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Background/Overview of the Scientific Tests & Techniques available in 1997/98

From OBI Scientific Report 1 - April 2026

Angela Gallop

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- Practising forensic scientist for 50 years
- Career split equally between prosecution and defence work
- Started in Forensic Science Service (FSS) as forensic biologist

THE FORENSIC SCIENCE SERVICE

- Then established:
  - consultancy advising defence

FORENSIC ACCESS

  - independent laboratory for police

forensicalliance LGC Forensics

  - company providing criminal justice services overseas for UK Government

AXIOM INTERNATIONAL

- Specialised in historic case re-investigations

Hand-picked team of Forensic Scientists

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Explosive devices
Chris Hester

Explosive substances
Keith Norman

Fingerprints
Kevin Kershaw

DNA
Philip Avenell

Textile fibres
Roger Robson

Marks and traces
Sarah Jacob

Questioned documents
Melanie Pugh

1. Introduction

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Provided with 2,000+ scanned documents from various sources, asked to:

- Provide an overview of forensic science and its role in criminal investigations
- And how it's changed since the late 1990s
- Explore technical subject areas in turn, answering specific questions about tests and techniques available in 1997/98, perceptions of their reliability, and how FSANI might have compared to other UK forensic laboratories
- Where these forensic laboratories were and what they did
- And quality standards, and forensic strategy setting

2a. Forensic science

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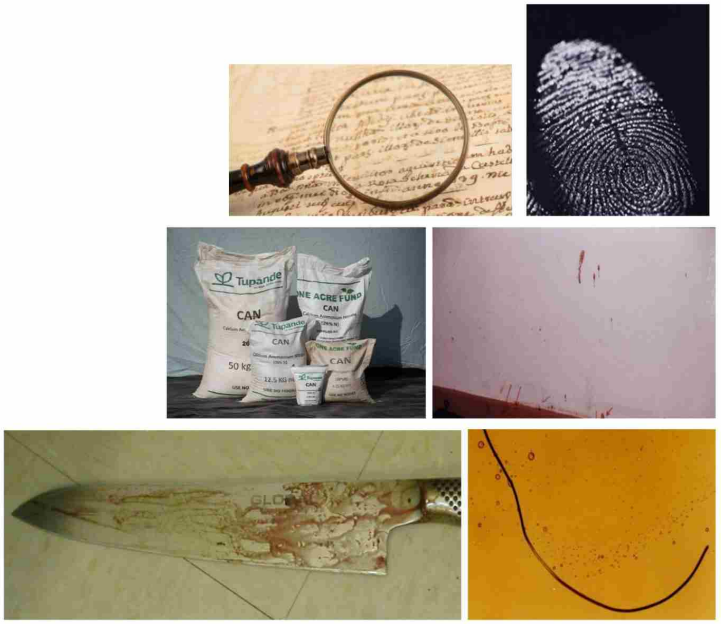
Very wide range of physical traces which can be used to:

- Confirm crime committed
- Understand sequence of events at crime scene
- Identify something which might lead to suspect
- Confirm or eliminate suspects
- Indicate who's telling the truth



2a. Common considerations

- How long physical traces last
- How large or small they are
- How common or rare they might be
- Any mixtures or patterns in them

And also

- How sure you can be about where traces came from (Continuity)
- Whether they might represent contamination (Integrity)

2a. Forensic strategy

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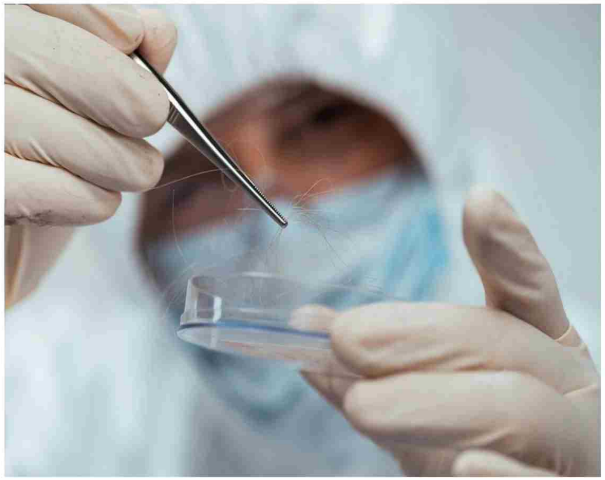
So

- Forensic science isn't just a series of tests, but also the evolving strategy binding them together, dictating:
  - Which items to examine
  - For what, and by whom
  - In what order
  - How to interpret and evaluate test results
  - In specific context of the case



2b. Forensic science in criminal investigations

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Pivotal role in SIO's evolving investigation strategy

At the crime scene:

- Interpreting crime scenes and helping collect evidence
- Visiting associated locations/scenes

And in the laboratory:

- Providing speedy, effective, independent steer on suspects
- Suggesting new lines of enquiry

And at court:

- Summarising evidence
- Providing impartial testimony

2c. Change in forensic science since late 1990s

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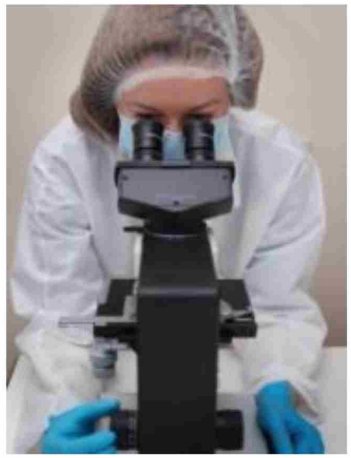
- Science and crime constantly evolving
- Science rate of change reflects funding, technical advances, and police needs
- Most change in 4 main areas:
  - Digital forensics
  - DNA
  - Chemical analysis
  - Evaluation and presentation of forensic evidence



Changes in digital forensics

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- Lifestyles increasingly dependent on digital devices
- Store huge amounts of information about owner's activities
- Combined with other devices e.g. CCTV, digital data increasingly important to law enforcement, and special tools developed to analyse it
- Some aspects of digital forensics covered by separate OBI expert

2c. Changes in DNA profiling

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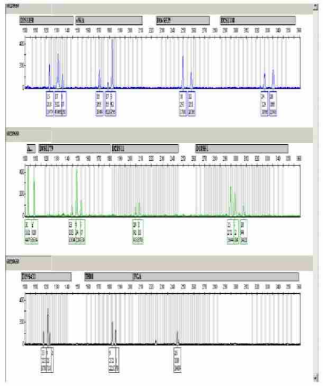
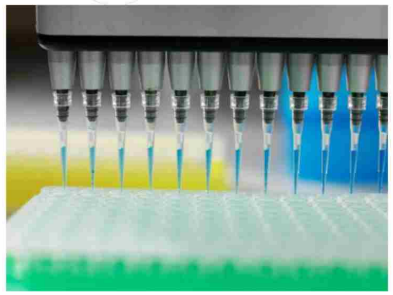
- Much less DNA required
  - visible stain → non-visible
- Much more discriminating
  - *full profile: 1 in a few m → 1 in 1bn*
- National Database much larger:
  - *people profiles 0.2m → 6m*
- Degraded DNA - now integrated in profiling
- Male-only DNA available
- Processes now largely automated - faster, less costly





2c. Changes in chemical analysis

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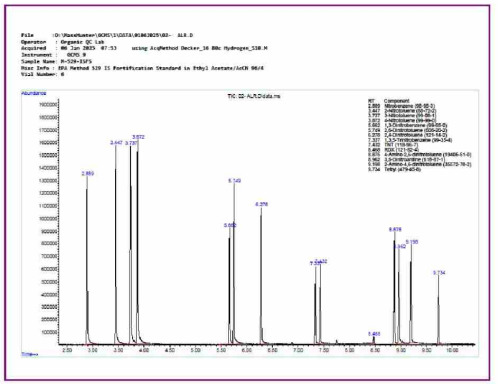
Similar benefits to DNA:

- Can analyse much smaller amounts
- Pick up minor components at much lower levels
- So, better able to discriminate between potential sources
- Providing stronger evidence of link between matching traces
- Instruments automatically identify compounds
- More automation so processes faster, more cost effective



2c. Changes in evaluation of forensic evidence

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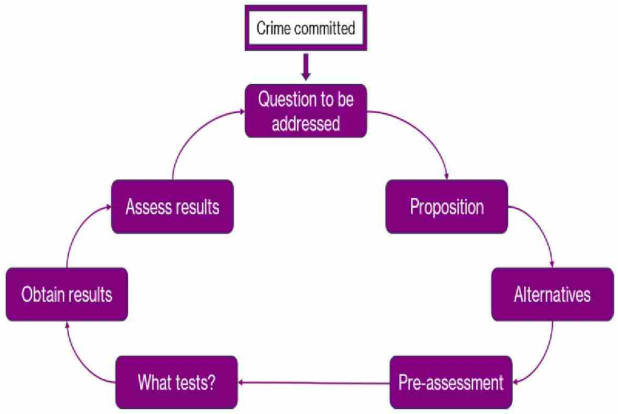

- **Case Assessment and Interpretation (CAI)** model
- Helps assess and prioritise testing options, and
- Evaluation of results in specific case contexts
- By considering:
  - which tests most helpful in distinguishing between respective prosecution and defence positions, and applying these tests to items in the case, then similarly
  - results of the tests, and which of the respective positions of prosecution and defence these best support

4. Scientific tests/techniques available 1997/98

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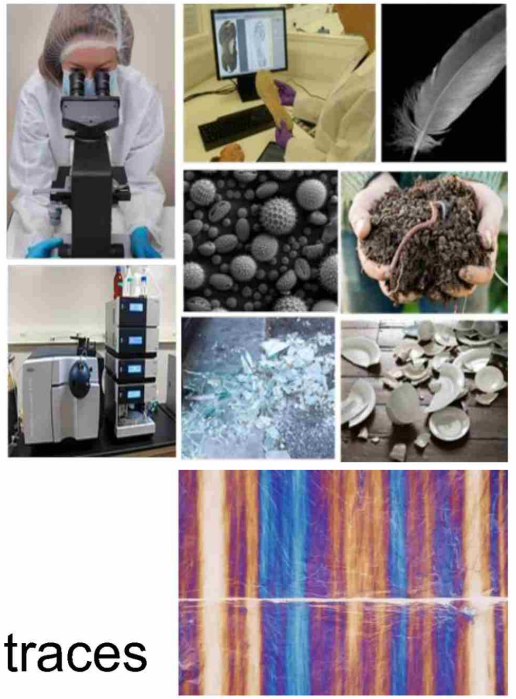
- Any kind of physical trace potentially relevant in complex investigations
- So, wide range of testing needs to be available
- Most commonly involving the 7 subject areas here
- Focus on tests and techniques in UK forensic laboratories in late 1990s
- Including for **finding** potential traces in the first place
- Highlighting contamination risks especially with smaller traces



5-11. Structure of technical sections in Report 1

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- Brief introduction, including to expert
- Tests/techniques available for police investigations in 1997/98
- How widely used
- Any limitations on their use
- How used practically
- What sort of material, and how much required
- Perceptions of tests' reliability – then and now
- Brief summary

5. Explosive substances

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Keith Norman *- an acknowledged expert in forensic chemical analysis especially drugs and toxicology, explosive substances manufacture and usage, and post blast scene examination. Based in Australia but worked in the UK for an extended period, and also in fragile and conflict-affected regions on behalf of UN.*

Tests and techniques

- Different types of explosives used for:
  - Detonator
  - Booster
  - Main charge
- Indicated by simple preliminary tests e.g. chemical and burn tests
- Followed by more sophisticated chemical analysis – spectroscopy FTIR and chromatography HPLC, IC, GC, for identification and comparison

5. Explosive substances

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Conclusion

- Analytical methods used by FSANI for explosive substances were fit for purpose
- Analytical protocol focused on very small number of explosive compounds, reflecting use in previous incidents
- Main limitation was apparently no routine screening for ‘other’ compounds incorporated in explosive material during manufacture or usage, which can add strength to suggested associations, although not always
- Only the Forensic Explosives Laboratory (FEL) can provide definitive list of tests and techniques available to the UK State at the material time

6. Explosive devices

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Chris Hester - National Security & Threat Specialist with extensive operational experience of high-profile investigations into critical security incidents across Great Britain. Specialist in assessing and investigating Improvised Explosive Devices (IEDs) and active terrorist networks within a high-level counter-threat unit. He served as a national bomb scene investigator and was the post blast investigator for the 2017 Manchester Arena attack

Techniques

- Managing the bomb scene
- Searching for IED components and any enhancements
  - At the scene
  - In debris recovered from the scene
- Making comparisons with devices from previous incidents

6. Explosive devices

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Summary

- Explosive devices – difference between conventional military devices as against improvised by terrorists
- Substantial additional challenges presented by bomb scenes to investigators and forensic scientists
- The five essential component parts of an explosive device, and how two bombs built by two different people can be distinguished from their specific components, and how these are joined together – creating the so-called ‘bombmaker’s signature’

7. Fingerprints

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Kevin Kershaw *- formerly Head of Forensic Identification Services for Greater Manchester Police, also worked extensively with the Metropolitan Police on terrorist incident investigations. Created the first national fingerprint training programme - blueprint for other forensic training and was seconded to Home Office to consider ways of improving police technical services nationally.*

Tests and techniques

- Wide range of techniques for visualising and enhancing fingerprints including oblique light, light sources, photography, powders, range of chemicals

- Fingerprint assessment and comparison processes involving:
  - Assessment for sufficient detail
  - Comparison with another specific fingerprint
  - Searching fingerprint database(s) – local and national collections, terrorist related fingerprints, and Active Files
  - Fingerprint identification and verification

7. Fingerprints

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Conclusion

- A wide range of physical and chemical techniques for visualising and enhancing fingerprints available by 1997/98, and both local and national databases to help identify sources of prints
- RUC apparently not taking more detailed, TACT fingerprints from terrorist suspects, and so some fingerprint detail may have been missed, and therefore opportunity to make identifications
- Allegedly no interaction between RUC and Met Police anti-terrorist fingerprint team with its particular breadth and depth of experience including of fingerprints in terrorist cases

8. DNA

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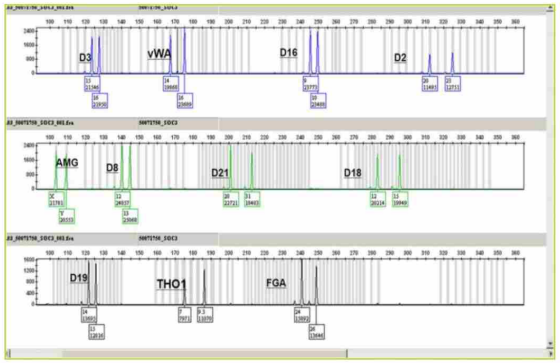
Philip Avenell *- a highly experienced forensic biologist who successfully led large, convoluted forensic investigations involving complex DNA analysis and interpretation, and combining this with other types of forensic evidence. Also held senior laboratory roles in managing forensic science casework, quality management, and research and development*

Tests and techniques

- History of development of DNA profiling
- Finding DNA - chemical tests and microscopy
- Four stage analytical process involving:
- Extracting the DNA
- Quantifying how much DNA captured
- Copying the DNA – polymerase chain reaction PCR to provide sufficient to analyse
- Analysing DNA – chromatography EP to separate into its component parts
- And then interpreting the results
- including direct comparisons, and local and national database searches



8. DNA

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Summary

- Forensic DNA profiling techniques of the general type used today in widespread use across the UK by 1997 including Northern Ireland, and DNA databases established and starting to prove their worth where a DNA profile obtained but no match to any suspects

- However, clearly visible body fluid staining still required to produce a profile. Not until the very late 1990s/early 2000s that newer techniques developed, capable of analysing very small quantities of DNA such as touch DNA

9. Textile fibres

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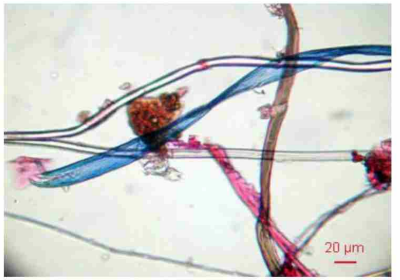
Roger Robson *- a leading UK expert on forensic examination of textile fibres with an international reputation. Specialised in the most complex criminal cases, has lectured and written extensively about textile fibres, and been a member of international working groups, professional standards committees, and served for 10 years on the Forensic Regulator's Advisory Council.*



Tests and techniques

- Recovering fibres from items - picking off or tape lifting
- Deciding which types to look for (reference fibres) amongst them
- Initial comparisons between recovered and reference fibres – microscopy
- More detailed comparison – microscopy (several types), with microspectrophotometry MSP and chromatography TLC/HPLC for colour, and microspectroscopy FTIR for fibre type
- Interpretation and reporting – databases, manufacturer/distributor data

9. Textile fibres

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Conclusion

- Forensic textile fibre examinations in the late 1990s conducted very much as today, except that evaluating the evidence they provide developed considerably since then
- Sensitivity and discrimination of analytical tests relatively well advanced, enabling tiny fibres to be included in comparisons and providing good confidence in any matches found.
- FSANI appeared to have equivalent capabilities to the FSS. Both also embraced the ‘linking fibres’ approach through which value could be attached to matching fibres from two places even when no potential source identified

10. Marks and traces

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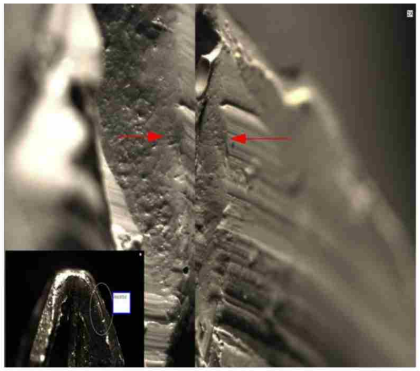
Sarah Jacob *- widely recognised as a highly skilled forensic chemist, specialising in marks and chemical traces including in the most serious and complex of cases. Delivered training courses for police – both in UK and overseas, and guest lectures at several UK universities. Recently contributed the trace evidence chapter for the latest edition of the Royal Society of Chemistry textbook 'Crime Scene to Court: The Essentials of Forensic Science'.*

Tests and techniques



- Marks – e.g. instrument, footwear, tyres, manufacturing, and physical fits
  - Visualisation and enhancement, and recovery – electrostatic/adhesive lifting, photography, casting
  - Examination and comparison - measurement, test marks, microscopy
  - Recovery of associated traces – as below
  - Identification and evaluation – use of databases, manufacturer/distributor data
- Traces – e.g. glass, paint, glue, make-up, waxes and polishes
  - Recovery – shaking, brushing, swabbing, picking off
  - Examination and comparison – microscopy (several types), and e.g. refractive index GRIM on glass and infra-red spectroscopy FTIR and gas chromatography-mass spectrometry GCMS on paint
  - Identification and evaluation – use of databases, manufacturer data

10. Marks and traces

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Conclusion

- Examinations for a variety of marks and traces in widespread use across UK in late 1990s. The main forensic laboratories appear to have approached the work in a similar way with only relatively minor differences in protocols

- Fundamentally, examination techniques remained very similar since then, although increased sensitivity of analytical tests may mean smaller traces detected, and increased strength of evidence of links between items from different places

11. Questioned documents (QD)

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Melanie Pugh *- specialises in examination of handwriting, signatures, and disputed documents. Works for the police/Crown Prosecution Service, defence legal teams, and Government departments, appearing in criminal and civil courts in the UK and overseas. Also an International Quality Standards assessor, representing QD on the Forensic Regulator's Interpretation Group.*

Tests and Techniques

- Handwriting and signatures, paper and inks examined, analysed and compared – microscopy, light- based imaging including UV, IR, photographic and video-spectral comparators VSC, indented impressions ESDA on paper, chromatography TLC of inks, physical fits
- Typewriter comparisons – typeface and alignment, mechanical defects and wear, ribbon and ink analysis, correction and alteration detection
- Photocopier/printer and Toner/ink-jet identification including machine identification codes - yellow dot patterns on paper, and recurring marks from dirt or damage on copier - trash marks
- Traditional printing - letterpress, intaglio, lithography, gravure, offset – lighting, microscopy
- Stenciling, malicious communications, stamp marks, recovery of obliterated text, damaged documents, postmarks - blue phosphor dots (on envelopes)

11. Questioned documents (QD)

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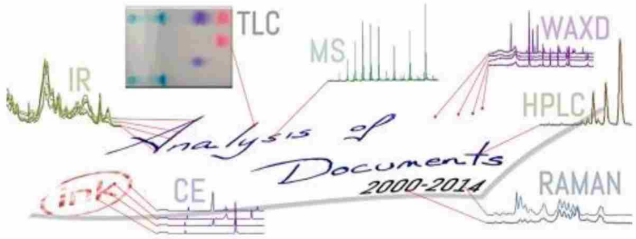
Conclusion

- A wide range of QD tests and techniques available from forensic laboratories across UK at the time of the Omagh Bombing. Covered handwriting and signatures, different kinds of printing, paper and inks, and alterations and forgeries involving all of these.
- FSANI apparently provided a broadly comparable range of services as other UK laboratories, although position less clear in relation to use of databases and other shared resources
- Forensic laboratories not accredited as they are today, but evidence that Quality Management Systems were in place, with collaborative inter-laboratory exercises which would show up marked differences in performance between them



12. UK Forensic science laboratories in 1997/98

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In England and Wales:

- **6 FSS (Home Office) laboratories** London, Chepstow, Birmingham, Huntingdon, Chorley, Wetherby
- **Specialist laboratories** eg. DSTL's Forensic Explosives Laboratory (FEL) - Sevenoaks, Transport Research laboratory (TRL) - Wokingham, Mass Spec Analytical Ltd – Bristol
- **Private laboratories** eg. LGC (Laboratory of Government Chemist) - Teddington, Document Evidence Ltd - Birmingham, Forensic Alliance Ltd - Oxford

In Scotland:

- **4 Police laboratories** – Glasgow, Edinburgh, Dundee, Aberdeen

In Northern Ireland

- **1 FSANI laboratory** - Belfast

12. Role of forensic science laboratories

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- Assist at crime scenes
- Advise about forensic strategies
- Conduct laboratory examinations of items and samples
- Assess and interpret results
- Draft and issue reports and/or witness statements
- Provide advice and expert testimony at court
- Conduct research and development
- Update police personnel on forensic developments

13. Standards and approach

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- Laboratories run along similar lines, contained same sorts of equipment, and had Quality Management Systems underpinned by same types of protocols
- Some specialist expertise eg. FSANI and explosives, and FSS Huntingdon and firearms
- Long history of collaboration
  - Regular director's meetings
  - Subject specific Inter-Laboratory Advisory Committees
  - Inter-laboratory proficiency testing trials
  - Collaborations with FSS Central Research Establishment (CRE)
  - Participation in broader, subject specific Working Groups e.g. European (ENFSI)

13. Development of formal quality management

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- Laboratory manuals - advisory
- 1980s embryonic quality management systems including Standard Operating Procedures (SOPs) – mandatory, in response to miscarriages of justice
- Third party accreditation - **1985 National Measurement Accreditation Service (NAMAS) – 1987 published ISO 9001, also specific National DNA Database requirements**
- 1995 United Kingdom Accreditation Service (UKAS) – 1999 published ISO 17025
- FSS at forefront of forensic accreditation, influential with ENFSI, extension of standards to CSIs/throughout forensic chain
- 2007 appointment of Forensic Regulator for England & Wales, statutory powers granted 2021

UKAS

ISO 17025

ENFSI
EUROPEAN NETWORK OF FORENSIC SCIENCE INSTITUTES

Forensic Science Regulator

14. Forensic science strategies

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- Ultimately SIO had responsibility for investigative strategy which includes forensic strategy
- Forensic strategy devised by Lead Scientist with other technical members of the SIO team
- Lead Scientist responsible for delivering forensic strategy within the laboratory
- Investigative and forensic strategies kept under constant review as new findings/information emerged – from both laboratory and investigation
- SIO could request a review/second opinion at any time if case stalling

In conclusion

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- Forensic science encompasses very wide range of physical traces - reflected in variety of scientific tests and techniques used
- Some fingerprint work in terrorist cases conducted by FSANI, but vast majority carried out by RUC Fingerprint Bureau
- SIO responsible for investigative strategy including forensic science - as advised by forensic scientists/other technical experts
- Bomb scenes amongst the most complex crime scenes, presenting substantial additional challenges to investigators and scientists
- Approaches to forensic work in 1997/98 remain broadly similar today, although technology has improved, providing:
  - Increased sensitivity – for more evidence, but greater potential risk of contamination

In conclusion …. continued

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- Enhanced discrimination between similar but not identical samples – for stronger evidence
- A more scientific way of deciding most useful tests to use, and how to interpret the results – for safer evidence

- In addition, improvements to quality management systems and appointment of Forensic Regulator, also contribute to safer evidence
- No detailed comparison of standards and approach possible to date, but main UK forensic labs (including FSANI) appear to have been operating in generally similar way in 1997/98, using same sorts of instruments and with only minor differences in protocols
- Any major discrepancies between them should have been picked up by eg. collaborative inter-laboratory proficiency testing, and/or reviews by defence experts

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Background/Overview of the Scientific Tests & Techniques available in 1997/98

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