



NIST Trace Evidence Data Workshop, 19-20 July 2016

THINK.CHANGE.DO

What Does the Future Hold for Trace Evidence?

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4. Ecole des Sciences Criminelles, University of Lausanne, CH-1015 Lausanne, Switzerland



**Understanding
the Problem**



**Revisiting the
Roots of
Forensic
Science**



**Crime Scene
as Scientific
Endeavour**



**Holistic View
of Trace
Evidence**



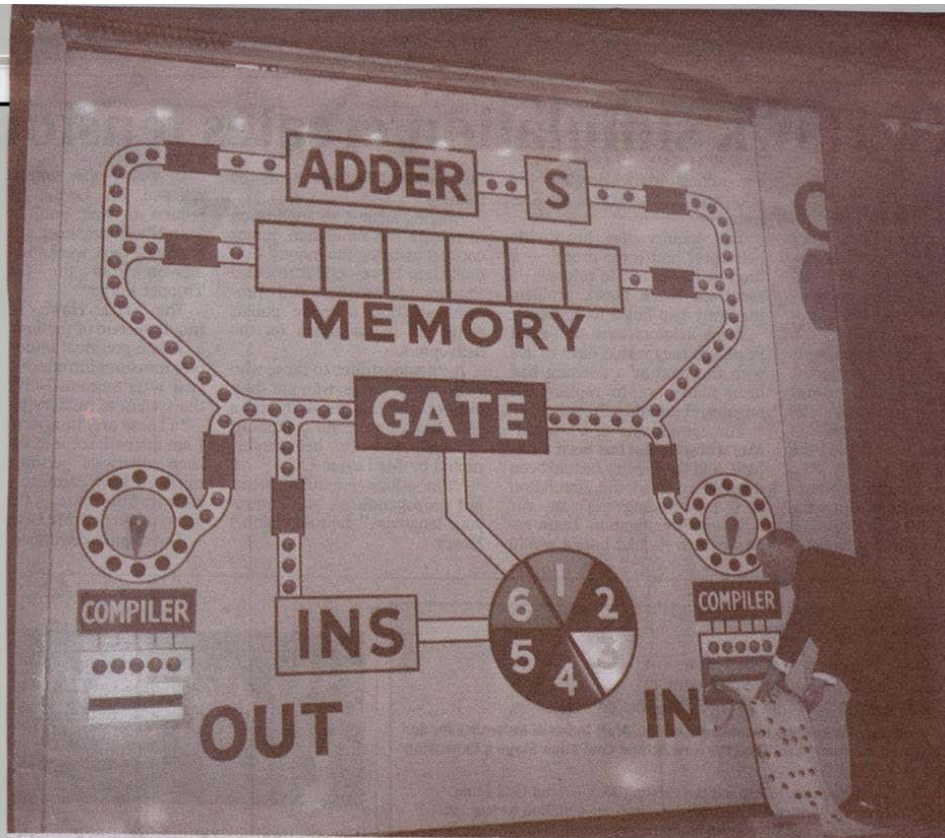
**Significance
and Pitfalls of
Databases**



**Trace
Evidence in
the New World**



The Future - Asymmetry of Time



“Computers in the future may weigh no more than 1.5 tons.”

Popular Mechanics, 1949

Science has not yet mastered prophecy. We predict too much for the next year and yet far too little for the next 10.

Neil A. Armstrong (1930-2012)

Democratic Society

- High expectations from forensic science
- Requires a process that is:
 - Impartial
 - Objective
- Requires results that are:
 - Relevant
 - Accurate
 - With known uncertainties
 - Expressed adequately and in an unambiguous manner



<http://blog.dimmi.com.au/>



Symptomatic Examples



Forensic Science in a State of Confusion?

Information sharing
is essential

Scientists should not
consider activity level

Too much fragmentation,
and too many silos

FS is assessed on turn around time
and compliance with ever-
complicated QA systems

Strong focus on
court proceedings



Integrated lab model

Pathology lab model

Only a small proportion of traces
go through the lab and end up in court

FS is assessed on impact on the
broader justice and security system

Scientists must be segregated
from police structures

Scientists are the best people
to develop hypotheses and reconstruct
events

Information sharing
must be tightly controlled



Financial Realities



&



<http://www.qls.com/Portals/20846/images/qls-price-increase.gif>

http://highdollar designer.com/wp-content/uploads/2010/02/Shrinking_Budget.jpg



End of the (Forensic Science) World?



<http://cdn.themetapicture.com/media/funny-calendar-end-of-the-world.jpg>



Trace Evidence Example

- Trace Evidence:
 - The surviving evidence of a former occurrence or action of some event or agent;
 - A very small amount of substance, often too small to be measured;
 - Needs to be detected, seen, and understood.

- As remnant of the crime:
 - Provide leads;
 - Eliminate suspects;
 - Reconstruct events and their sequence;
 - Establish charges;
 - Identify links in serial crime.



Trace Evidence Seminal to Forensic Science



R.A. Reiss



H. Gross: Magistrate

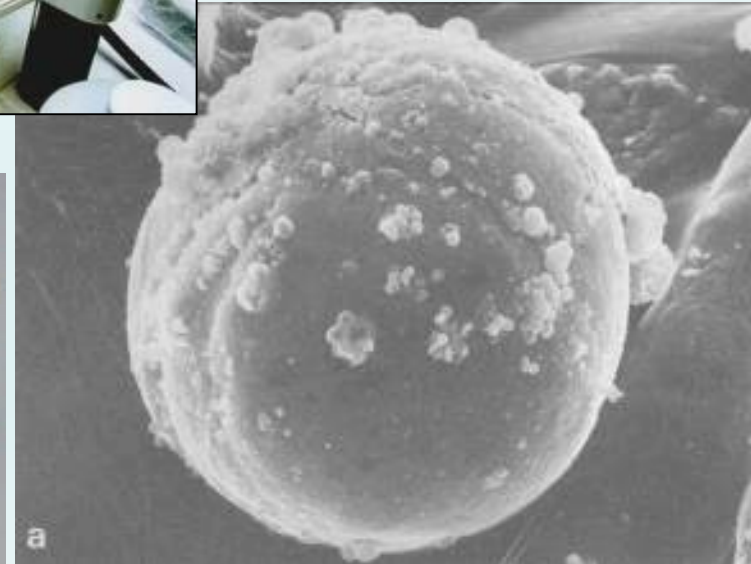
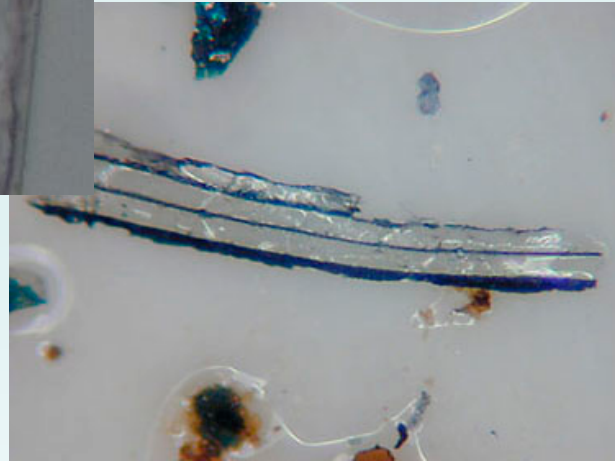
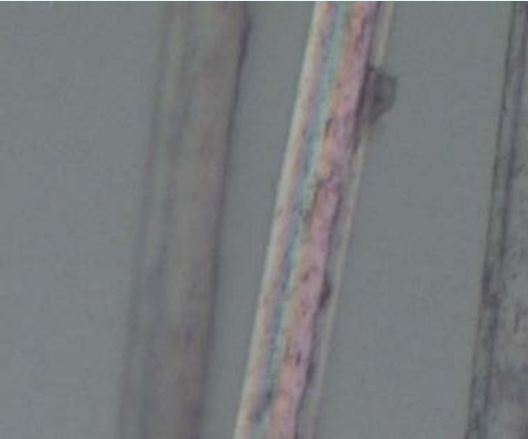
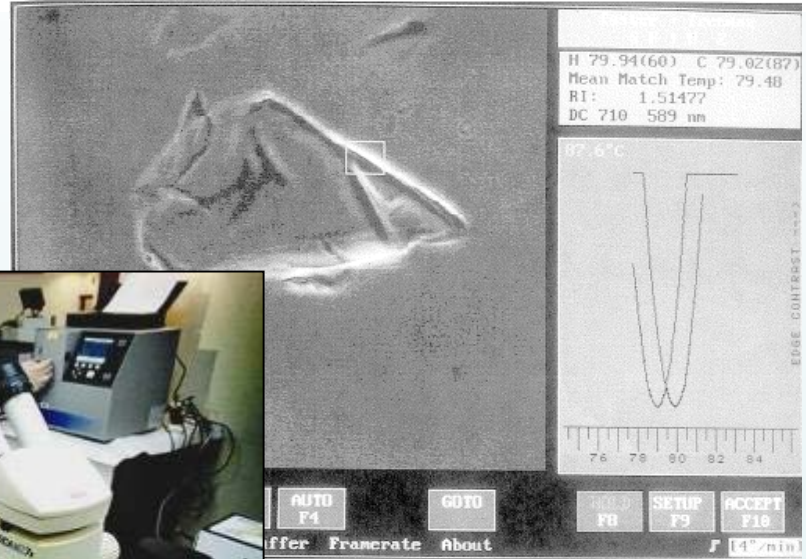
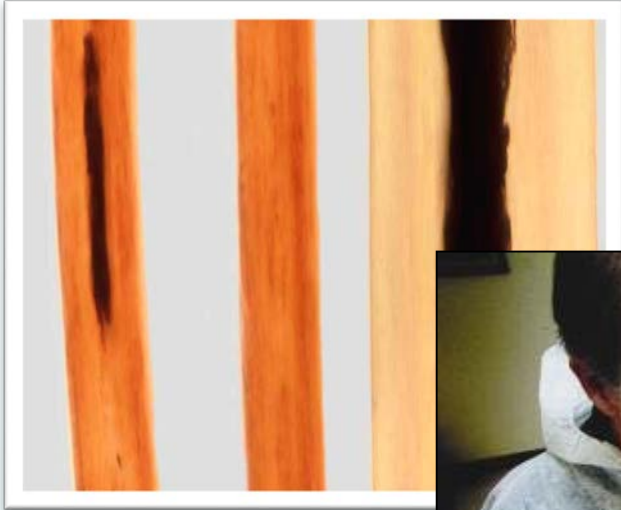


A. Bertillon: Police

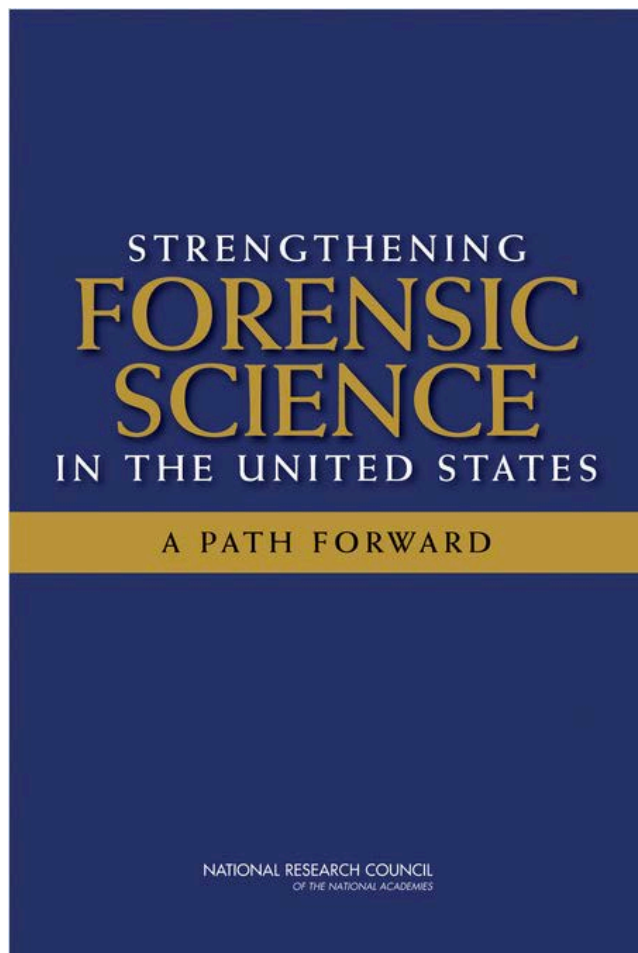


E. Locard: Court expert

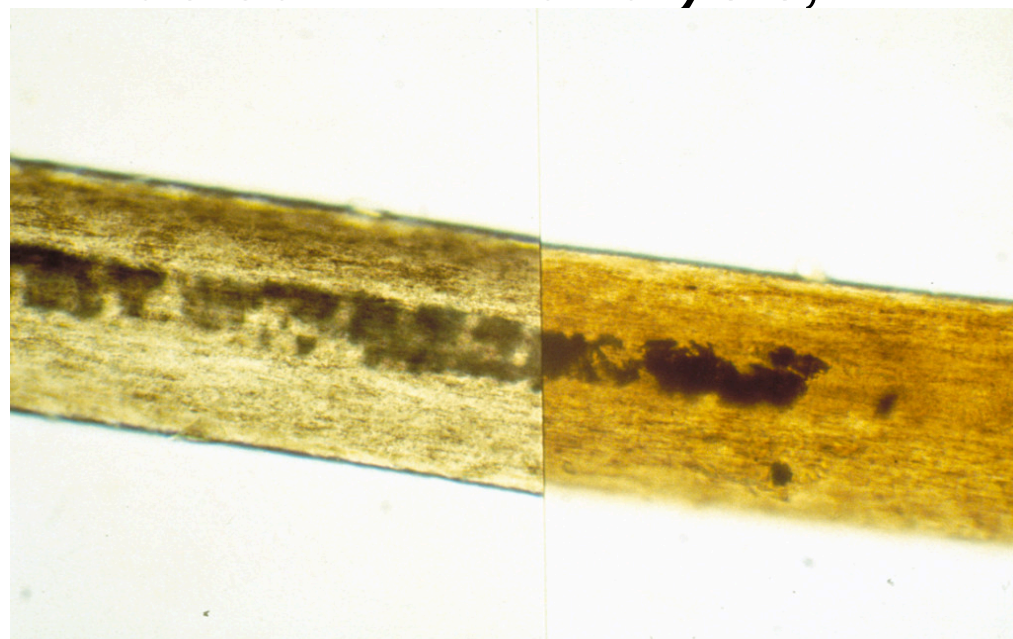
Typical Trace Evidence Materials



Trace Evidence & NAS Report



- *“With the exception of nuclear DNA analysis,*



specific individual or source”.

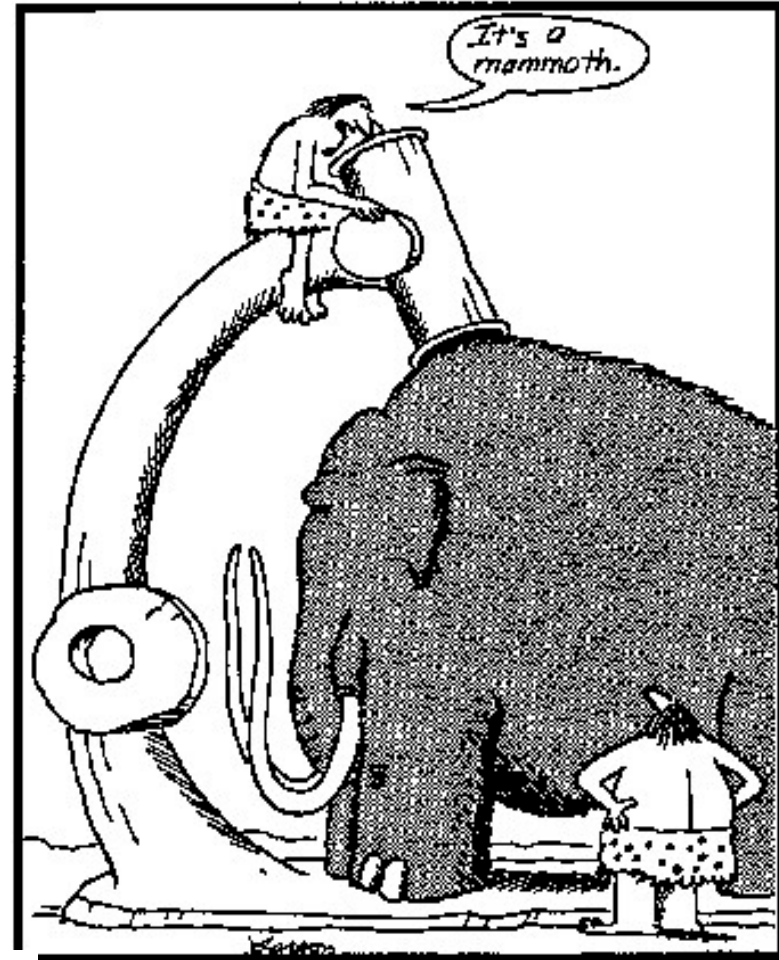


Trace Evidence under the NAS Radar?



Trace Evidence under the NAS Radar?

- Reveals two major stumbling blocks:
 - End users may be (too) focused on the identifying dimension of forensic science; and
 - Trace evidence is primarily perceived to be the endeavour of a high-tech laboratory that necessarily applies well-formalised, time-consuming and costly procedures.



Early microscope



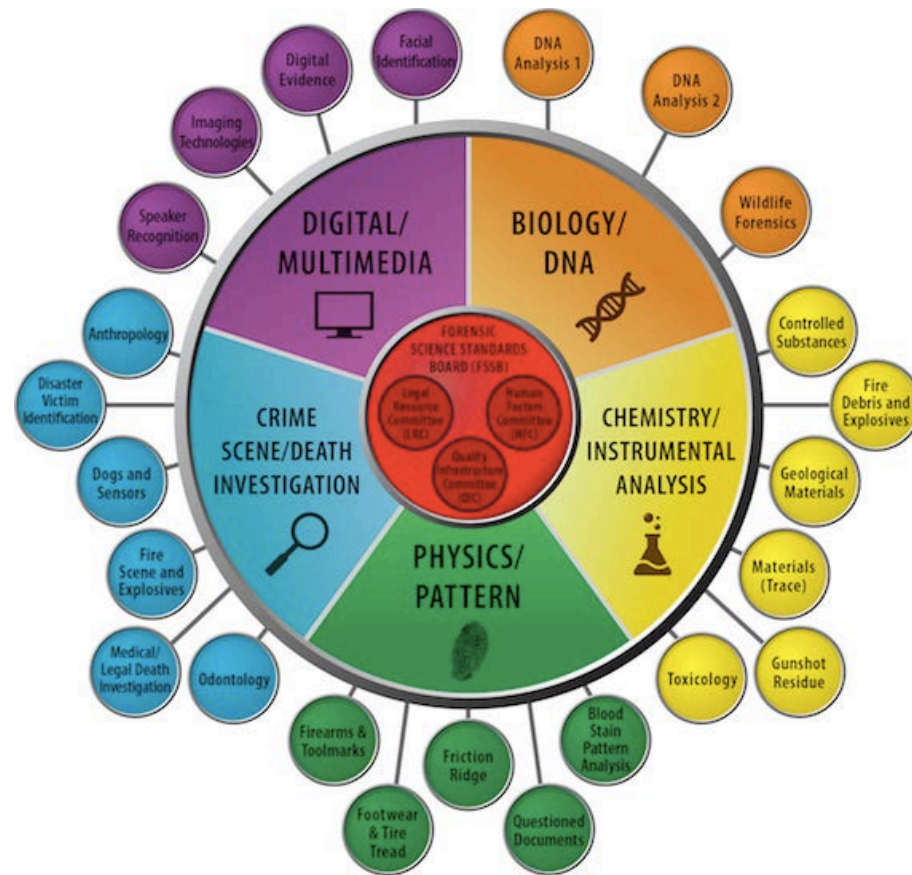
The Problems Started 40-50 Years Ago!

- Moved away from problem solving;
- Institutionalised fragmentation.



Working Groups

NITE-CRIME



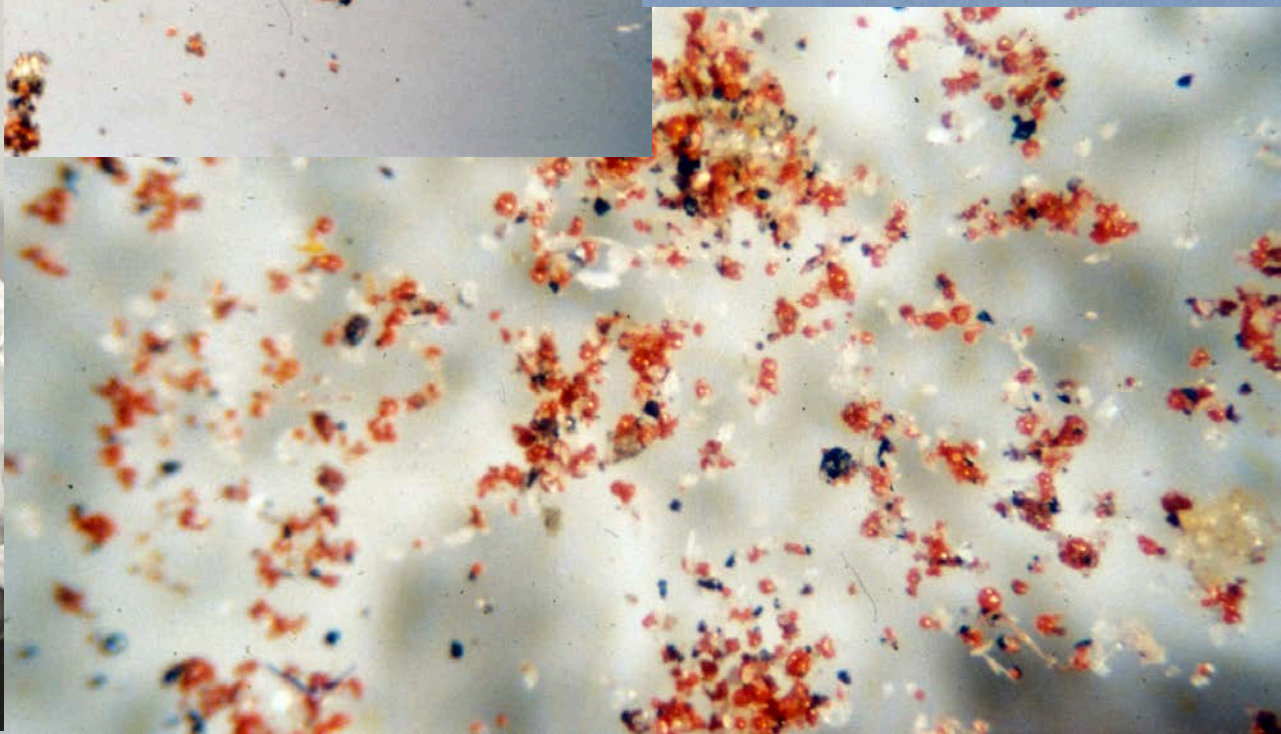


ROYAL COMMISSION

REPORT

concerning the conviction
of

EDWARD CHARLES SPLATT





And then...the DNA Revolution

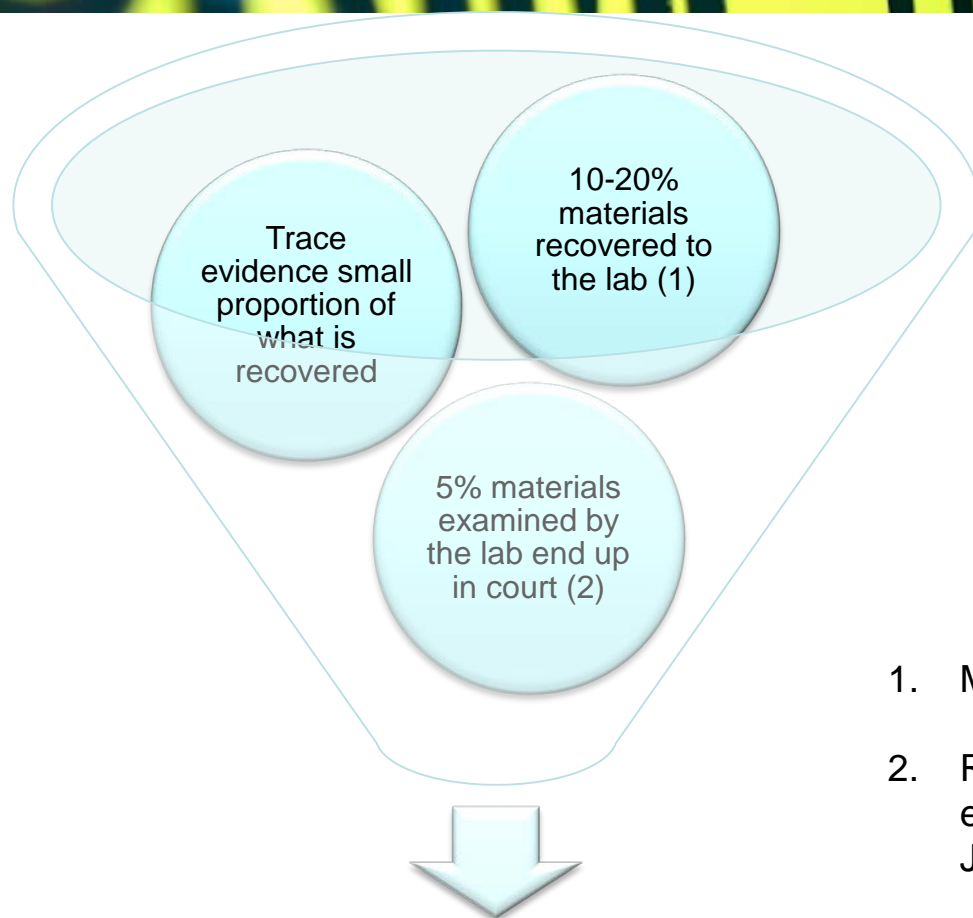


- Highly discriminating
- Increased resources for forensic science
- Powerful intelligence tool through national databases
- Raised overall standards in forensic science



- Resource sink away from other areas of forensic
- CSI Factor
- Many scientists turned into process workers
- Too slow, too costly
- Business drivers stifling innovation
- Heavy emphasis on identification

Apparent Cost-Benefit Issue



Viability of a full service trace evidence laboratory?

- Expensive to run;
- Challenging interpretation;
- Cost of training and R&D.

1. Milne R. Forensic intelligence: CRC Press; 2012.
2. Robertson J. Forensic science, an enabler or dis-enabler for criminal investigation? Australian Journal of Forensic Sciences. 2012; 44(1):83-91.



Low-Number-of-Service-Requests Paradigm

The evidence types that attract less demand and that are more time-consuming to examine tend to be culled first



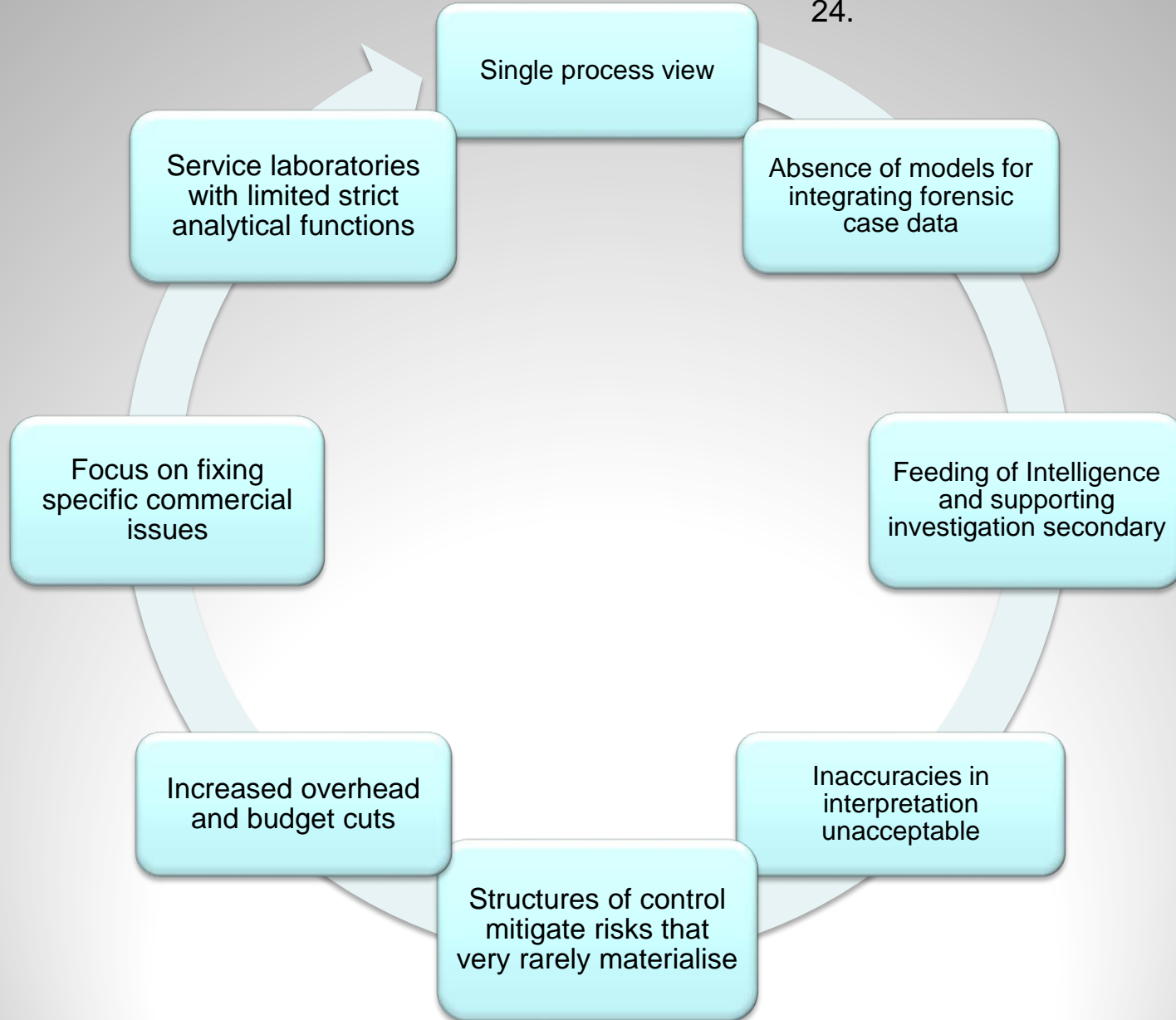
Home ▶ E-Edition ▶ Mapping

Virginia's crime labs cut back on services

- State chiefs of police decry elimination of some tests amid shrinking budgets

Spiraling out of Control?

Roux C., Crispino F., Ribaux O., From Forensics to Forensic Science, Current Issues in Criminal Justice, 24 (1), 2012, 7-24.



Revisit and better understand the Roots of Forensic Science

Frc
Currel
Claud



Australian Journal of Forensic Sciences

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/tajf20>

Forensic intelligence: deregulation or return to the roots of forensic science?

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^c Centre for Forensic Science, University of Technology, Sydney, Australia

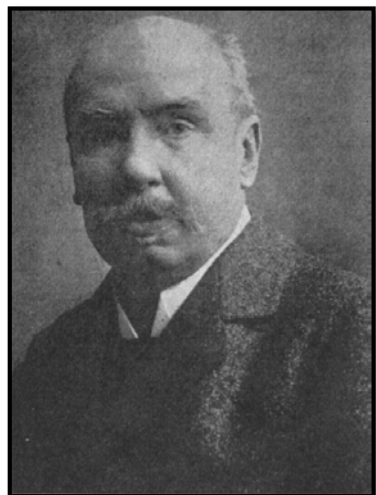
Published online: 06 May 2014.

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To link to this article: <http://dx.doi.org/10.1080/00450618.2014.906656>



Develop the 'Right' Culture...



Hans Gross



Rodolphe Archibald Reiss



August Vollmer



Paul Kirk

Education and research

Photos:

<http://www.s9.com/Biography/Gross-Hans>

<http://www.erbzine.com/mag20/2003.html>

Ecole des Sciences Criminelles, University of Lausanne

http://en.wikipedia.org/wiki/File:Mgm_Paul_L_Kirk.png



The trace can define our discipline...

- ***“Forensic science has an object: the study of crime and its traces. These are silent witnesses that need to be detected, seen, and understood to make reasonable inferences about criminal phenomena, investigation or demonstration for intelligence, investigation and court purposes. After all, traces are the most elementary information that result from crime.”***



Margot, P., Forensic science on trial - What is the law of the land?, Australian Journal of Forensic Sciences, 2011, 43:2-3, 89-103.

Revisiting Locard's Exchange Principle

- The truth is that none can act with the intensity induced by **criminal activities** without leaving multiple traces of his path. [...] The clues I want to speak of here are of two kinds: Sometimes the perpetrator leaves traces at a scene by their actions; sometimes, alternatively, he/she picked up on their clothes or their body traces of their location or presence.



<http://theinvestigation.yolasite.com/innovators.php>

E. Locard, L'enquete criminelle et les methodes scientifiques, Flammarion, Paris, 1920.

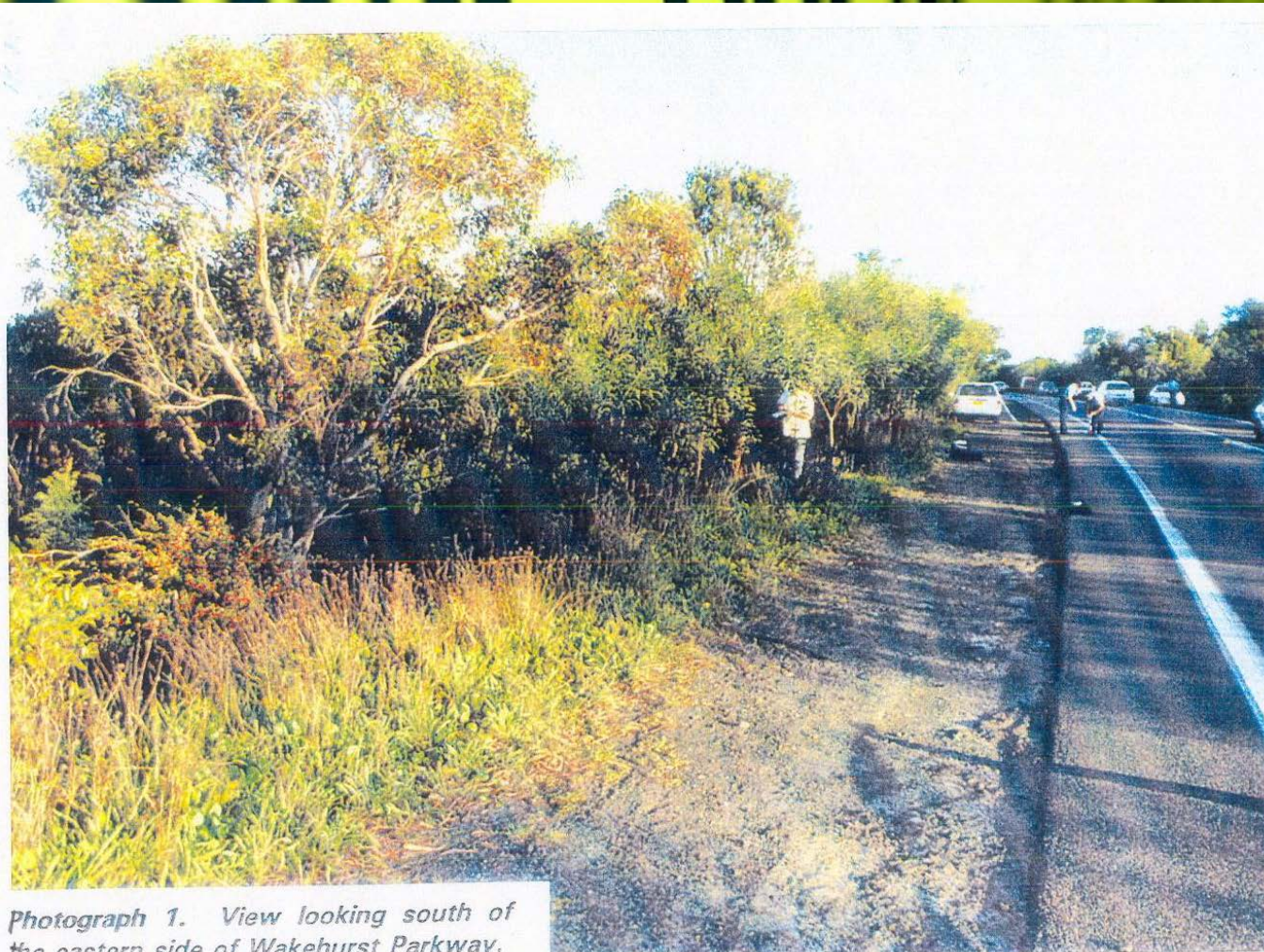


Critical Questions for Trace Evidence

- **How can we improve the knowledge base needed to better address activity questions through trace evidence?**
- **How can we address source questions without agonising on discrimination issues?**
- **How can we better direct investigations through trace evidence?**
- **How can we integrate trace evidence information with other forensic case data that may be physical or virtual?**
- **How can we optimize and rationalize trace evidence integration into intelligence and policing frameworks ?**
- **How can trace evidence more broadly contribute to society's effort in regards to security?**



Tizzone Murder, Sydney, 1995-2000



Photograph 1. View looking south of the eastern side of Wakehurst Parkway.



Tizzone Murder, Sydney, 1995-2000

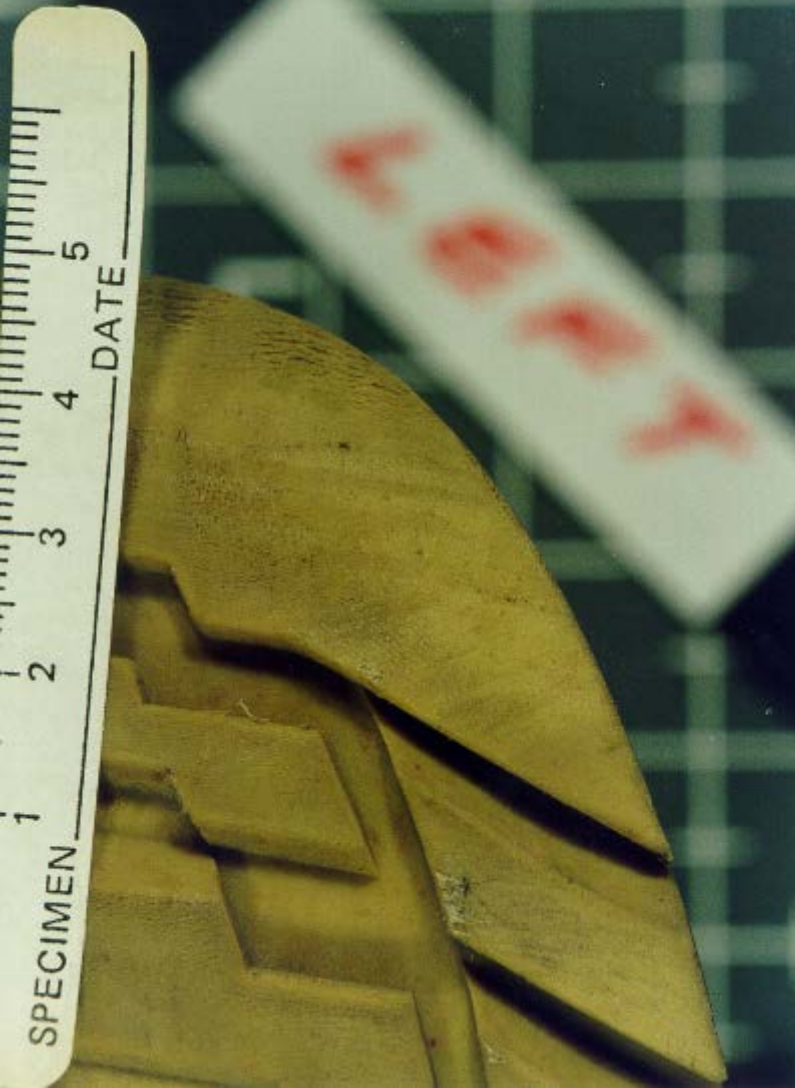
Right Shoe - Close Ups



4 grey polypropylene fibres
7 blue polypropylene fibres
24 black polyester fibres



Left Shoe - Close Ups

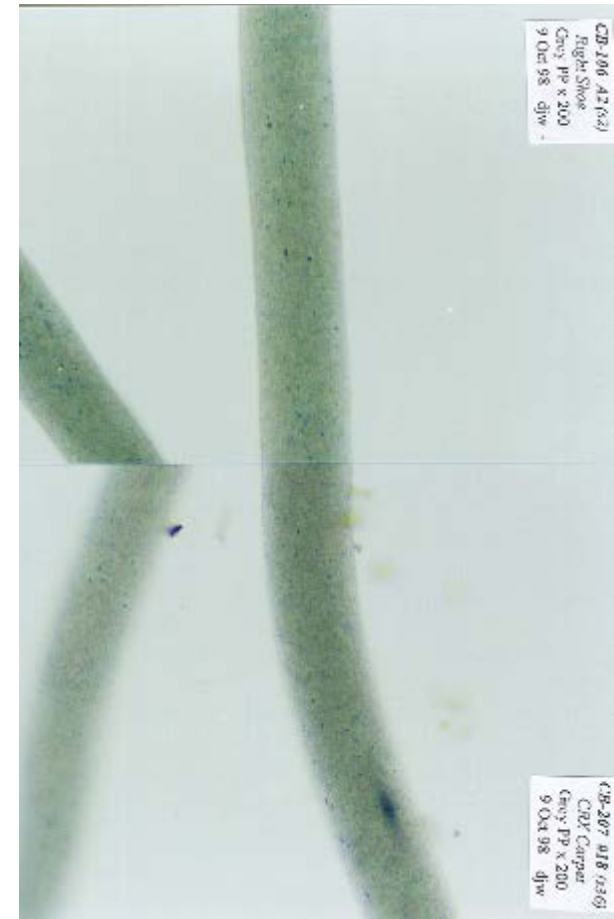
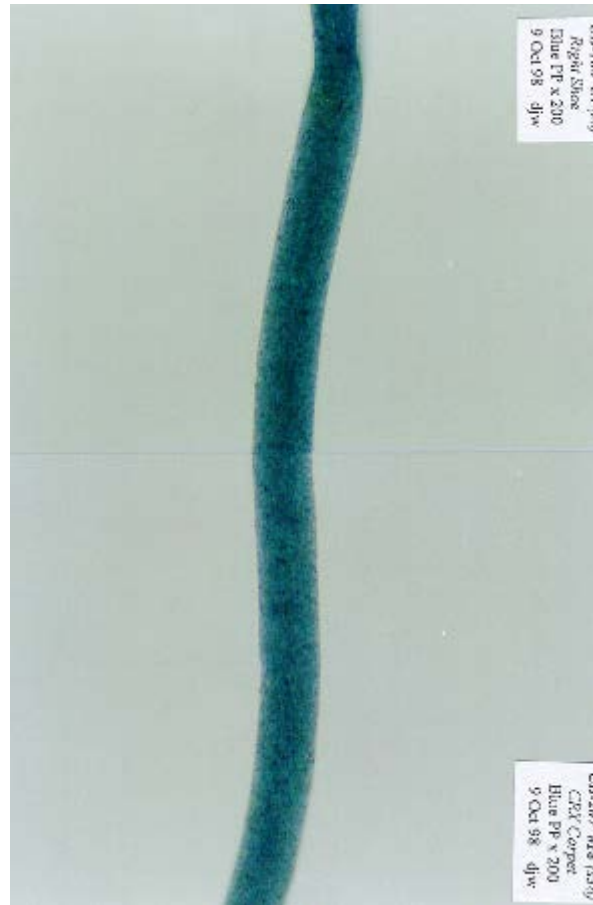


5 grey polypropylene fibres
5 blue polypropylene fibres
26 black polyester fibres





Microphotographs





Fibres are not unique, are they?

- This particular carpet was made exclusively for the 1991 Honda CRX
 - Fibre samples were obtained from 175 cars (29 Hondas)
 - Only 15% of samples contained 3 or more fibre types
 - 296 of such vehicles had been sold in Australia.
 - Only 5 vehicles were unaccounted for, one of which was this particular vehicle.
-
- **IDENTIFICATION WAS NOT AN ISSUE IN THE CONTEXT OF THIS CASE, BUT THE CRUCIAL ARGUMENTS WERE AROUND WHEN? WHERE? WHY?**

Bennett, S., Roux, C.P., Robertson, J. The significance of fibre transfer and persistence-A case study. *Australian Journal of Forensic Sciences*. 2010; 42(3):221-228.



Court Outcome

DAILY TELEGRAPH 21/07/00

20 years for murder

By ANTHONY PETERSON

Twice guilty killer sentenced

JOHN Serratore refuses to accept he murdered his childhood sweetheart despite two juries finding him to be a killer.

After Serratore was sentenced to a maximum 20 years' jail yesterday for the second time, his lawyer said Serratore maintained he did not kill Frances Tizzone and had already lodged an appeal against the conviction.

A jury found Serratore guilty in November 1998 at the conclusion of his first trial, but he appealed after sentencing. A year later the Court of Criminal Appeal ordered a retrial

because of a legal error. In June this year a new jury again convicted Serratore but within weeks he had filed an appeal.

"We'd like to know who was involved. He'd like to know who it was, it could have been anyone," Serratore's lawyer Sam Macedone said outside the NSW Supreme Court.

While Serratore is claiming the verdict was "unsafe and unsatisfactory", the Tizzone family feels less than satisfied with the sentence, believing a life term would be appropriate.

Ms Tizzone, a 21-year-old uni-

versity student, had a turbulent and often violent relationship with Serratore before she was strangled. Her body was dumped near the Wakehurst Parkway at Frenchs Forest on March 29, 1995.

As their relationship soured, Serratore became jealous and obsessive but Ms Tizzone felt attracted to him and secretly renewed contact after breaking up with him.

On the day she disappeared, Serratore arranged to meet her and fibres found on her boot soles proved she had

been in his Honda CRX just before her death.

Justice David Kirby said the arrangements to meet and the efficient dispatching of Ms Tizzone "point to premeditation and planning".

"Although Mr Serratore's act was, on the one view, a crime of passion, it was smouldering, vindictive passion, which had more to do with revenge than love," Justice Kirby said.

"This was a brutal and awful crime. A young woman, of considerable promise, was lured into a trap and slain."

The court heard Serratore enlisted a friend to hurt Ms Tizzone in late 1994 which led to her taking out an apprehended violence order.

After the sentencing, Patricia Tizzone said she longed for Serratore to show contrition for killing her daughter.

Mr Macedone publicly voiced Serratore's feelings.

"He still maintains he is innocent. He has never changed from that position," Mr Macedone said.

Serratore was sentenced to a minimum 14 years' jail but after taking into account time already served he will be eligible for parole on May 17, 2012.



Recapturing the Holistic View of Trace Evidence

“Fingerprints are wonderful. I would say (...) it is privileged evidence. But, beyond, one can find prints of a variety of species: tooth print, nails, traces from the entire body, hair, dusts. Dust analysis is an infinite, unlimited resource. One can exactly know what the man did”

Locard in a radio interview, 1955.



Recapturing the Holistic View of Trace Evidence



Criminals can't control all the 'traceogenic' aspects of human action



A less specialised treatment of more than one type of trace is preferable to the specialised in-depth treatment of one type of trace only

Effective from scientific and cost viewpoints



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Contents lists available at ScienceDirect

Forensic Science International

journal homepage: www.elsevier.com/locate/forensiint



Original Research Paper

Utilization of environmentally acquired very small particles as a means of association



David A. Stoney^{a,*}, Andrew M. Bowen¹, Paul L. Stoney

Stoney Forensic, Inc., 14101-G Willard Road, Chantilly, VA 20151-2934, USA



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Contents lists available at ScienceDirect

Forensic Science International

journal homepage: www.elsevier.com/locate/forensiint



Exploitation of very small particles to enhance the probative value of carpet fibers



David A. Stoney^{a,*}, Cedric Neumann^{b,c}, Kim E. Mooney^d, J. Matney Wyatt^d, Paul L. Stoney^a

^a Stoney Forensic, Inc., 14101-G Willard Road, Chantilly, VA 20151-2934, USA

^b Two N's Forensics, Inc., Brookings, SD 57006-4649, USA

^c South Dakota State University, Department of Mathematics and Statistics, Brookings, SD 57007, USA

^d Defense Forensic Science Center, Chemistry and Firearms Branch, 4930 N 31st Street, Forest Park, GA 30297-5205, USA



Jama Case – Victoria, 2006-10

REPORT

INQUIRY INTO THE CIRCUMSTANCES THAT LED TO THE
CONVICTION OF
MR FARAH ABDULKADIR JAMA

<https://assets.justice.vic.gov.au/justice/resources/4cd228fd-f61d-4449-b655-ad98323c4ccc/vincentreportfinal6may2010.pdf>

THE HONOURABLE F H R VINCENT, AO QC

Ordered to be printed

VICTORIAN GOVERNMENT
PRINTER
May 2010





DNA 'Match' – What about Other Traces?

November 06

**DNA profile identified to
Farah Jama, 19 y.o.**

**No traces of Jama at or
around the nightclub:**

- **Video-surveillance**
- **Fingerprints**
- **Phone records**
- **Parking – speed cameras**
- **Witnesses**

Alibi – 3 testimonies



Farah Jama, aged 19



House of Commons

Science
Comm

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Volume

Volume I:
minutes, c

Additional
Volume II
at www.p

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D. Richardson, LGC, on P. 13

...we might previously have been sent a jacket and been



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Recapturing the Crime Scene as a Scientific Endeavour



- Trace evidence starts at the crime scene;
- Mechanical process and administrative objectivity vs. true scientific endeavour;
- Integrating crime scene management within scientific scrutiny as a way to move forward.

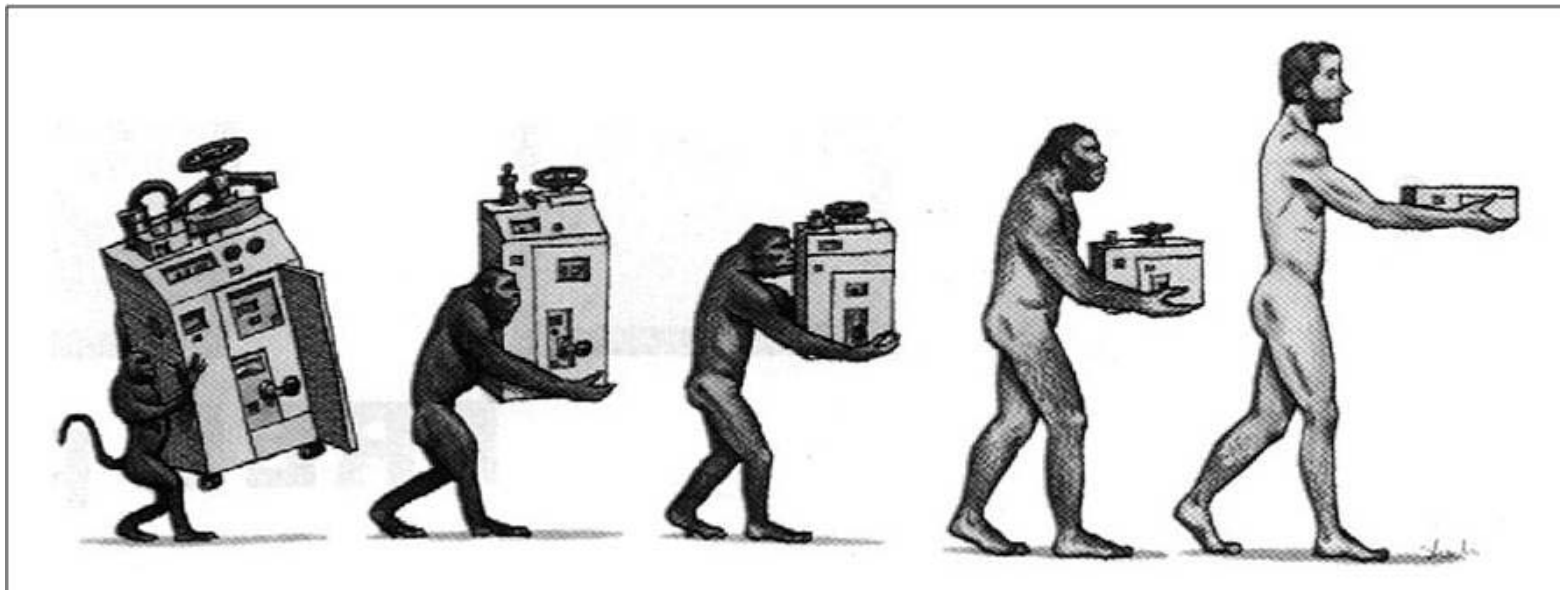


The Forensic Scientist's Retreat

“We appear to have relegated the framing of questions to non-scientifically educated detectives leaving criminalists with technician functions and fancy hardware, operating in a reactive mode, doing only what is asked of them. This has certainly been the trend. When we take a good look at this model, to which we seem to have grown accustomed, does it make any sense? If the laboratory is set up on the clinical model and crime scenes are handled exclusively by non-scientists, there is no problem-solving scientist on the "front end”.

De Forest P. Recapturing the essence of criminalistics. *Science & Justice*. 1999;39(3):196-208.

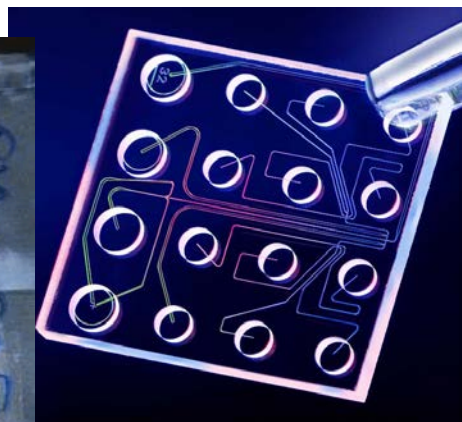
Bringing the Laboratory to the Scene



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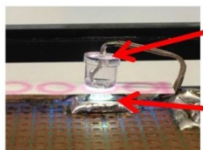
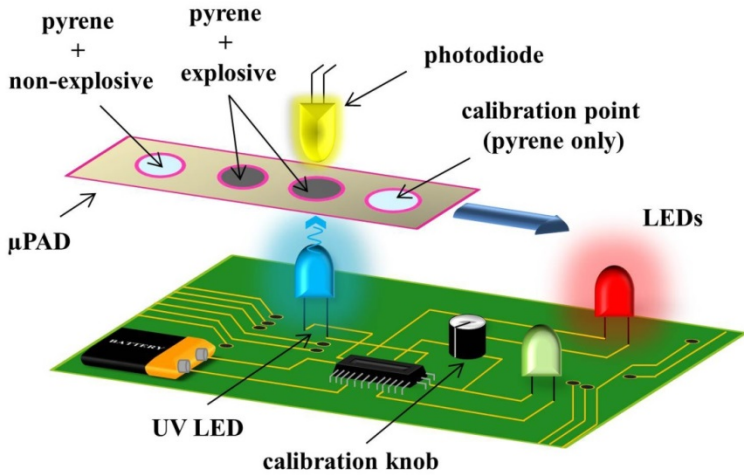
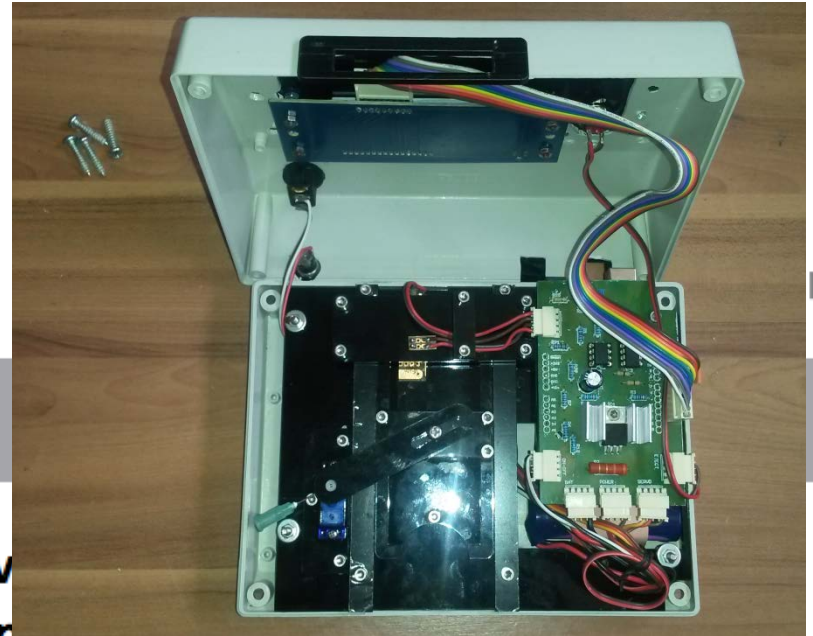


<http://global.fncstatic.com/static/managed/img/fn-latino/news/TruNarc%20new.jpg>



Agilent Technologies

Lab-on-a-Chip



photodiode

UV LED

LEDs

● = Explosive

● = Non-explosive

osiv

pyrene deposited on coloured wax

Alison Be
Blanes*^a

son-Wild

UX,^a

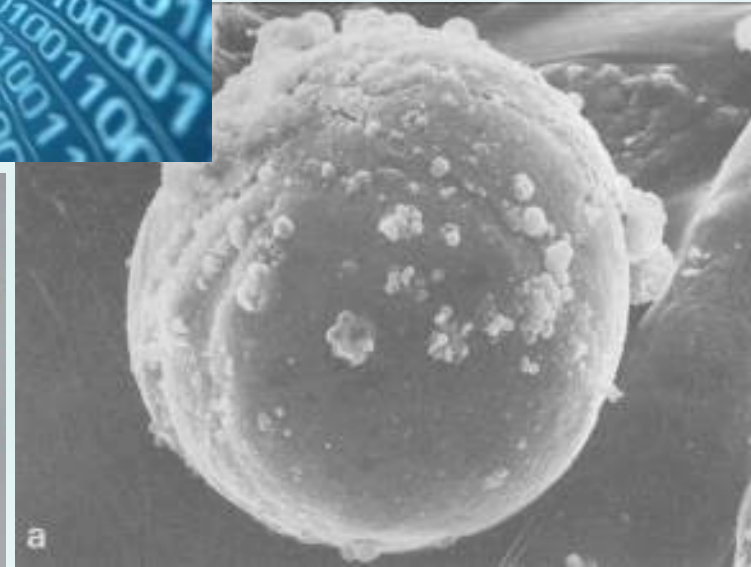
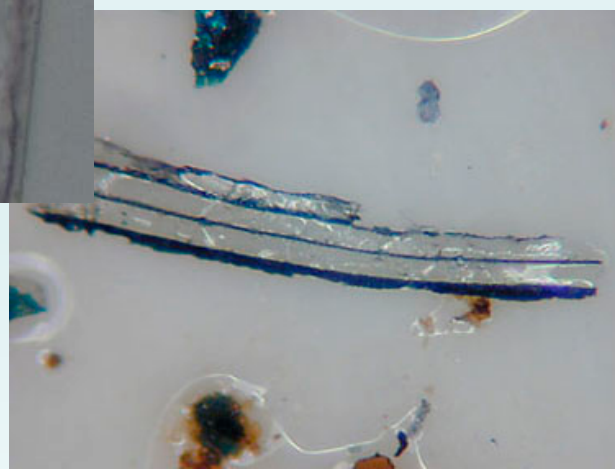
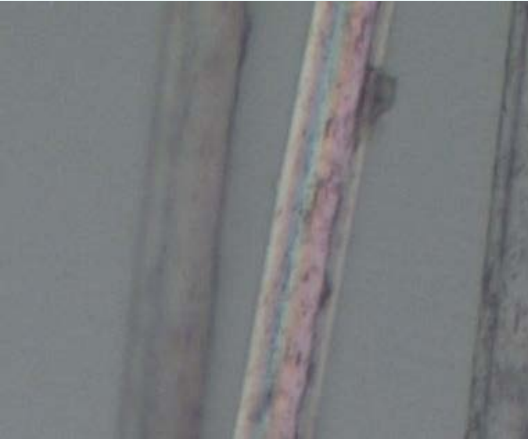
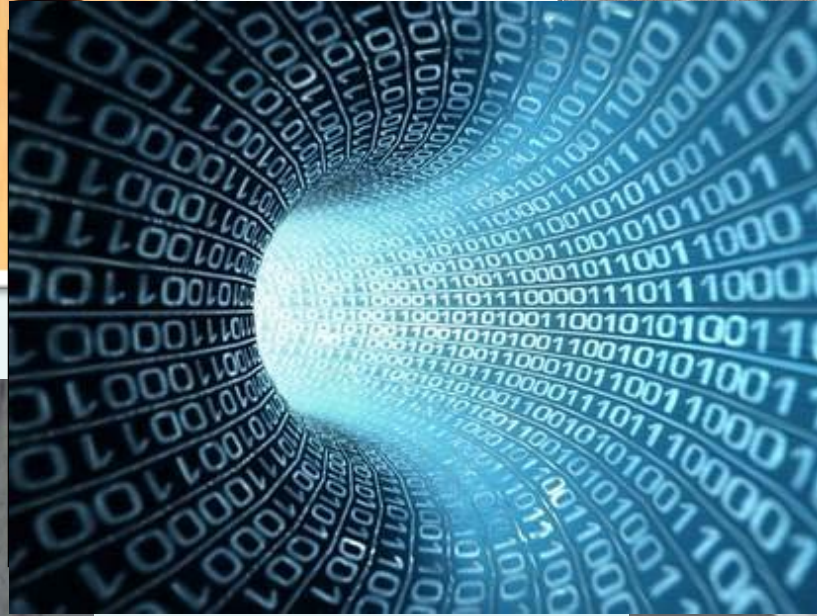
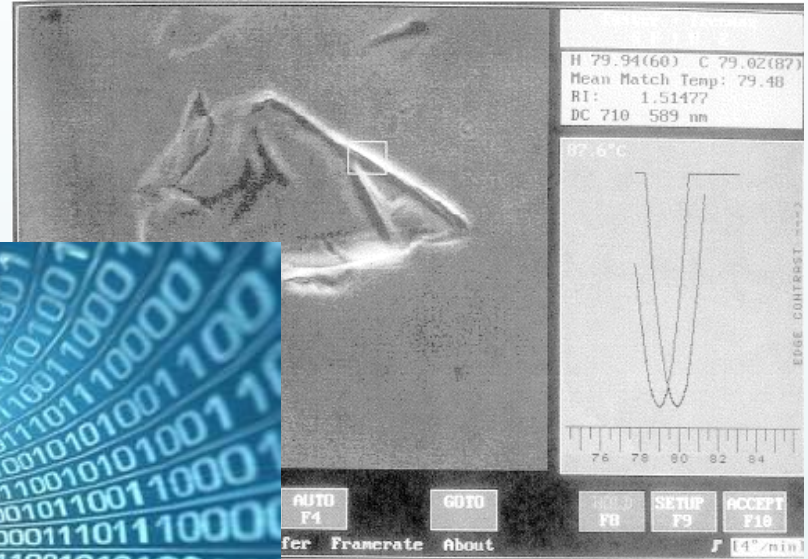


Drones



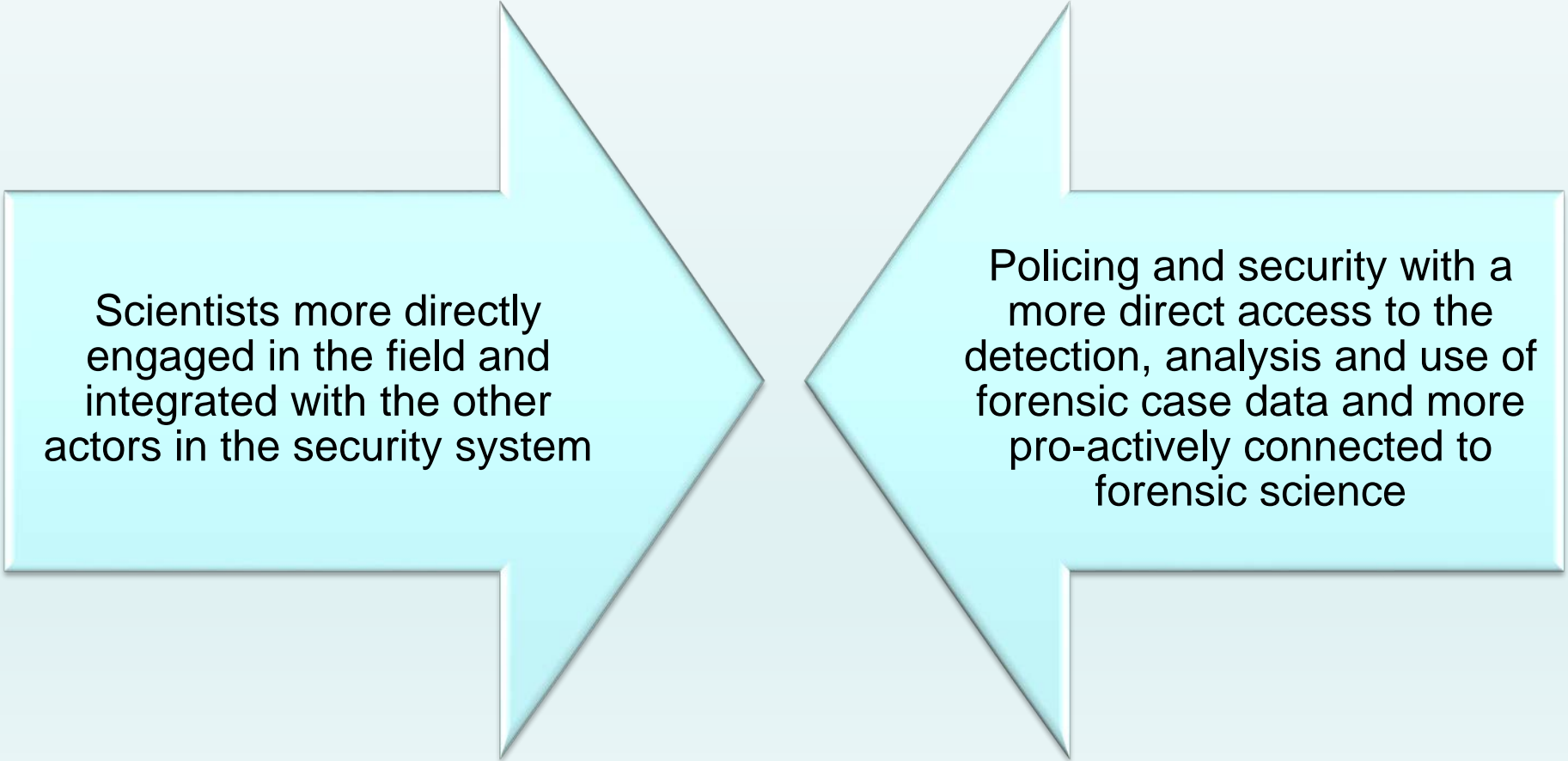
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<http://www.libertynews.com/wp-content/uploads/2013/06/policedrone-3-300x199.jpg>
https://postmediacanadadotcom.files.wordpress.com/2014/12/bc_mill_shooting_20140430.jpg

Introducing Traces into the Digital Space



Blurring the Boundaries between the Scene and the Specialised Laboratory

Potential to reconnect forensic science with problems it is supposed to solve



Scientists more directly engaged in the field and integrated with the other actors in the security system

Policing and security with a more direct access to the detection, analysis and use of forensic case data and more pro-actively connected to forensic science



Critical Challenges with Technologies

Tested models for
integration into well-formed
policing and intelligence
strategies?

True impact or enhanced
capability and efficacy to
forensic science?

More research required
Not only technical aspects,
but also criminological,
legal, ethical and more
broadly sociological and
philosophical dimensions.

What is the purpose?
What does it mean?
What do we do with the data then?



A New Approach is Required

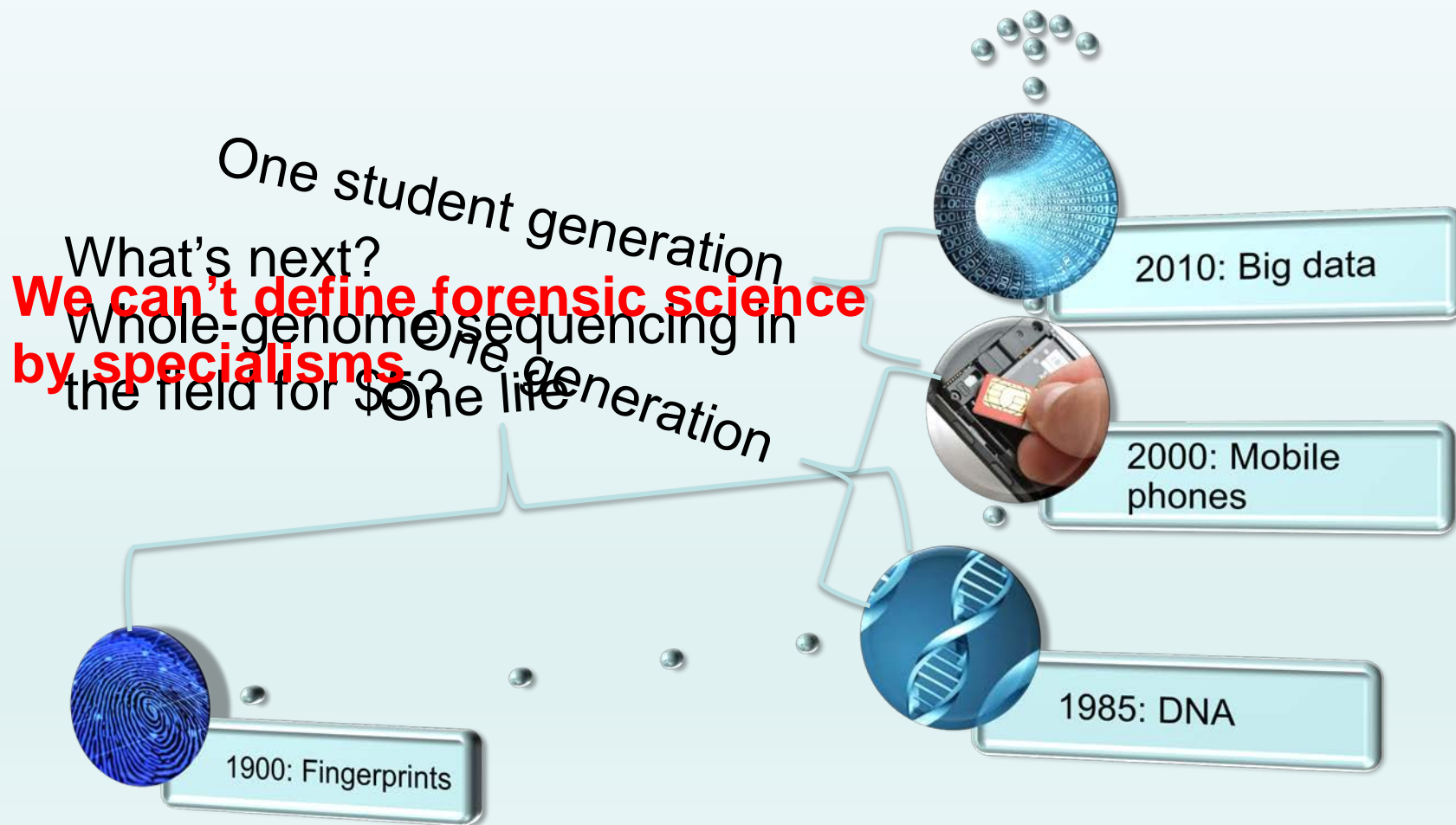
“The route towards effective use of new technologies is contrasted with how forensic science laboratories are currently choosing and employing them. The conclusion is that although new technologies are contributing, we are not on a path that will result in their most effective and appropriate use. A new approach is required.”



Stoney D.A. & Stoney P.L. Critical review of forensic trace evidence analysis and the need for a new approach, Forensic Science International, 2015, 251, 159-170.



Exponential Changes in Technologies





Contents lists available at SciVerse ScienceDirect

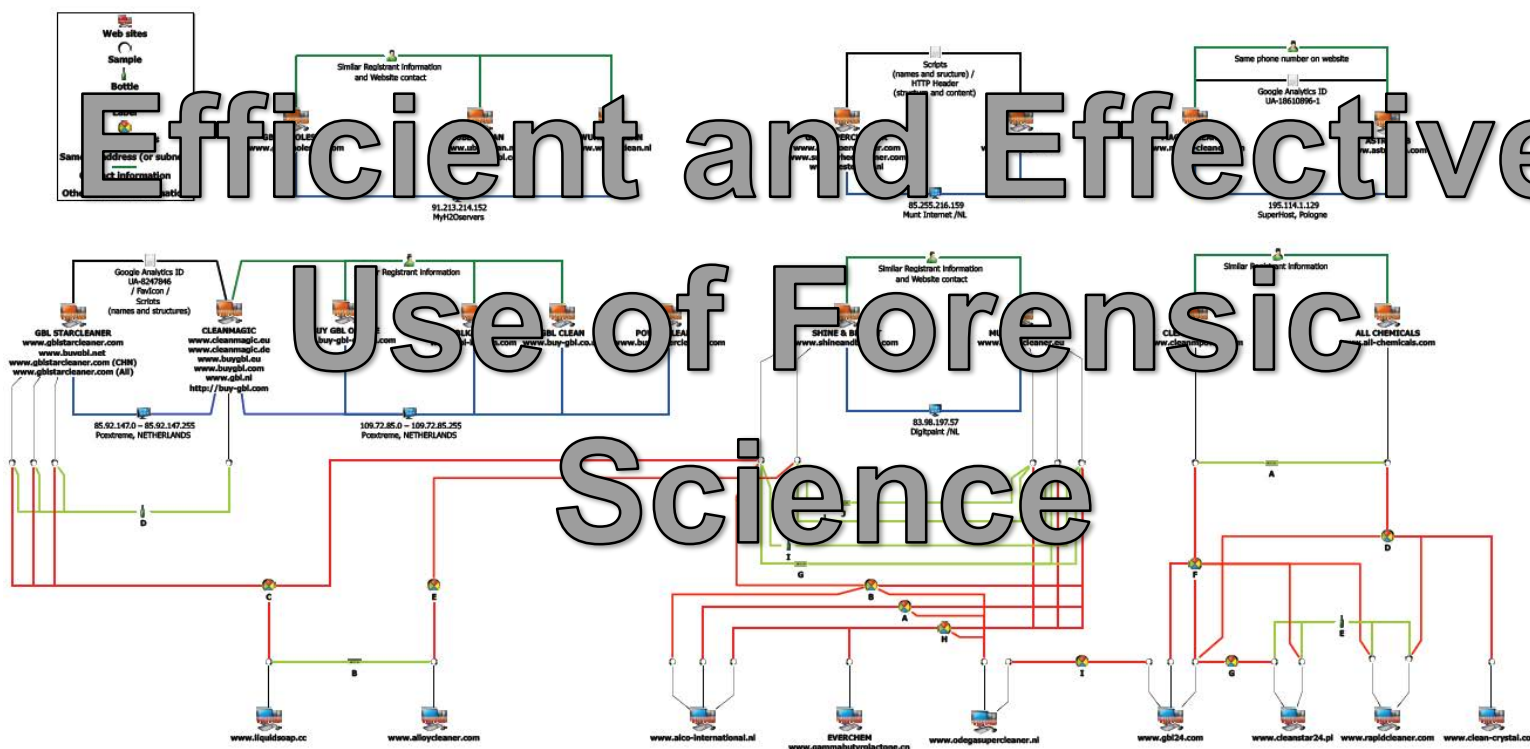
Forensic Science International

journal homepage: www.elsevier.com/locate/forsciint

Combining Internet monitoring processes, packaging and isotopic analyses to determine the market structure: Example of Gamma Butyrolactone[☆]

Diego Pazos^{*}, Pauline Giannasi, Quentin Rossy, Pierre Esseiva

Institut de Police Scientifique, Ecole des Sciences Criminelles, Université de Lausanne, 1015 Lausanne-Dorigny, Switzerland





Removing Silos

Forensic Science International 236 (2014) 181–190



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Contents lists available at [ScienceDirect](#)

Forensic Science International

journal homepage: www.elsevier.com/locate/forsciint



Forensic intelligence framework—Part I: Induction of a transversal model by comparing illicit drugs and false identity documents monitoring



Marie Morelato^a, Simon Baechler^{b,c,*}, Olivier Ribaux^b, Alison Beavis^a,
Mark Tahtouh^d, Paul Kirkbride^e, Claude Roux^a, Pierre Margot^b

^a Centre for Forensic Science, University of Technology, Broadway, Sydney, NSW, Australia

^b Ecole des Sciences Criminelles, Université de Lausanne, 1015 Lausanne, Switzerland

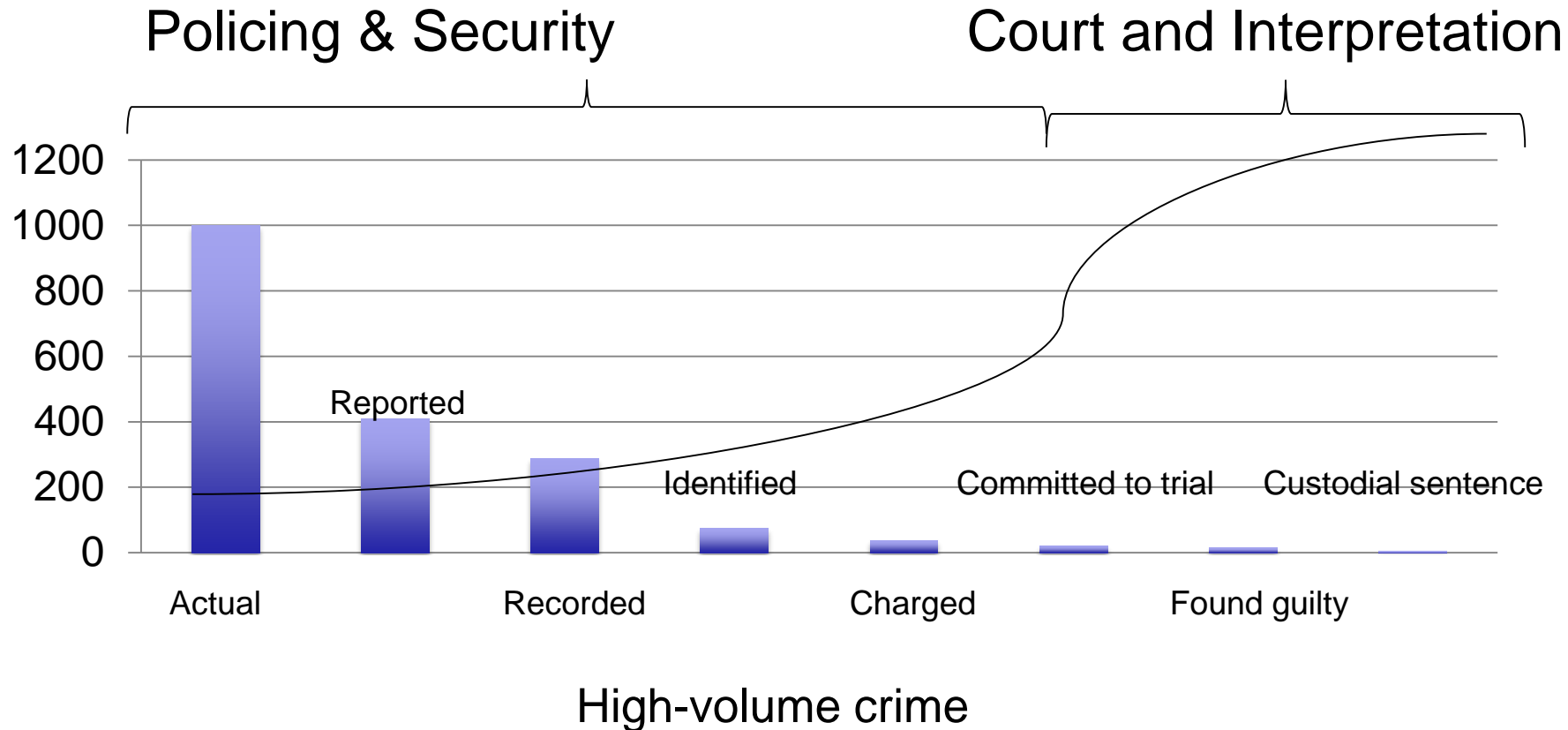
^c Service forensique, Police Neuchâteloise, Rue des poudrières 14, 2006 Neuchâtel, Switzerland

^d Forensics, Australian Federal Police, Sydney, NSW, Australia

^e School of Chemistry and Physics, Flinders University, Bedford Park, South Australia, Australia



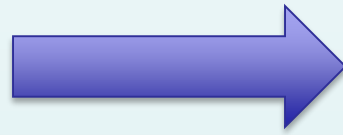
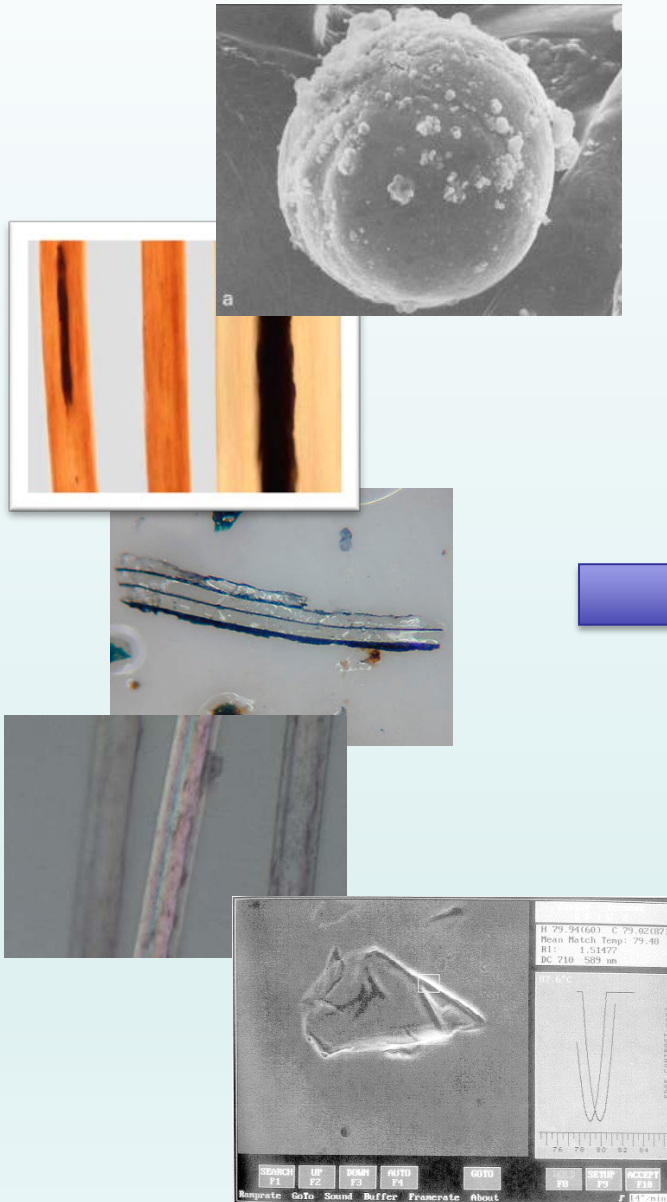
Effectiveness Interrogations



J. Ratcliffe, "Intelligence-Led Policing", Willan, Collumpton, UK, 2008

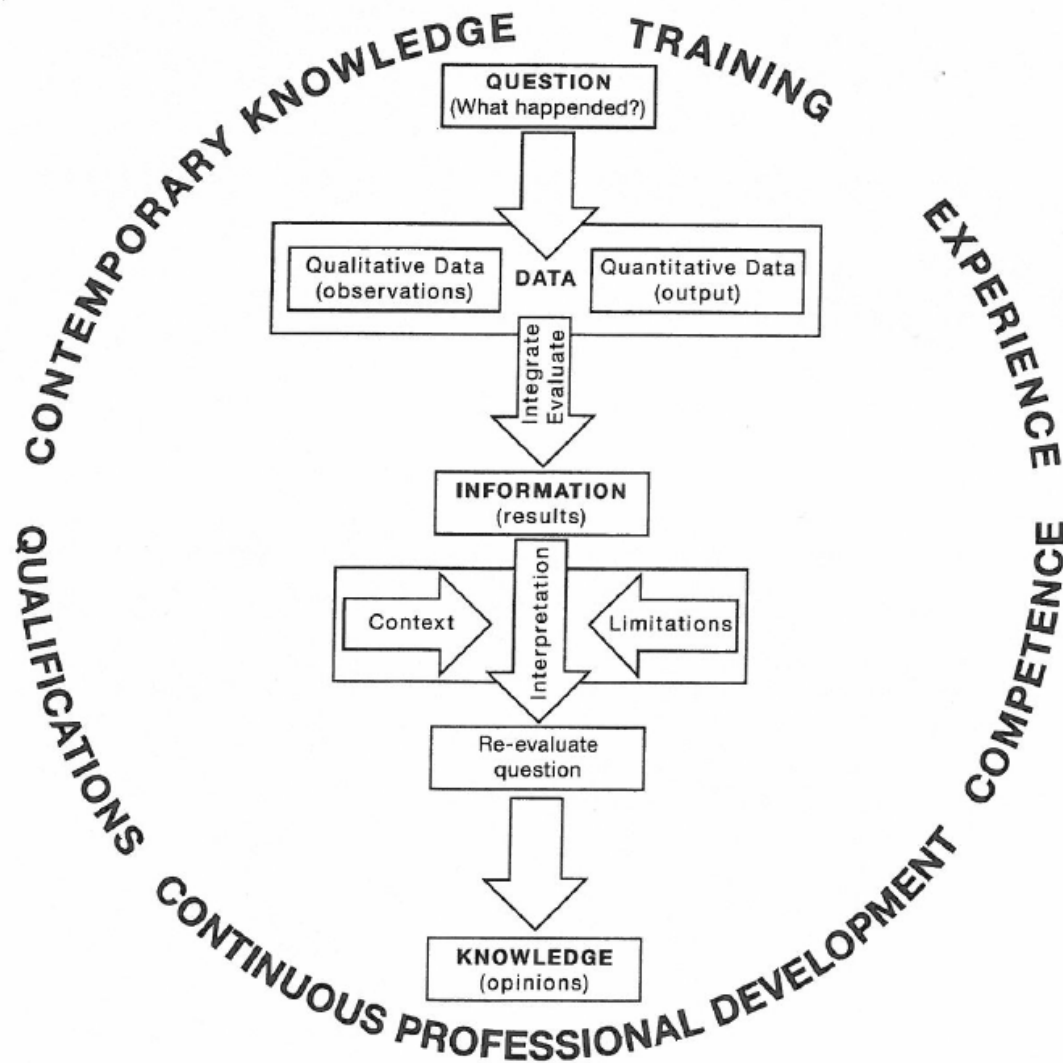
Graph developed by O. Ribaux in Collaboration with F. Crispino and C. Roux
for Aus Academy Forens Sci Conference on Interpretation, Dec 2011

Broadening the Applications of Trace Evidence





Why Databases?

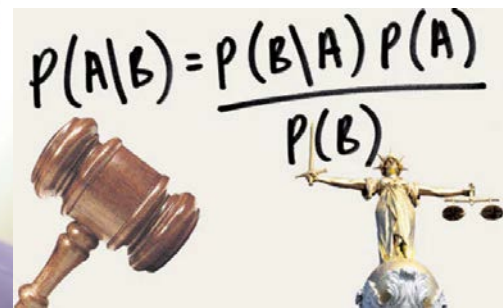


- Australian Standard 5388.3:
 - Translation of qualitative and quantitative data into results
 - Assist in the interpretation of the result in context

Use of Databases = More Reliable FS?

- Issues to consider:
 - Forensic relevance
 - Scope
 - Representativeness
 - Currency
 - Fit for intended purposes
 - Integration of result with other information

**Not asking the right questions
gives a sense of wrong reliability**



$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

Data must be used within appropriate intellectual and logical frameworks

Trace Evidence in the New World?

Frontline detection

- Fast
- Fit for purpose (as opposed to completeness)
- Contextualised and integrated with other forensic case data
- Feeds intelligence and investigation processes in routine
- Collaborative problem solving



Specialised treatment

- More comprehensive
- More fragmented and specialised
- Results assessed considering hypotheses proposed by others
- Fulfills court requirements
- Centre of specialisation or outsourcing

Trace Evidence in the New World?

Strategic, measured use of particle analysis in a way that responds directly to investigative issues, contributing to the investigation at every stage and taking advantage of information from many different types of particles

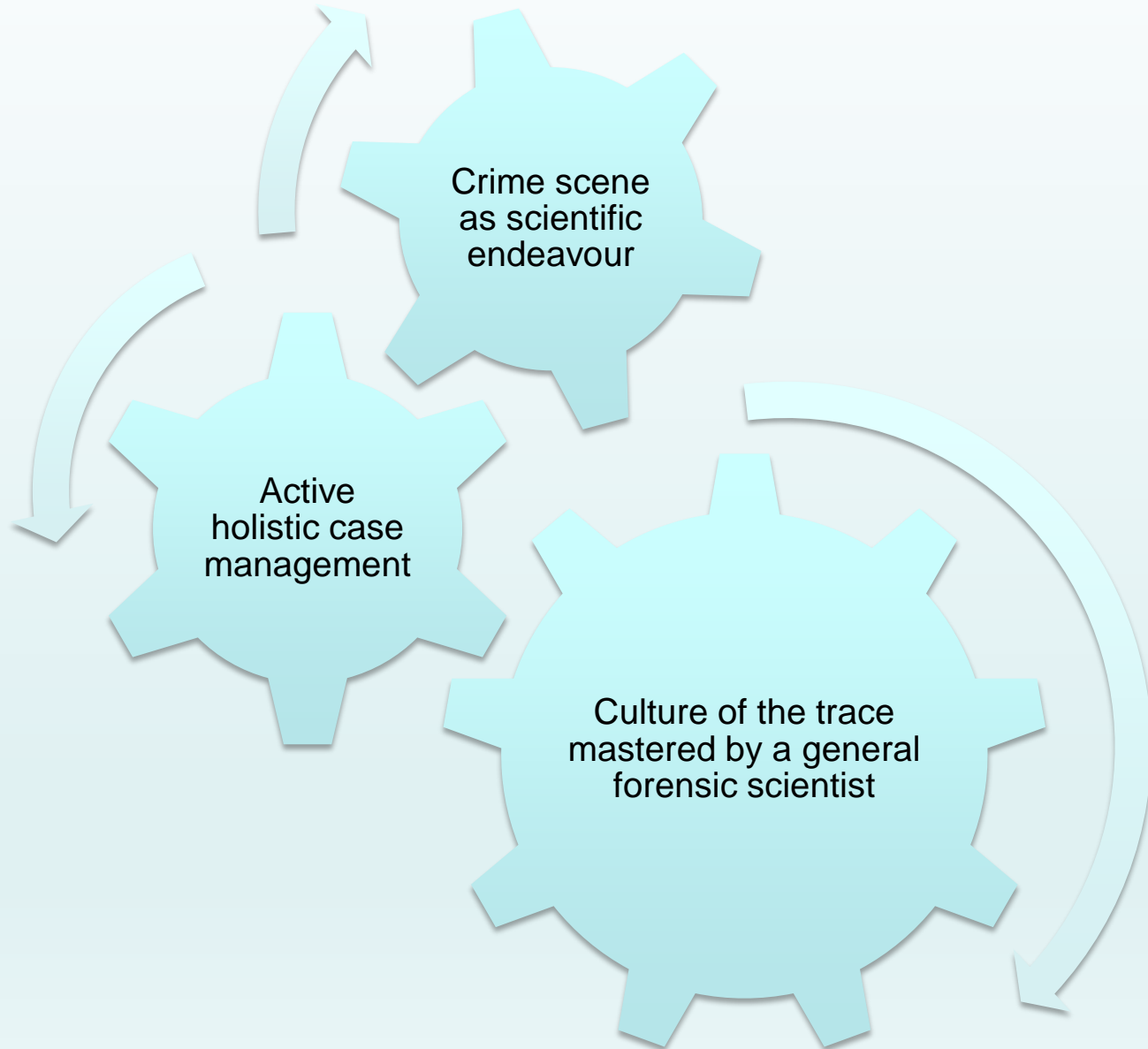
- Stoney D.A & Stoney P.L. Illustration and analysis of a coordinated approach to an effective forensic trace evidence capability, *Forensic Science International*, 2015, 253, 14-27



Coordinated forensic particle analysis

- Dynamic forensic analytical approach
- Concise and efficient protocols addressing particle combinations
- Multidisciplinary capabilities of analysis and interpretation
- Readily accessible external specialist resources
- Information integration and communication

Key for a Brighter Future





Conclusions

- Forensic science should not be centred around ‘specialisms’, but on advancing the expertise and knowledge of the trace – the remnant of presence and activity/action;
- Forensic science should not be centred on the current laboratory-centric conception of forensic science, but should recapture the crime scene as a scientific endeavour;



Conclusions

- Forensic science should be a significant contributor to crime investigation and the resolution of broader security problems;
- Forensic science should cover the study of its contribution along the whole chain of the judicial process, from the crime scene, to the presentation of forensic information in court;
- Research in forensic science needs an epistemological component for elaborating upon the foundations of an investigative logic exploiting information conveyed by traces;



Conclusions

- Research ON forensic science is equally important to research FOR forensic science;
- Forensic science should refocus on problem solving, which will provide a more central position to the discipline, as well as greater stability and sustainability;
- Data and databases are definitely part of the solution but they must be fit for the intended purpose and must be used within appropriate intellectual and logical frameworks.



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