the United States. The fly in the ointment is that the Guideline encourages the formation of likelihood ratios as a primary form of testimony; but as it says, “Forensic practitioners often experience difficulty in assigning and justifying probabilities when the assignments are based on expert knowledge.” But this is not a major problem because “likelihood ratios can be informed by subjective probabilities using expert knowledge.” Subjective probability, we are informed in turn, “is the measure of your belief in the occurrence of an event. A number between 0 and 1 represents this measure. The laws of probability apply to these probabilities just as they apply to calculated probabilities.” In elaborating on these ideas, Alex Biedermann has asserted that for forensic purposes “probability ought to be interpreted as a measure of an individual’s belief about something . . . that is unknown to the individual.”<sup>7</sup> I beg to differ to some extent.

First, the technical point. Numbers between 0 and 1 created by anyone, forensic scientists or not, to “measure belief in the occurrence of an event” are simply artifacts of that person’s mind. They most certainly do not necessarily “obey the laws of probability,” in part because “laws” of probability do not exist, so far as I am aware. Rather, axioms do, and valid proofs based on those axioms do as well. There is no “law” that I violate if I am asked what is my belief in the probability of X and I say .6 and then when asked what is my belief in the probability of  $\sim X$  I say also .6. To be sure, I will not likely be able to do meaningful calculations on these numbers, as they do not appear to be within any axiomatized system,<sup>8</sup> but there is no a priori requirement, no “law” in other words, that I do calculations on my beliefs, either. This is not a defense of irrationality; rather, it is making the point that the “numbers” a person creates will be calculable as mathematical probabilities only if formulated within a consistent axiomatization of probability such as Kolmogorov’s. Among other things, this requires a full specification of the probability space such that the probability of one of the events in the probability space occurring is 1.0. I dare say that I doubt this describes many of the formulated “personal probabilities” of forensic scientists or anyone else.<sup>9</sup>

The problem at trial rarely is just the initial formation of the probability space; it also involves the updating of beliefs in the light of new evidence, but an immediate difficulty is the absence of objective data. Here the work by Savage and others on subjective probability comes into play. The Guideline seems to suggest that in the absence of objective data, one can simply make up numbers instead. There are

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<sup>6</sup> Ronald J. Allen, *The Nature of Juridical Proof: Probability as a Tool In Plausible Reasoning*, forthcoming, 21 *Int. J. E. & P* \*\*\*

<sup>7</sup> Alex Biedermann, *The Role of the Subjectivist Position in the Probabilization of Forensic Science*, 1 *J. of Forensic Science and Medicine* 140, 141 (2015).

<sup>8</sup> Note that there are paraconsistent logics.

<sup>9</sup> This is the analog to the problem of Bayes nets noted above. One actually needs to know the conditional probabilities.

numerous difficulties here.<sup>10</sup> First and foremost, updating personal beliefs within Savage's axioms, or anyone else's, merely guarantees consistency of beliefs and nothing more. Consistency of beliefs is considered by some to be a hallmark of rationality.<sup>11</sup> In my subjective opinion, consistency of beliefs is a fine thing, but it is not the objective of trial: Accurate outcomes under constraints is.

The difficulties here go further. In addition to providing a means of maintaining consistent belief states, Savage and others (de Finetti, Von Neumann and Morgenstern, Ramsey) provided means of eliciting the personal beliefs of individuals, but<sup>12</sup> as two of my colleagues at Northwestern sum things up:<sup>13</sup>

Savage's theorem implicitly defines probability as the degree of belief implied by the decision maker's choice over uncertain prospects. Probability is not an objective property of the world, but the decision maker's subjective assessment of the likelihood of various events, as expressed in his willingness to make bets on those events. In Savage's framework it makes no sense to talk about beliefs being 'right' or 'wrong,' overly optimistic or pessimistic, or whether some probabilities may be more 'objective' than others.

At a philosophical level, I will assert my belief that this emphasis on belief states misses the point of trials. If I may anthropomorphize trials, trials are not interested in anyone's beliefs, although they may be interested in the reasons for those beliefs. Trials are not about belief states; they are about appraising evidence in order to apply the decision rule (preponderance, clear and convincing, beyond reasonable doubt, intine conviction, whatever). This is about acceptance, not belief.<sup>14</sup> A fact finder could utterly disbelieve that anybody could do what a particular criminal defendant is accused of, but if the evidence shows beyond reasonable doubt that he did<sup>15</sup>, the verdict is guilty.

The Guideline and forensic scientists are driven to subjective probability, I believe, because in a sense no other philosophical interpretation of probability seems to work. Propensity and classic probability obviously are irrelevant, and rarely are there explicit relative frequencies at trial to operationalize a relative frequency approach. That leaves subjective probability as the last man standing, so to speak, and thus one must embrace it or leave the world of probability behind. But here there is a curious lack of scientific rigor that must be noted. What data is there that even remotely suggest that following the prescription of formulating subjective probabilities and likelihoods in this fashion will increase the accuracy rate at trial? To my knowledge, exactly none. There is a literature that statistical medical diagnosis is systematically better than clinical diagnosis, but that literature exploits objective probabilities (although I realize using that phrase may get me in hot water here). Interestingly, the Guideline itself states that "Forensic practitioners often experience difficulty in assigning and justifying probabilities when the assignments are based on expert knowledge." I take it that this is because the forensic practitioners are fully aware of the ambiguity, uncertainty and gaps in the evidence that they are being asked to appraise, as well as gaps in their own knowledge, and thus they are fully aware of the unreliability of formulating and expressing what the Guideline calls "probabilities." If that is true, how could all of these cognitive difficulties and limitations disappear by simply making up a number between 0.0 and 1.0 and calling it a "subjective probability"? This would be a remarkable feat were it possible. Indeed, it would be miraculous.

But, like David Hume,<sup>16</sup> I have my doubts about miracles. If the forensic scientists have no good idea what a reasonable assessment is, those problems do not go away by the simple expedient of making up a number between 0.0 and 1.0 and calling it a subjective probability. Doing so gives a scientific patina to unscientific speculation and obscures rather than clarifies. Of course, it also facilitates computation, which I

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<sup>10</sup> Ronald J. Allen, Rationality, Algorithms, and Juridical Proof: A Preliminary Inquiry, 1997 International Journal of Evidence and Proof (Special Issue) 254-275.

<sup>11</sup> The equivalence of rationality with proceeding according to any axiomatization of subjective probability is a remarkably limited view of the nature of rationality. Ronald J. Allen, Taming Complexity: Rationality, the Law Of Evidence, and the Nature of the Legal System, 12 Law, Probability & Risk 99-113 (2013), reprinted in Maksymilian Del Mar & Burkhard Schafer, Legal Theory and Natural Sciences (2014).

<sup>12</sup> And their utility functions. Maybe. These matters are complicated. For a fine overview, see Robert F. Nau, De Finetti Was Right: Probability Does Not Exist, 51 Theory and Decision 89-124 (2001).

<sup>13</sup> Nabil I. Al-Najjary and Luciano De Castroz, Subjective Probability, in The Wiley Encyclopedia of Operations Research and Management Science.

<sup>14</sup> L. Jonathan Cohen, An Essay on Belief and Acceptance (1992).

<sup>15</sup> Many criminal cases actually are like that. I defended in the Supreme Court of the United States a defendant who had his nine month pregnant wife kidnapped from her home and murdered. Heath v. Alabama, 474 U.S. 82 (1985).

<sup>16</sup> David Hume, An Enquiry Concerning Human Understanding Section X: Of Miracles.



suspect is the real motivation operating here. But any ensuing computation should be looked at quite skeptically, or again as we say in the United States, “Junk in; junk out.”

Since I have gotten myself into hot water by referring to objective relative frequencies, let me say a word or two about them. The debate over subjective probability is driven by decision theoretic concerns, in particular preserving rationality in decision under uncertainty (not risk, but uncertainty). When dealing with epistemological uncertainty, Savage and his colleagues offer advice that will often prove useful, but that it often may prove useful does not mean that it is the only game in town. It is certainly not the only game in town in physics, for example. The half-life of uranium-235 is approximately 704 million years, no matter what anybody’s subjective belief may be about the matter. If someone asserts to the contrary, they are just wrong (one can always quibble about margins for error). The hunt for the Higgs Boson was one big objective probability exercise. I certainly hope that this audience in particular will not tell me that it is just a subjective belief that the two DNA strands contain nucleotides composed of a nitrogen-containing nucleobase of either cytosine, guanine, adenine, or thymine (T). And so on. It is not subjective beliefs that matter; it is whether they’re right or wrong, or how likely it is that they’re right or wrong, or better yet, what are they based on and is that right or wrong? The emphasis on subjective probability neglects what its creators have warned us about for over half a century, which is that there is no necessary relationship between beliefs and truth. My colleagues again: “De Finetti points out that a subjective proposition, such as a subjective probability assessment, is one which ‘no experience can prove [...] right, or wrong; nor, in general, could any conceivable criterion give any objective sense to the distinction [...] between right and wrong.’”<sup>17</sup> As they elaborate:

On the one hand, Savage's theory may be seen as too permissive a frame-work for defining rationality. Any probability measure on the state space, no matter how absurd, qualifies as rational belief. Believers in Intelligent Design and members of the Flat Earth Society are rational, provided only that they are consistent with the representation. Savage is simply not in the business of passing normative judgments about what is and isn't a reasonable belief, or how beliefs should be formed. Rather he seeks criteria for coherence of beliefs “to distinguish between coherent behavior and blunder, or demonstrable incoherence in the face of uncertainty” and it is best thought of as a tool “by which a person can police his own potential decisions for incoherency.”<sup>18</sup>

One of the ironies of the focus on subjective probabilities in the forensic context is the neglect of this fundamental point.

My remarks may begin to sound to you as either irrational or implicitly defending a relative frequency account of juridical proof, as there doesn’t seem to be anything else left, and this would be exactly right. It is a relative frequency focusing on errors. Trials are definitely decisions under uncertainty but ones in which society provides a decision rule based on policy prescriptions about the likely distribution of errors (among other less important variables), and with regard to that decision rule could not care less about the subjective probabilities of witnesses or factfinders.<sup>19</sup> Thus, the contemptuous dismissal of Lindley that the idea of “chance is preposterous in the [juridical] context” exposes his ignorance of the objectives of trials.<sup>20</sup> To be sure, it is not “chance” as I suspect he is using the term that matters, but the rate of errors at trial most definitely matters, call it what you like. One thing that it is not is preposterous.

Lindley’s mistake, and one I am urging the European Network of Forensic Science Institutes to avoid, is ironically insisting on analyzing trials from his own personal perspective, his personal beliefs, so to speak. “Chance” and “long run relative frequency data” are, I suspect, at the core of his beliefs about decision under uncertainty, and since they are ruled out nothing else is left except subjectivism.

Legal analysts like myself find this kind of approach interesting, and in many ways quite useful, but fundamentally mistaken for the reasons I’ve identified. The legal analysts are attempting to construct a functioning legal system in which rationality certainly matters quite a bit, and in doing so are happy to borrow ideas that are useful wherever they find them, but, and this is the key point, those ideas are then domesticated by the needs of the legal system resulting in unrecognizable creations to specialists in other fields. So let me explain what is that you are observing. As I have mentioned, a significant objective of trials

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<sup>17</sup> Nabil I. Al-Najjary and Luciano De Castroz, *supra*, quoting de Finetti, *Probabilism*, 31 *Erkenntnis*, 169, 174 (1989).

<sup>18</sup> Nabil I. Al-Najjary and Luciano De Castroz, quoting Savage, *Difficulties in the theory of personal probability*, 34 *Philosophy of Science*, 305, 307 (1967).

<sup>19</sup> Again, there are deep waters here. Ronald J. Allen, *Factual Ambiguity and a Theory of Evidence*, 88 *Northwestern Law Review* 604-640 (1994).

<sup>20</sup> DV Lindley, *Probability*, in Airken & Stoney (eds.), *The Use of Statistics in Forensic Science* 27 (1991).



is to regulate errors. Obviously, the best way to do that under conditions of uncertainty would be through objective (there is that word again) relative frequencies, but here Lindley is right that they rarely exist.

And even when they do, they can be radically misleading. Consider the example of DNA samples on a bag in the Guideline, where the Guideline recommends that the witness testify that “in my opinion, the finding is in the order of 400 times more likely if Mr. J was the person who handled the bag rather than someone else handled the bag and Mr J’s DNA transferred via Officer P.” That may very well be true, but how does it integrate with all the rest of the evidence in the case? This is not just a question of formulating priors but of knowing the dependence relationships of all the other evidence. To use a stark example, DNA analysis may show an accused’s DNA to be present in a sample, but its implications are entirely dependent on all the other evidence suggesting that the accused may have left that sample. If the hypothetical in the Guideline example were real, there would almost always be much more complex stories being told with highly interactive sources of evidence. In that context, to say “X is 400 times more likely than Y” would be, to be charitable, radically misleading at best. Obviously, the Guideline is attempting to reduce examples to manageable size, but the point is that the reduction may transform them in such a way that their pertinence to real cases is problematic. I also cannot resist pointing out that the only sense to make of such a number in a forensic context is precisely that the expert would expect to find this distribution of DNA in about one in 400 similar cases involving similar facts—precisely the chance or relative frequency account ridiculed by Lindley.

In the absence of reliable data of this sort (stable relative frequencies, knowledge of dependencies), and other issues as well, liberal legal systems ask fact finders to compare the relative plausibility of the explanations on offer at trial and adjudicate accordingly.<sup>21</sup> To be sure, the objective is to find the most probable explanation in a sense in civil cases and the really probable one in criminal cases, but that judgment is reached through the criteria of plausibility (consistency, coherence, etc.), which include probability as well.

Forensic scientists are thus observing a system that does not conform to their rules. The focus on subjective probability in the Guideline may be in a sense an effort to nudge the system in their direction. I suspect that it will fail, although the failure may not be explicitly acknowledged (data can just be ignored or given less weight than someone else think it deserves). Legal systems have proven over millennia to be rather stable entities and not terribly moved by external critics. Sometimes this intransigence is for lamentable reasons, but at times it is justifiable because the external critics often do not understand the legal system. The general resistance to subjective probability as a matrix for decision is fully justified for its erroneous modeling of the decision problem at trial. Trials need knowledge, which here means reliable and comprehensible evidence (this does not mean the justified true belief of the epistemologists, although that is another story). Subjective opinions, whether about probabilities or anything else, are only useful to the extent that fact finders can extract from them reliable data (there is another long story here about “opinion evidence”).

I may sound critical, but note that at this critical juncture, my explanations and the primary thrust of the Guideline coincide almost perfectly. The emphasis on subjective probability in the Guideline is a distraction from the main event and indeed is really epiphenomenal. The main event in the Guideline as I read it is the significance of explanations and explanatory power and those are exactly what liberal legal systems need. The Guideline says “Explain yourselves” in what is the best articulation of this that I have ever seen. Disclose and facilitate the examination of the “body of knowledge” on which you are basing your testimony. Be clear where systematic data underlie your testimony and when you are winging it. And then if you want, go ahead and talk about likelihoods and so on. I would be sanguine about that because our experience in the United States is that fact finders attend to the data more than someone else’s inferences about it.

In closing let me say again that I admire the efforts that you are engaged in here, as well as the parallel efforts in the United States (it is lamentable that apparently not much cross-fertilization has occurred). As you make progress, the result will be to continue to reduce the number of miscarriages of justice in my opinion. I may be utterly wrong about the utility of focusing on subjective probability in those efforts, but I cannot resist concluding by pointing out the measure of your success will, in fact, be a relative frequency of errors.

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<sup>21</sup> See Allen & Pardo, *supra*.

**Notes**

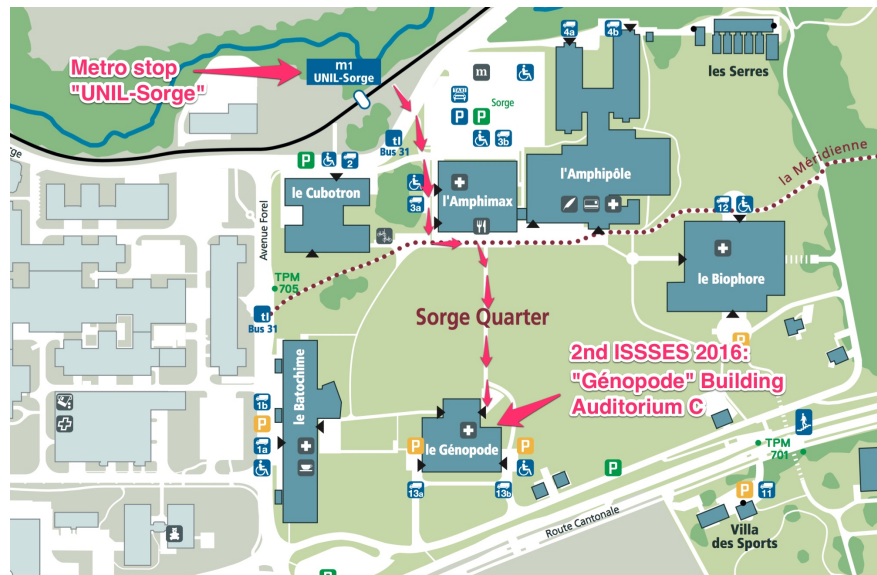
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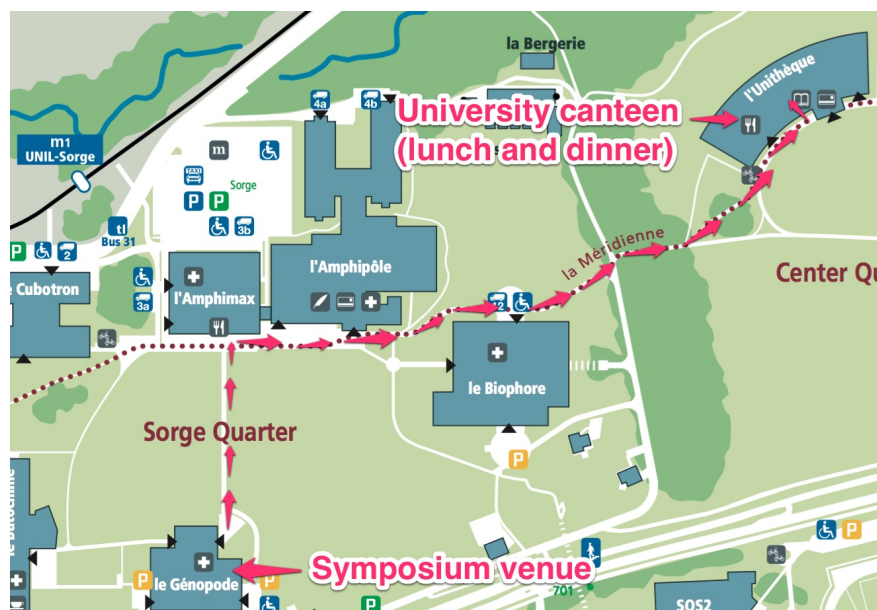
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