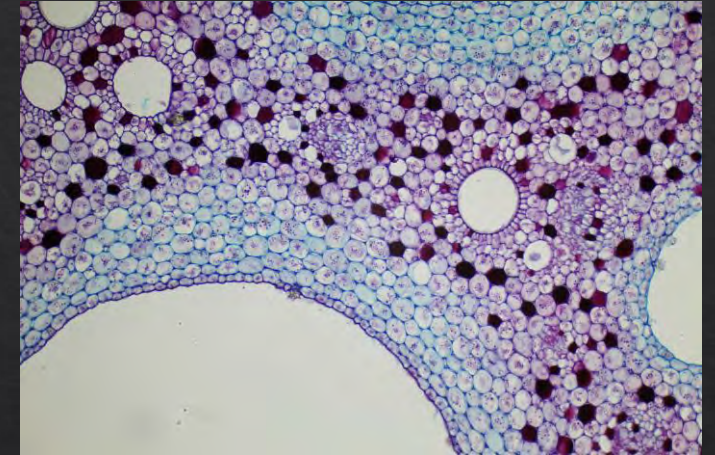
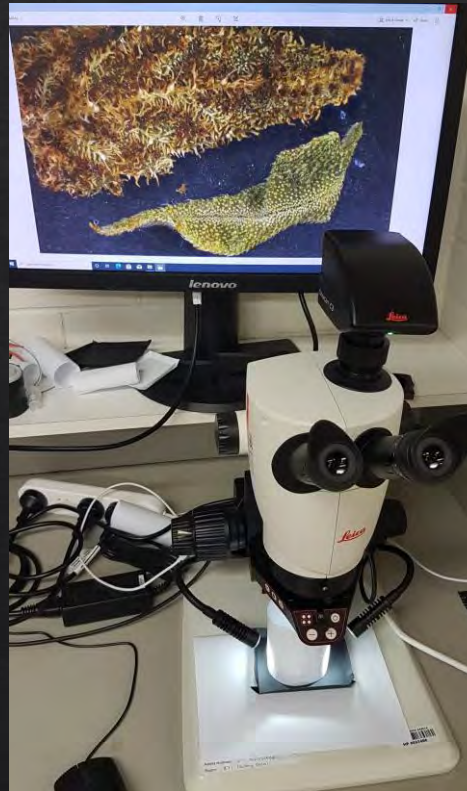


A Perspective on Forensic Botany

Cases and Techniques

James Indsto

Formerly Forensic and Analytical Science Service
(now retired)



A Brief Profile

I have both a horticulture and biological sciences research background and have published about 20 peer-reviewed papers in various fields including plant virology, the cancer genetics of melanoma, orchid pollination ecology, plant molecular systematics and applied scientific photography

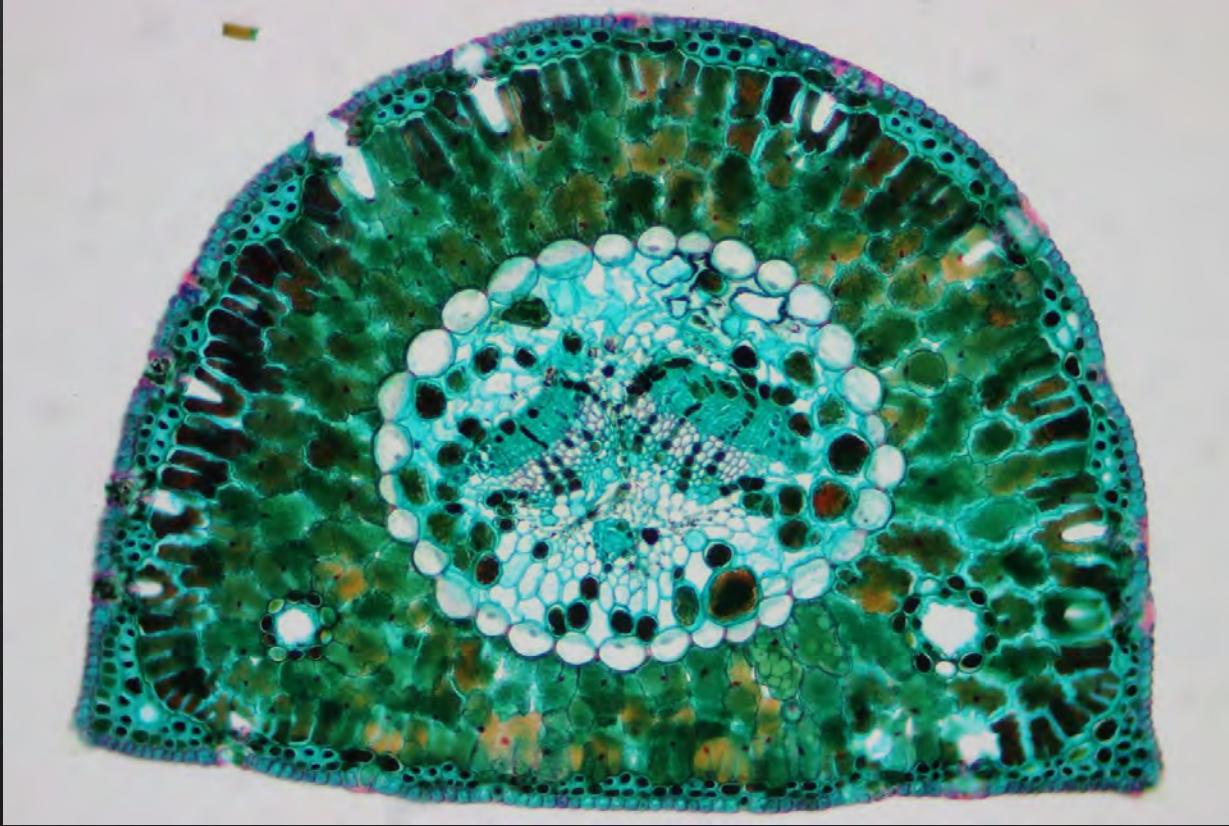
- In 2007 I was appointed as Forensic Botanist with the NSW Police Force with a brief to establish a forensic botany laboratory and to establish a forensic botany service in major crime investigation
- In 2012 my role was integrated into the Forensic and Analytical Science Service at Lidcombe, NSW where I have been working primarily in drug botany (Cannabis casework) and have undertaken a number of major crime forensic botany cases.
- I have been interested in further developing my botanical and scientific photography skills and have combined these into a project to improve the botanical knowledge of Cannabis for drug botanists and at the same time to develop advanced photomacrography techniques for the analysis of trace botanical evidence.

What is forensic botany?

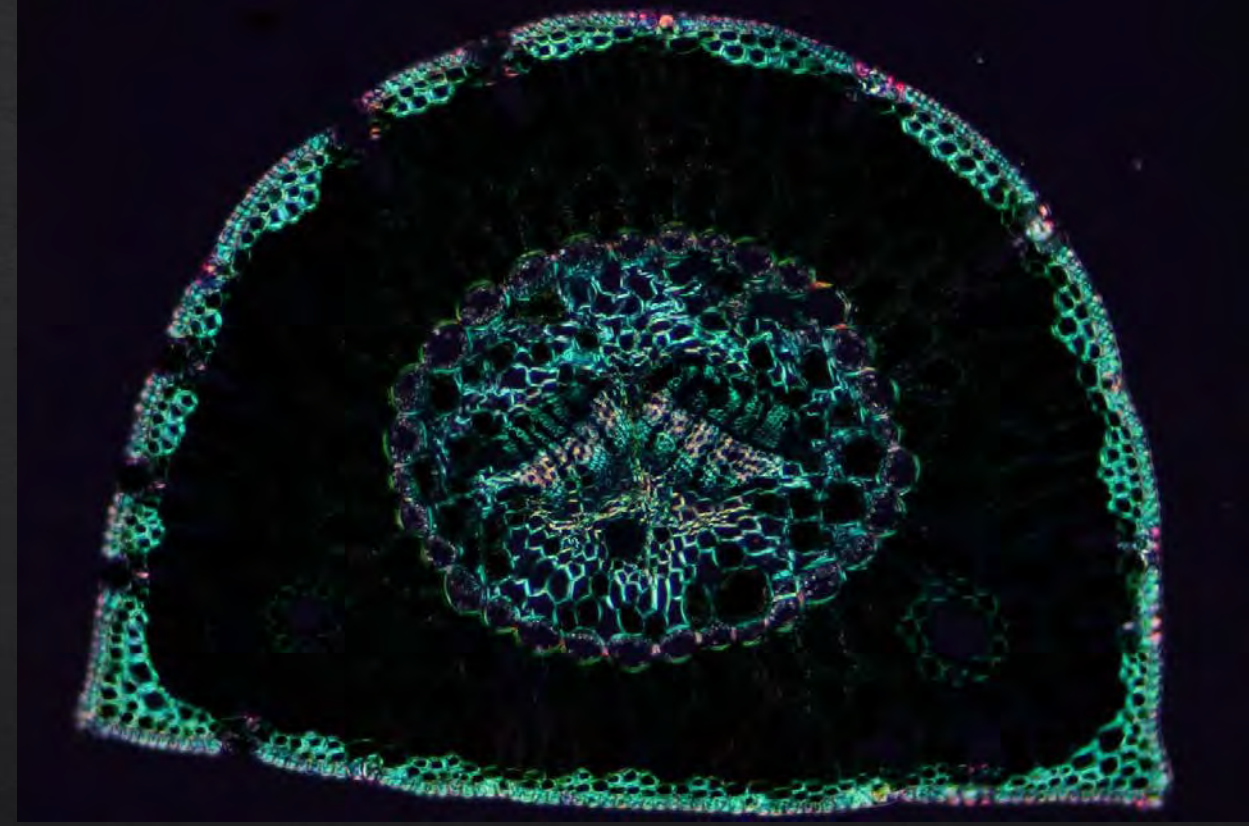
- ◇ Forensic botany is a field of many subdisciplines
- ◇ Many are 'borrowed' from other fields
- ◇ A good general botanical and horticultural knowledge helps
- ◇ Forensic palynology – pollen transferred to clothing and other items
- ◇ Forensic wood analysis – comparison and species matching
- ◇ Trace botanical comparison
- ◇ Microscopy techniques
- ◇ Soil analysis
- ◇ Detailed photographic examination – useful to record and demonstrate your findings

Microscopy with 'Crossed Polars'

Not used in casework yet but a nice technique
Prepared Pine Needle Section



Brightfield



Crossed Polars

Plant material contains many birefringent substances that fluoresce different colours in polarised light

Graeme Thorne Murder



**Basil Thorne with £100,000
cheque for 1960 Opera House Lottery**



Famous case where Australia 'lost its innocence'

Notable as (earliest?) example of complex forensic science used to solve a major case

8 year old Graeme Thorne is Kidnapped on the Way to School



Later that morning a phone call was made demanding £25,000 Ransom or Graeme would be 'fed to the sharks'

A blue 1955 Ford Customline had been seen by witnesses at time of kidnapping

A massive search failed to find the body

5 weeks later two schoolboys found the body wrapped in a blue tartan blanket under a rock in Seaforth

Steven Bradley, a Hungarian immigrant is a suspect

The Evidence

- * The blanket was found to have traces of pink mortar, plant fragments and dog hair
- * Dog hair also found in trunk of Bradley's car
- * Dr Joyce Vickery (Royal Botanic Gardens, Sydney) identified the fragments as two garden conifers
- * Police release a pamphlet describing features of house of interest
 - a postman recognises Bradley's house in Clontarf



Dr Joyce Vickery



***Chamaecyparis pisifera*
'Squarrosa'**



Arizona Cypress

Major 1961 Trial

- Large Crowd outside Central Criminal Court, Darlinghurst
- for the Graeme Thorne murder trial in 1961
- (Australian Photographic Agency - 10148)



Significance of Graeme Thorne Case in Forensic Botany

The use of botanical trace evidence to assist in a case investigation was highly unusual at the time

Dr Joyce Vickery was awarded an MBE for her contribution in this case – she was reluctant but felt that it would help promote the work of the Royal Botanic Gardens

Leafy detritus

A common evidence type that may transfer from a scene to an item



Leaves of numerous species may be present that can be used to provide a scene profile

Nail Varnish Peels

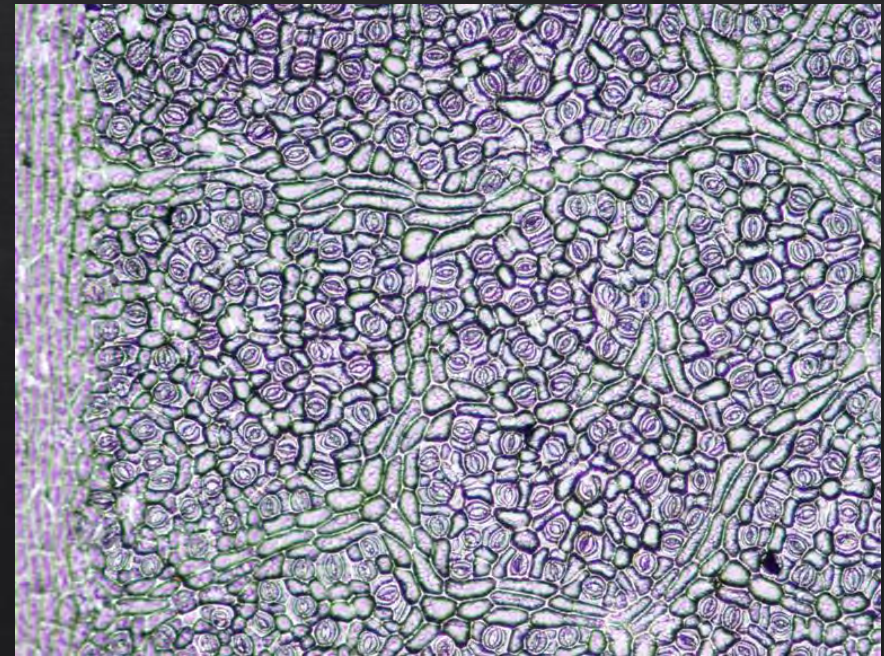
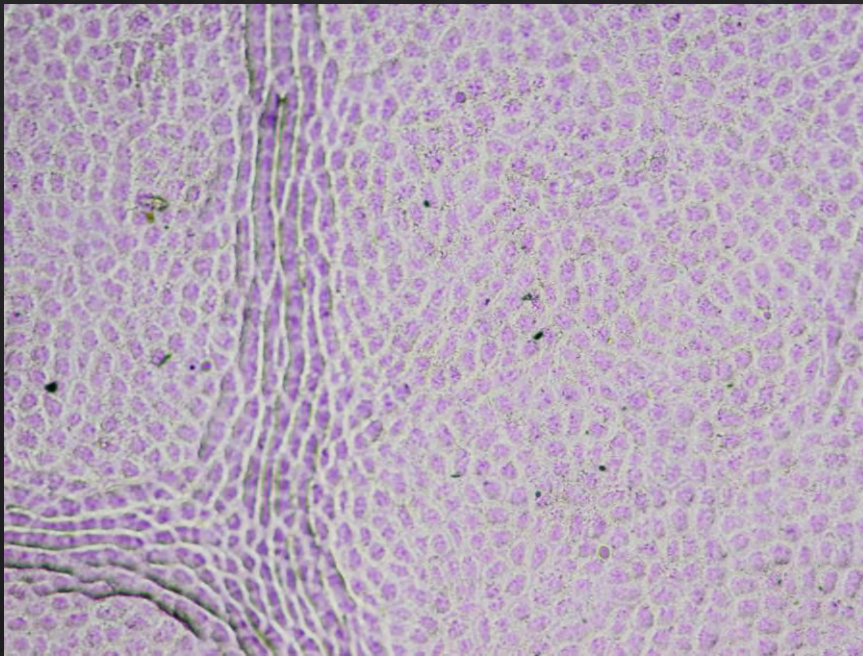
Casts of leaf or other surface that can show detailed surface anatomy

A 'rubbery' type of nail varnish is painted on leaf surface

Allow to set ~ 1 hour

Gently peel off leaf and place contact side up on microscope slide

View with standard brightfield microscopy with perhaps some oblique lighting



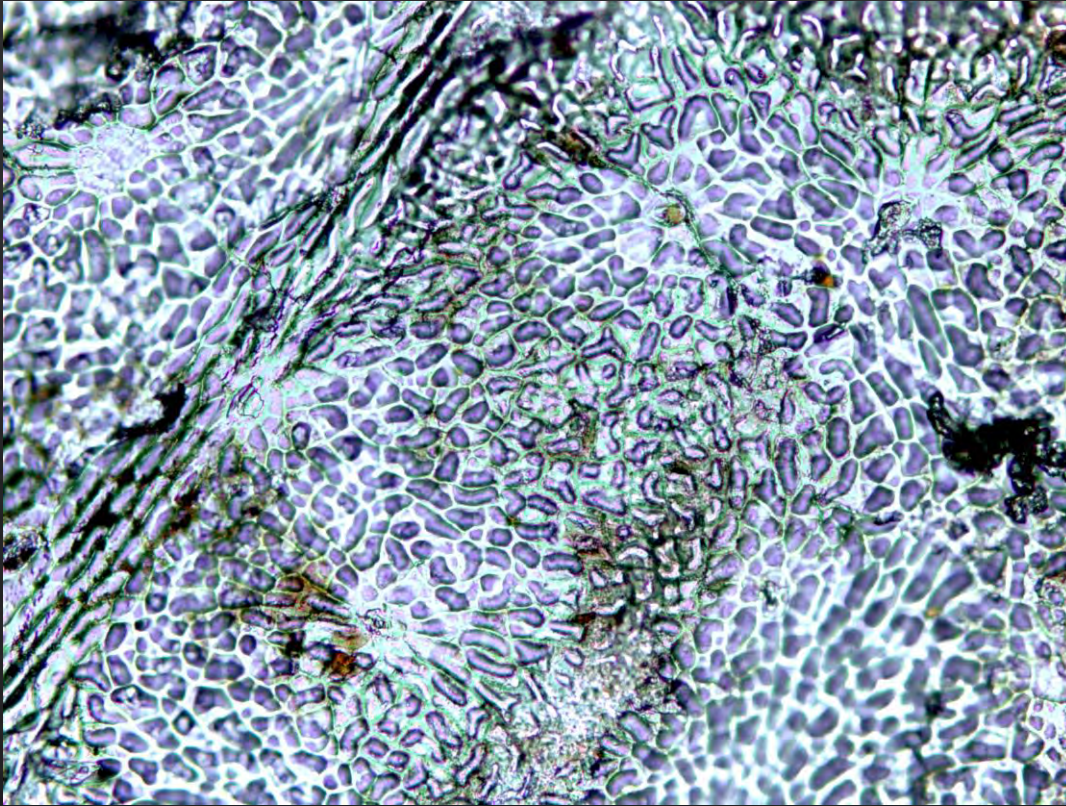
Camphor laurel leaf upper and lower leaf surface views

Leaves of *Syncarpia glomulifera*

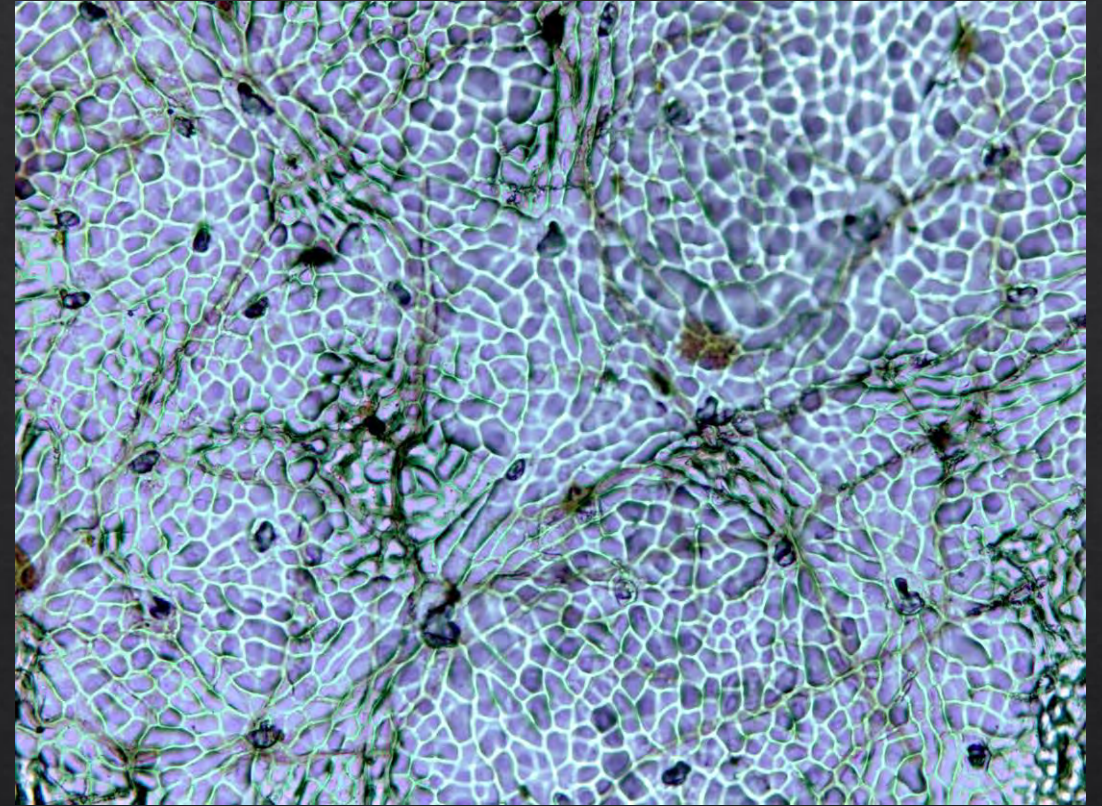


The leathery leaves of *Syncarpia* have a smooth upper surface and densely tomentose lower surface

Evidence and Reference Nail Varnish Peels in Case



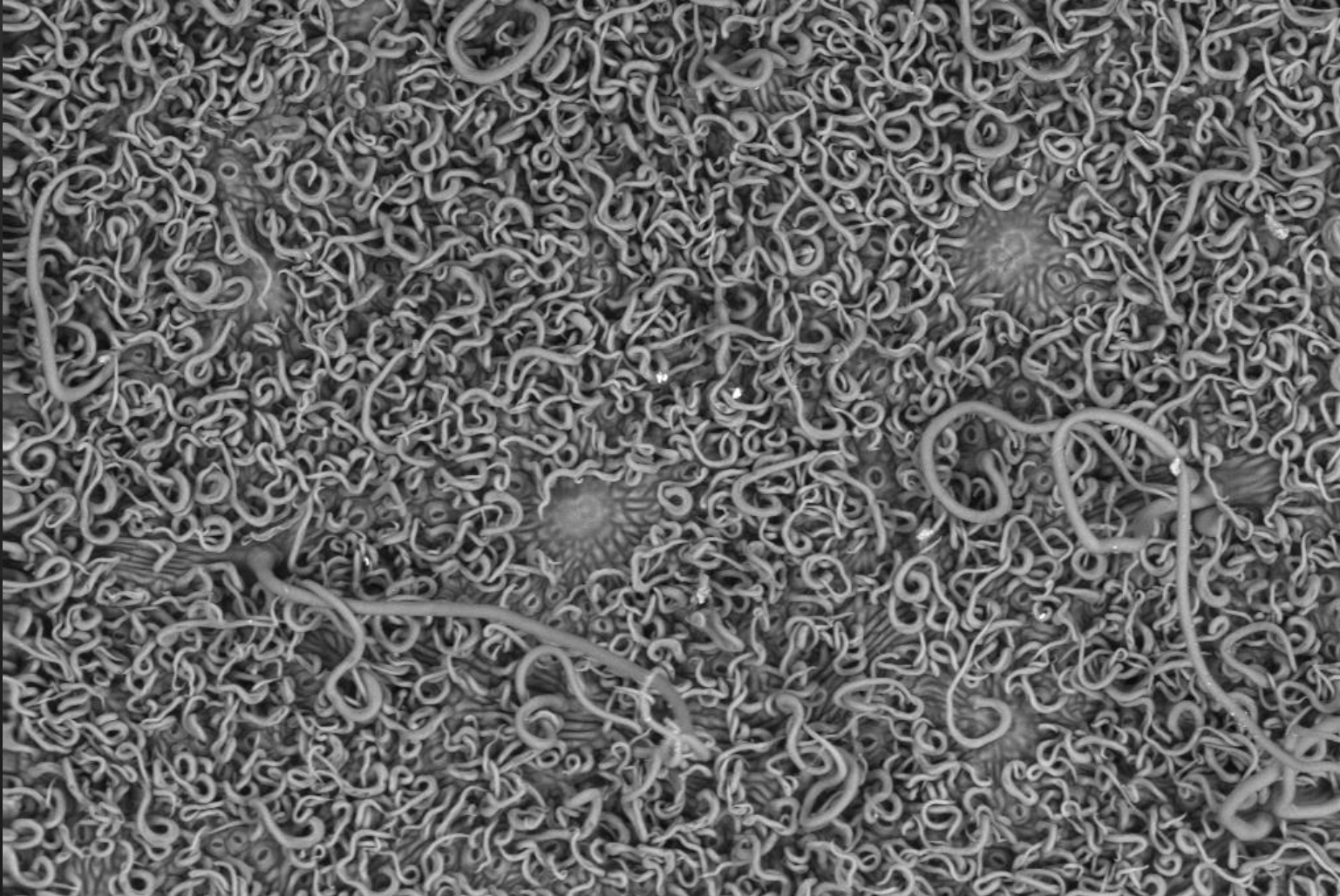
Evidence item 20X



Reference *Syncarpia* upper leaf surface 20X

Matching features support identification of evidence item as *Syncarpia glomulifera* leaf

A Photomacro Resolution Challenge



Lower surface of turpentine leaf
(*Syncarpia glomulifera*)

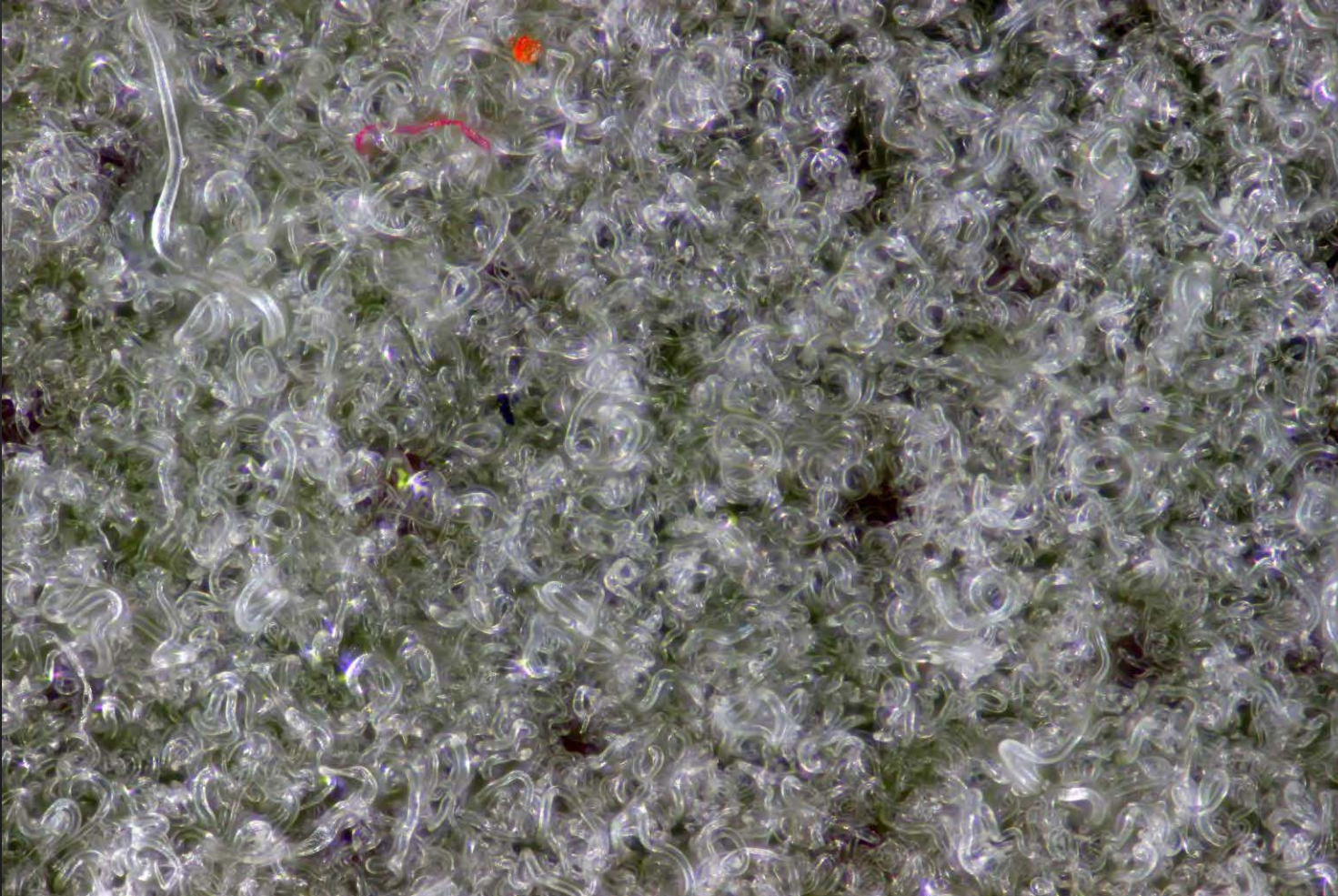
Pubescent surface looks like
'Crazy Spaghetti'

Scanning Electron Microscope
Image

Field of View ~ 1.5mm across

Could a similar image be produced with a DSLR camera and photomacro techniques?

Photomacro Image at 12.4X Magnification (FOV ~ 1.8mm)



50 images stacked using Zerene Stacker using Dmap algorithm

‘Crazy Spaghetti’ clearly resolved!

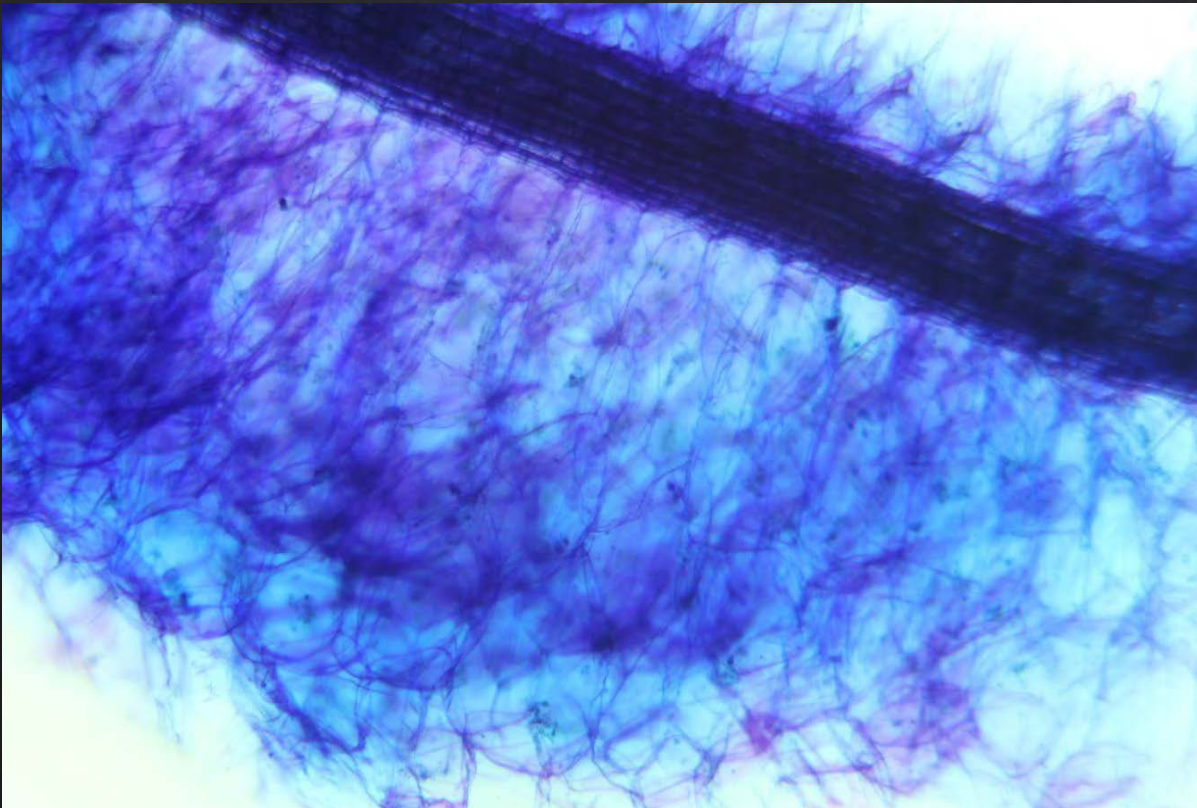


Nikon CFI 10X microscope lens with
Canon 50-250mm zoom lens as ‘tube lens’

Case Evidence

Drug Importation

- ❖ Importation of Aloe vera drinks from China with methamphetamine substituted
- ❖ Aloe vera drink with pulp chunks
- ❖ Offenders allegedly filtered pulp chunks out through a sieve
- ❖ Drug crystallised from collected liquid



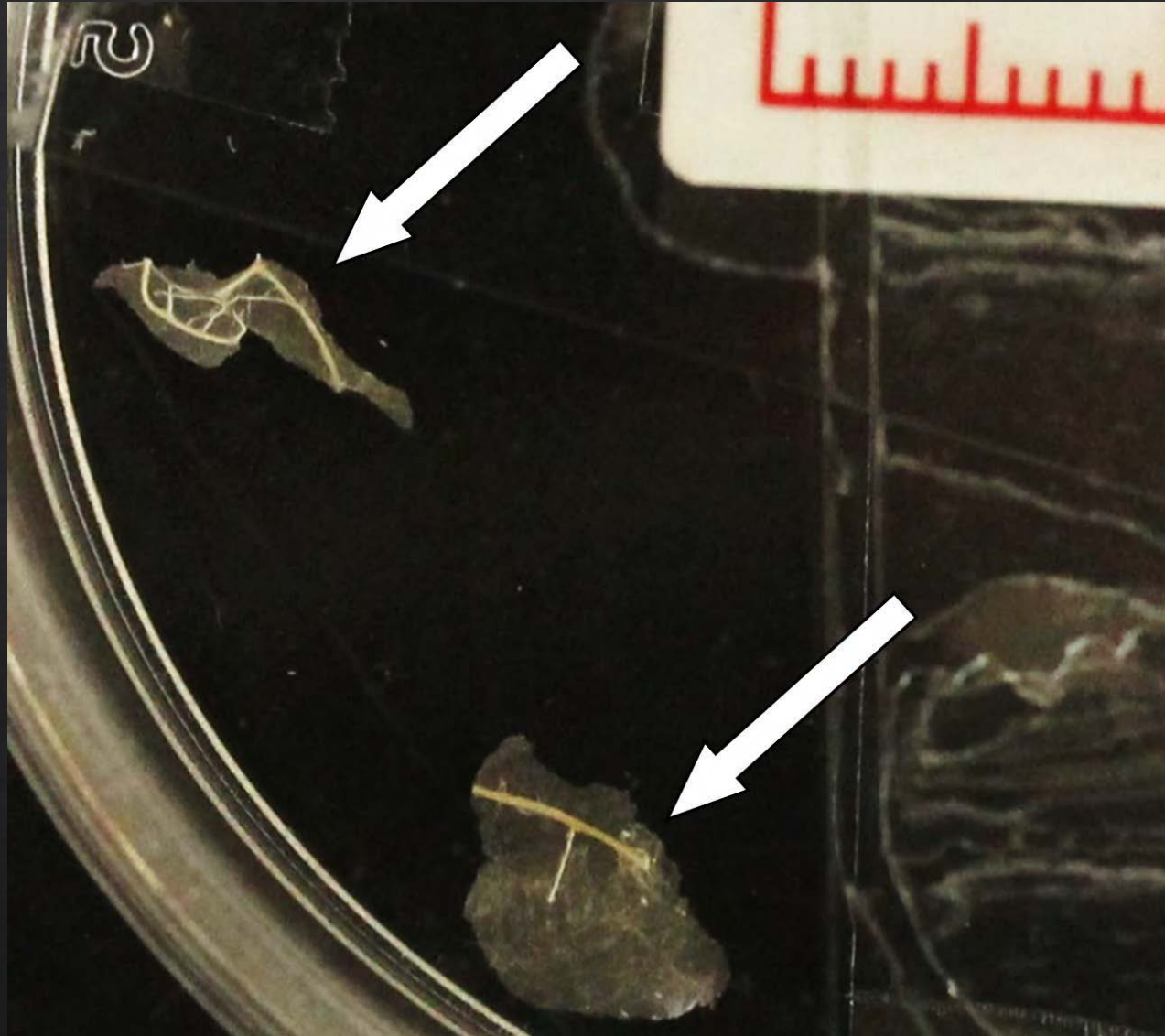
Stained parenchyma cells
show little useful detail



Australian example

Aloe vera case (continued)

Some pulp pieces were found to have vein traces



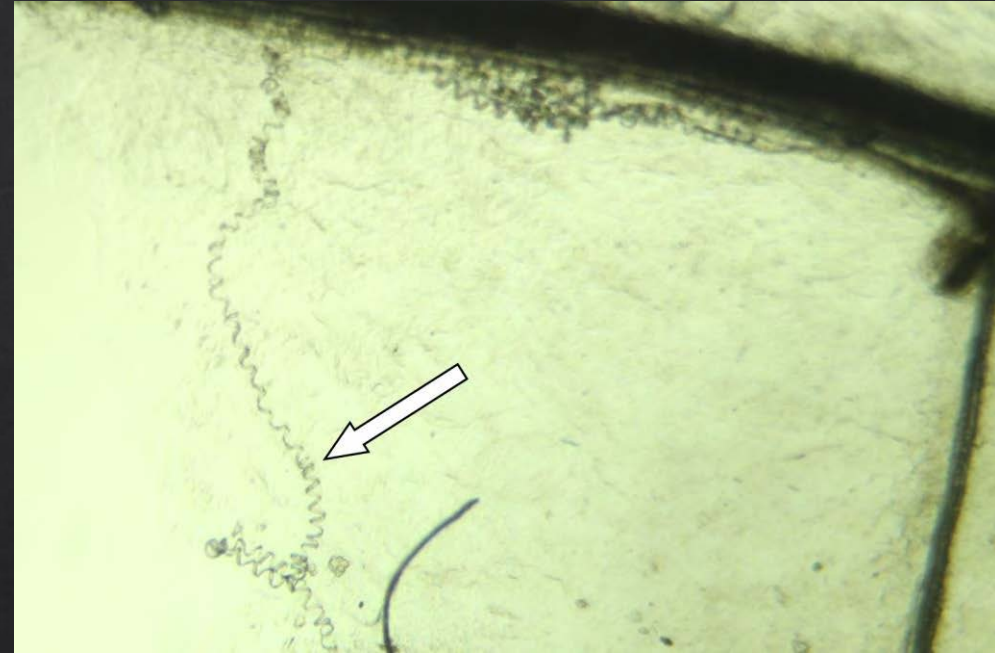
Evidence pulp fragments with
vein traces

Comparison of Evidence and Reference Material

Veins showed spilling xylem secondary thickening



Reference Aloe vera vein



Evidence Aloe vera vein

Examination provided strong support for match due to shared features and presentation

Coronial Inquest

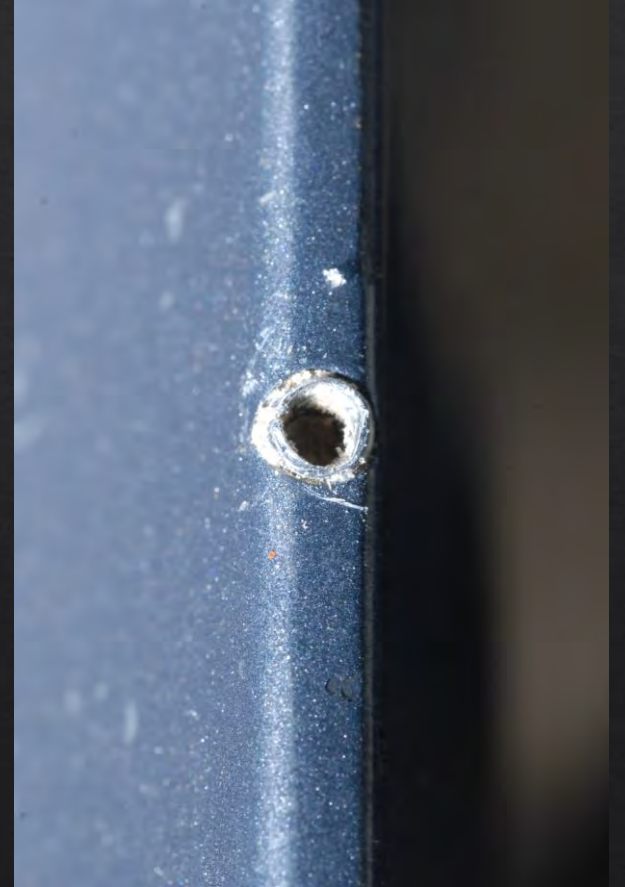
Drowning By Boating Misadventure



New 60hp 4-stroke outboard motor



Damage to shaft



Fibres in speed sensor

Fibres Collected

Examination Needed to Confirm Nature of Material

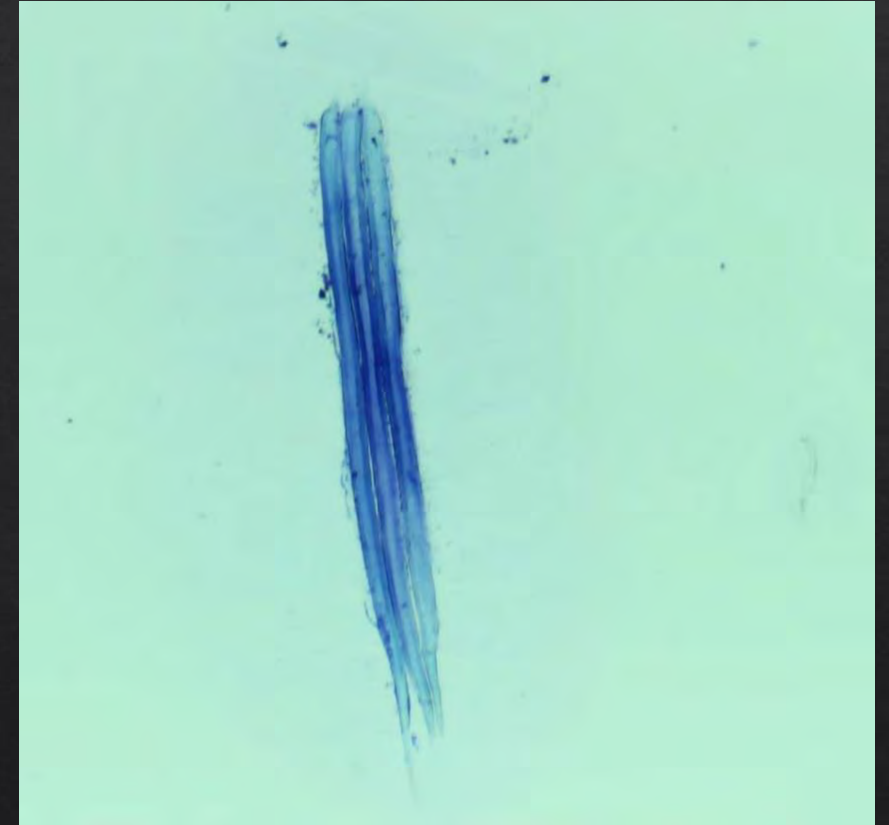


Vessel Element Fragments and Fibres Confirm Fibres are Hardwood

Finding supports case for boat colliding with underwater 'snag' and accidental drowning



Vessel element fragment



Wood fibres

2018 Murder of Cecilia Haddad



Body found at edge of Lane Cove River, Woolwich
by kayakers in April, 2018

Victim identified as Cecilia Haddad, a Brazilian national
working in mining industry

NSW Police suspect Mario Marcello Santoro, also a Brazilian national
and estranged partner

Suspect flees the country and returns to Brazil the next day

Police investigation quickly uncovers a very strong case

Victim's car used to transport body to Woolwich scene

Vegetation found in driver's side footwell of vehicle

Australia has no extradition treaty with Brazil.

NSW Police officers travel to Brazil to give evidence in trial

Santoro found guilty and sentenced to 27 years prison

Scene of Crime



Evidence from Footwell of Vehicle



Evidence Compared with Similar Material from Crime Scene

Comparisons of evidence, reference and outgroup material at 3X magnification



Evidence from footwell



River Oak Reference material from scene
(*Casuarina cunninghamiana*)



River oak (*Casuarina glauca*)
(outgroup) reference

Analysis confirms evidence is 'River Oak' that links to crime scene

Exploring Probative Value of Evidence

She-Oaks are 'unpopular' as street trees and are rarely planted: thick thatch kills grass, surface roots which sucker, they grow too big etc.

However, she-oaks are used widely as screening trees on main roads, large parks and similar situations

The presence of vegetable matter in car footwell suggests the foliage must have been scattered over road surface (not just in gutter). This is unusual

The crime scene possessed the rare features (quiet street, protected location at bottom of hill) that could have resulted in the plant material being deposited in car footwell

The combinations of these observations make compelling case for the evidence linking the vehicle to the crime scene

Cannabis Imaging Project

Specialised photomacrography used to illustrate Cannabis microscopic features

Previous studies relied on microscopy (SEM and light microscopy)

Very specific detail gave a 'myopic' perspective lacking overview

Photomacrography is close-up imaging at greater than 1:1 magnification

There are various ways of achieving high magnification using lens combinations.

Specialist photomacrography lenses may be used, but improvised combinations can also be very effective.

The technique typically includes image stacking, where many images are combined to form a single, composite image

Photomacrography requires dedication to master, but has huge potential in forensic botany and other physical evidence disciplines to reveal minute details at high resolution

Cannabis leaf



Upper leaf surface



Lower leaf surface

Photomacro imaging gives a landscape view

Numerous features and association patterns become clear



A single leaf serration
(leaf tooth)
3.6X magnification
Field ~6.2mm across

This figure alone reveals 5 new features new to science!

Hypertrophic Non-glandular Hairs of Floral Bract



A high resolution image such as this can be explored and used as a training resource
– Cannabis lower leaf surface of leafy bract at 3.6X magnification (field ~6.2mm across)

Cannabis Glandular Hairs and Resin Glands

A high magnification of 12.4X shows great detail



A High Magnification Setup

My kitchen bench is a convenient stable surface!



Canon 600D DSLR Camera setup for 12.4X magnification

- Special 10X microscope objective stacked on 250mm zoom lens
- Notice flocking to avoid flare
- Lighting is from 2 speedlight flash guns
Operating in wireless mode
- In this case the reverse of a turpentine (Syncarpia) leaf is imaged by stacking 50 images

High Resolution Photomacrography Has Huge Potential in Examination of Trace Evidence!

The technique requires dedication to master but after time can become routine

The End

Thank you for your attention

I wish to acknowledge the support of the New South Wales Police Force and the Forensic and Analytical Science Service, NSW in making this presentation possible