

Forensic Science: It's not all about DNA!

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Who are we?

- Established 1975 – our Ruby anniversary!
- Associated office of D/Justice & Equality
- Situated Garda HQ since 1979
- In a 1970s style office block (not built as a laboratory)
- Staff of ~ 90 (scientific/administrative)
- Aim – to provide a scientific service to the criminal justice system
- Vision - “Science Supporting Justice”

DNA

- A powerful evidential tool in many situations
- But:
- Cannot say when the contact occurred (at present)
- Legitimate contact e.g. family, partners etc.
- Not all contacts result in DNA transfer
- DNA may degrade e.g. time, harsh conditions
- Closely related individuals may have similar profiles
- Mixed DNA profiles (>2) difficult to interpret

Evidence Types

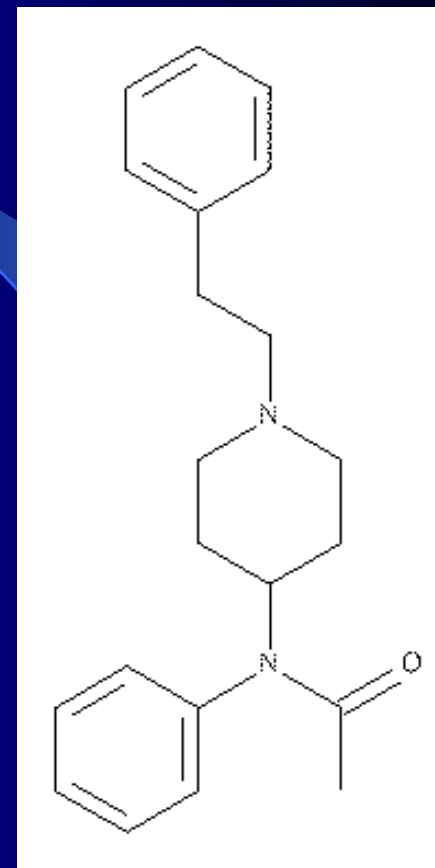
- IDENTIFICATION of suspect materials – controlled drugs, explosives, accelerants, toxicology
- TRACE EVIDENCE – firearm residue, fibres, paint, glass
- MARKS / IMPRESSIONS – footwear impressions, tyretracks, plastic bags, adhesive tapes, bloodstain pattern analysis (BPA), damage to clothing.

Drugs

- Expect to receive ~ 9000 cases in 2015
- All S15/17 (dealing) cases will be analysed
- Do not have capacity to analyse all S3 (personal possession) cases
- Presumptive Drug Testing (PDT) by Gardai meant to deal with this – mixed results
- Statistical sampling policy for large seizures
- Developing a toxicology service for sexual assault cases

New Psychoactive Substances (NPS)

- Major challenge in recent years
- Made by “tweaking” existing illicit substances
- Can have unpredictable effects
- Legislation has difficulty keeping up with them
- Co-operate with EU early warning system

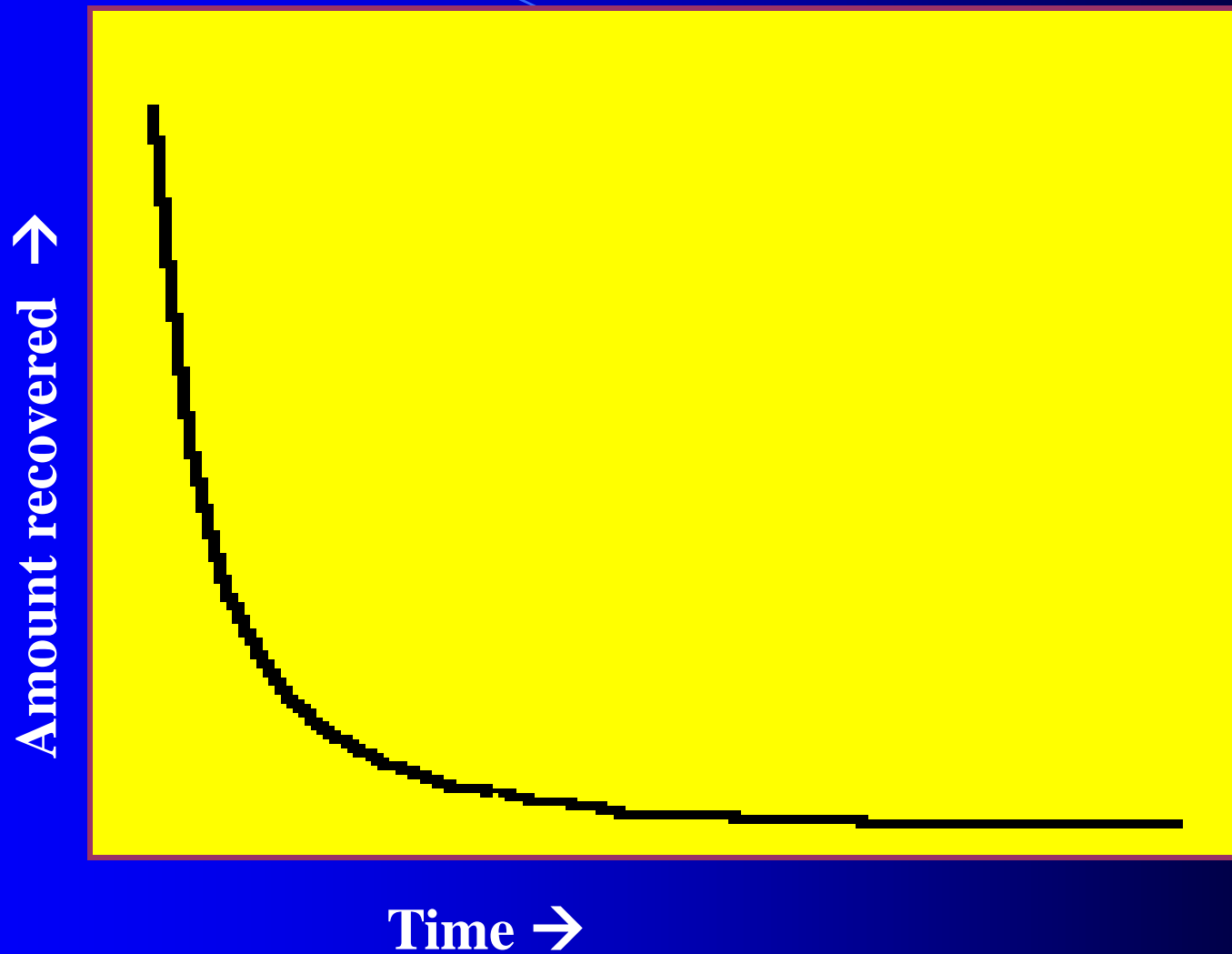


Acetylfentanyl

Trace Evidence

- Could be any material capable of being transferred e.g.
- Firearm Residue (GSR) – shooting incident
- Fibres (clothing/bedclothes) – violent/sexual assault
- Paint/Glass – Burglaries, Hit and Runs

Trace Evidence v Time



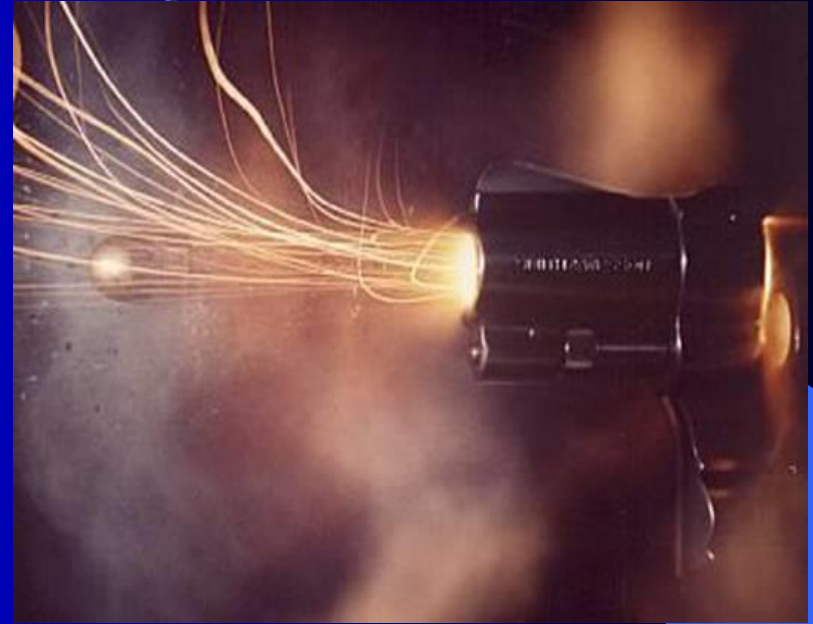
Is this bad news or good news?

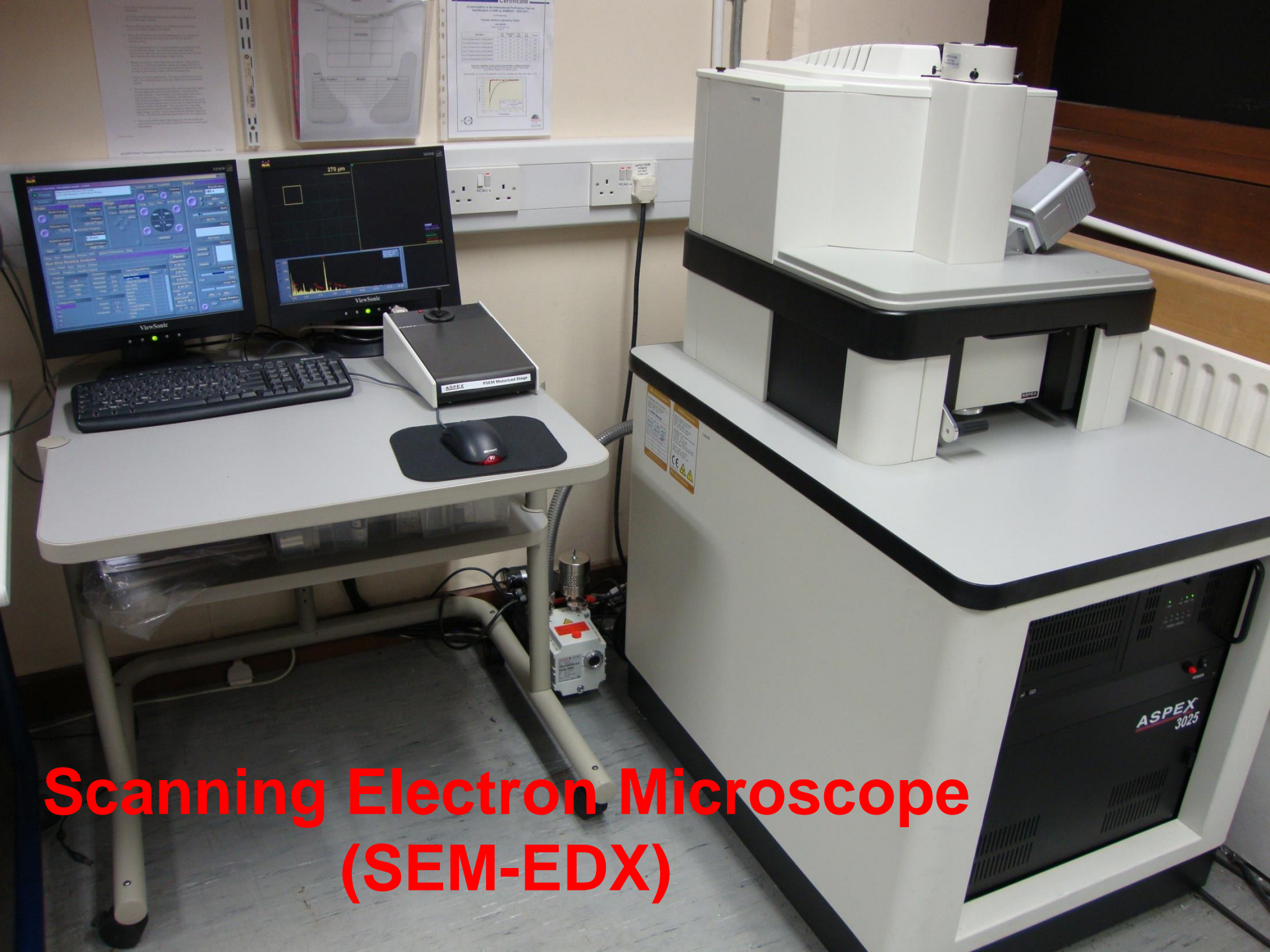
Trace Evidence v DNA

- Evidence for contact generally less strong
- But
- Finding of trace evidence implies contact was recent

Firearm Residue (GSR)

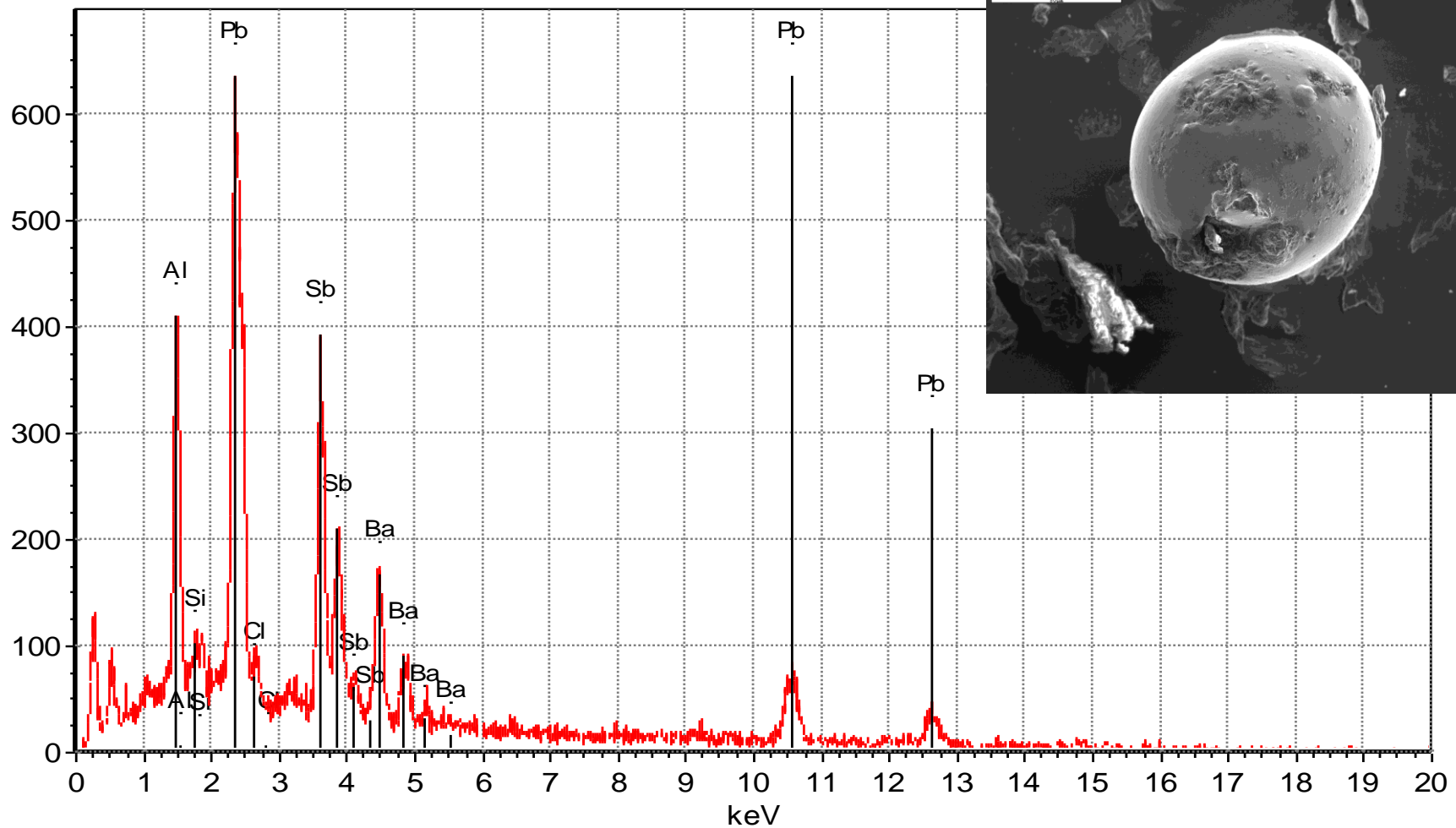
- Shooting incidents – rarely bodily contact between victim and shooter
- Cloud of tiny metallic particles generated from discharge of firearm
- Some of these particles “characteristic” of GSR
- Deposited on firearm and whatever is close to it (e.g. hands & clothing of shooter)





**Scanning Electron Microscope
(SEM-EDX)**

Characteristic Particle



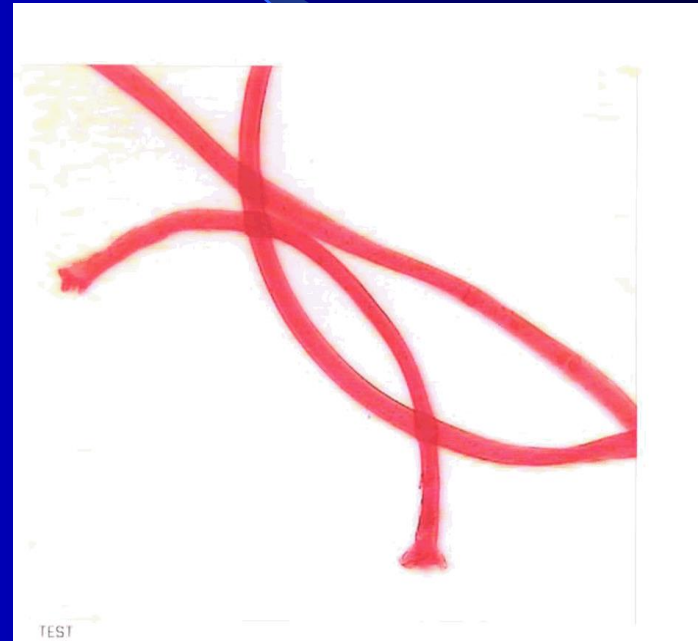
Textile Fibres

- Everywhere in our environment e.g. clothing, bedclothes, car seats, curtains, carpets etc.
- Require some degree of force to transfer
- Lost rapidly
- Wide variety available
- Can have batch variation within same product e.g. different dye mixtures



Where fibre comparisons may assist

- Violent/sexual assaults (transfer between clothing victim/suspect)
- Burglaries (around points of entry)
- Vehicle thefts (between clothing/car seats)
- On explosive devices

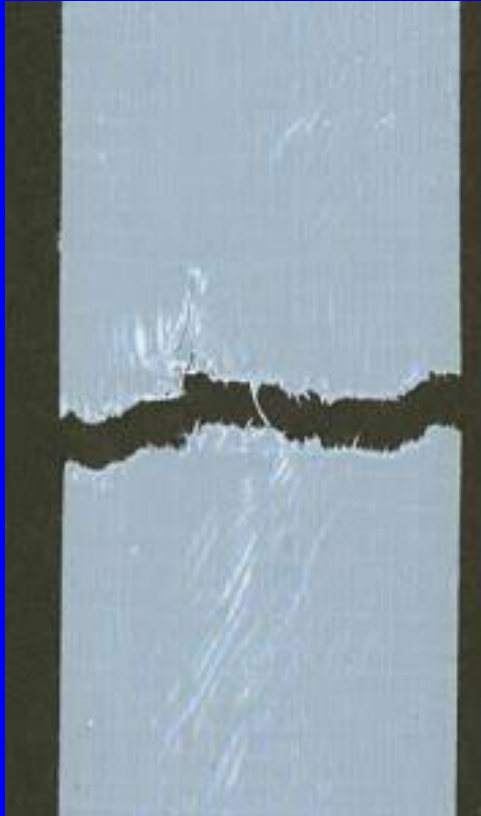


Marks/Impressions

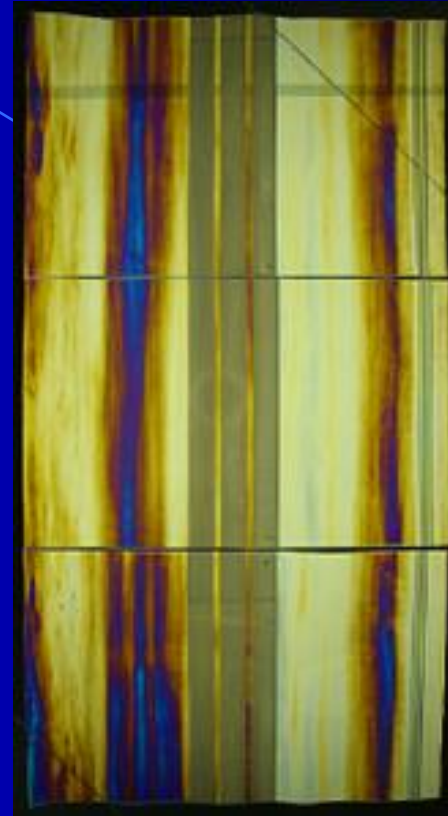
- e.g. fingerprints (Garda Technical Bureau)
- footwear impressions
- wide variety of patterns
- pattern further individualised by accidental marks
- Can provide strong evidence linking a person's shoe to a location
- But cannot generally be aged except in unusual situations e.g. footwear impressions in blood at the scene of a violent assault



Bags & Tapes



Torn adhesive tape – if edges correspond, provides strong evidence these were originally one e.g. tiger kidnappings etc.



Manufacturing marks on plastic bags visualised under polarised light – can provide evidence that bags were part of same batch or sometimes that one bag came after another in the sequence

Bloodstain Pattern Analysis (BPA)

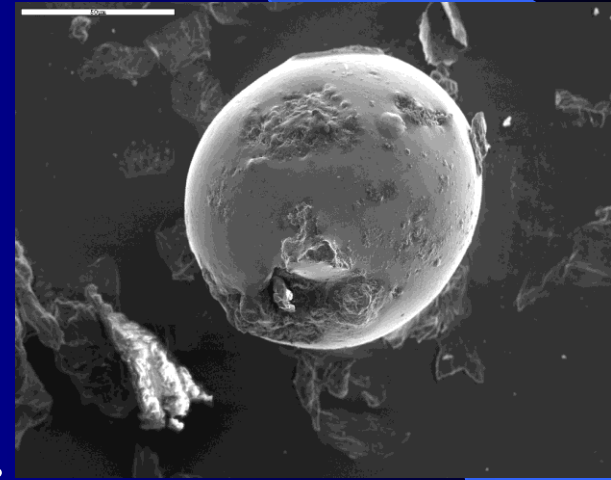
- Blood is a complex fluid
- Different physical forces acting on it produce different types of pattern
- Patterns expected can be determined experimentally
- BPA scientist may be able to interpret a bloody scene in terms of;
- What happened? In what sequence did events occur?
- Stain selection – anomalous stains

Kicking v Contact?



Interpretation of scientific findings

- Suspect in a shooting sampled 3 hrs after incident
- 1 Pb/Sb/Ba particle found on his hands
- Does this support suggestion
- that he is the gunman?
- Given that information on its
- own, a jury might think so



- Probability of finding 1 GSR particle on “random man” $\sim 1/100$ (0.01)
- Probability of finding >1 is miniscule
- But suppose;
- Eyewitness says gunman wearing gloves
- Gloves linked to suspect with many GSR particles on them
- Illustrates importance of scientist having background information to enable them to interpret findings

Conclusion

- DNA is a very powerful technique
- But other evidence types also have a role to play
- As DNA techniques become more sensitive, new challenges arise e.g. anti-contamination measures
- International best practice standards constantly evolving
- Difficult to incorporate into a 1970s style office block
- **A purpose built forensic science laboratory is urgently required**

- Thank you for your attention.