

## Session f

## FORENSIC PALYNOLOGY

***Hypericum* pollen determines the presence of burglars at the scene of a crime: an example of forensic palynology**

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The use of forensic palynology to assist law enforcement agencies to solve crime has become a routine task in New Zealand and is increasingly being used in many other countries. An obvious use has been in examination of soil caught up in the commission of a crime, but many other items also hold pollen that can assist in determining what happened at a crime and associated scenes. Some of the unusual items that have been investigated include animal fur (rustling; e.g. Mildenhall 1989), enamel planks (break-in of a museum to steal a live tuatara from its enamel painted protective box), plywood (around an indoor hydroponic cannabis growing operation), apricots (illegal importation), rope (used to tie up victims, e.g. Mildenhall 1988), corn flour (actually bee-pollen; Mildenhall 1999), and stomach contents (to determine what the victim had last eaten and where the body had entered the water in a drowning). However, clothing remains one of the best sources of pollen that can potentially be picked up by a suspect from the scene(s) of their crime (Mildenhall 2003). Pollen grains are designed to adhere and they readily become deeply embedded into clothing, especially if the grains are still alive and mobile, and difficult to completely eliminate even after dry cleaning.

Two suspects entered a house in which the sole female occupant slept having left the back door unlocked for the return of her live-in boyfriend. One suspect got into her bed and starting fondling her. She awoke and when she saw a stranger in her bed, and another person at the foot of the bed, she naturally screamed. The assailants ran off, one leaving a jacket behind on the kitchen floor. One of the suspects subsequently returned to recover his jacket. The boyfriend, who had by this time returned home, was not aware of what had gone on and returned the jacket to the suspect who snatched it and ran off. In his rush to leave the house he brushed against a flowering *Hypericum* bush growing just outside the back door. A suspect was soon arrested later that day and charged with indecent assault on a female and burglary, but denied any involvement and refused to name any associate.

A day following the offence the suspect's clothes were taken for forensic examination. Pollen analysis of selected parts of his clothing showed that his track pants contained 14% *Hypericum* pollen, denim jacket 24%, and polo shirt 27.5%. Traces of *Hypericum* pollen occurred on other items. Most of these pollen grains still had their cell contents preserved and were on the clothing in clumps consistent with having recently been collected by the clothing and not having been aerially dispersed. The pollen from the *Hypericum* bush was identical in colour, shape, development and size range to the pollen from the clothing. These clothes had so much *Hypericum* pollen on them that they had to have been in direct and intimate contact with a flowering bush.

Pollen evidence is by its nature circumstantial and often cannot be used on its own to convict, or more strictly to determine the truth. The suspect may have been in contact with *Hypericum* elsewhere, but detailed investigations indicated that this was unlikely. What we can say is that it is very unlikely for Police or even a forensic palynologist to pick somebody at random and find on them so much pollen like *Hypericum* without suspecting that they had that pollen on them in the first place. In 30 years of New Zealand forensic work *Hypericum* had only ever been found in clothing in trace amounts.

MILDENHALL, D. C. 1988. Forensic palynology in New Zealand. In: **Abstracts**, 7<sup>th</sup> Int. Paly. Congress, Brisbane, August 1988 p. 111.

MILDENHALL, D. C. 1989. Deer velvet and palynology: an example of the use of forensic palynology in New Zealand. **Tuatara** 30: 1-11.

MILDENHALL, D. C. 1999. Corn flower or corn flour? **Canadian Assoc. Palynol. newsletter** 22: 17-19.

MILDENHALL, D. C. 2003. Hitched by *Hypericum* pollen. **Canadian Assoc. Palynol. newsletter** 26: 4-6.

**Palynology and QEMSCAN: a powerful combination for forensic investigation**Wiltshire, P. E. J.<sup>1</sup>; Pirrie, D.<sup>2</sup>; Butcher, A. R.<sup>3</sup> & Power, M. R.<sup>2</sup><sup>1</sup>University College London, 31-34 Gordon Square, London WC1H 0PY (UK).<sup>2</sup>Camborne School of Mines, University of Exeter, Redruth, Cornwall, TR15 3SE (UK).<sup>3</sup>Intelligence Ltd., Queensland Centre for Advanced Technologies, Pullenvale, Queensland 4069 (Australia).

It is now becoming recognised that soils and sediments (even traces) can provide compelling evidence in forensic investigation. The analysis of organic entities within such matrices (pollen, spores, and other plant and animal remains) has proved to be invaluable but, until recently, the traditional methods of mineralogical analysis have proved to be susceptible to operator bias and statistically unreliable. QEMSCAN is a scanning electron microscope-based, automated mineral analysis system that provides rapid, statistically reliable, repeatable mineralogical data from virtually any sample containing particulates. It is well suited to samples where the mineralogy, chemistry, and texture of the matrix are site specific.

A case history will be presented where the analysis of plant macro-remains, palynology, and QEMSCAN were combined to provide evidence in a murder investigation. These techniques provided the only forensic evidence in the case which resulted in a conviction and life sentence for the accused.

**Forensic analysis of a recent homicide case: usage of Palynology to help determine time and location of death**Wall, N. A.<sup>1</sup>; Reinhard, K. J.<sup>2</sup> & Okoye, M. I.<sup>3</sup><sup>1</sup>Master of Forensic Science Program, Nebraska Wesleyan University, 50<sup>th</sup> and St. Paul, Lincoln, NE, USA.<sup>2</sup>School of Natural Resource Sciences, University of Nebraska, Lincoln, NE, 68588, USA.<sup>3</sup>Nebraska Institute of Forensic Sciences, Inc., 600 South 70<sup>th</sup> Street, Lincoln, NE, 68510, USA.

This paper reports on the role and importance of Palynology within the forensic science field. Palynological studies were conducted in a recent homicide case. Pollen was processed from three different samples, which included the hair, intestinal tissue, and the underlying carpet on which the deceased was found. The microscopic analysis of the palynomorphs revealed interesting results such as dietary pollen and the type of environmental found at the crime scene, which could be beneficial in the overall forensic analysis of the case. Further studies should be conducted in a collection and identification of the outside pollen at the crime scene in order to strengthen the results of the indoor pollen found.

**The value of obtaining palynological information from corpses**

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Over the last five years, it has proved possible to obtain a great deal of information and evidence from murder victims during *post mortem* examination. This involves sampling of clothing, skin, hair, and the turbinate area of the ethmoid (upper nasal passages). In this way, both temporal and spatial information has been gained to aid investigators. In some cases, it has been possible to differentiate between the deposition and murder sites, and identification of the location of those places. The techniques have also been useful in determining factors which have contributed to the cause of death. Some case histories will be presented to illustrate the techniques that have been developed, and the contribution that palynomorph retrieval from corpses has made to criminal investigation.

### A "Crime Pollen Calendar" from pollen of corpses

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In forensic Palynology human bodies are among the most interesting, though laborious, substrata to find the pollen fingerprint. Pollen grains recorded on corpses are especially suitable to detect the season of death, because the majority of them are trapped from the bio-aerosol the last few days before the death (Montali *et al.*, in press).

The present paper presents the results of a pollen investigation performed along more than one year (from December 2002 onwards) on corpses from violent or sudden death carried out to the morgue of the Legal Medicine Institute of Parma (Emilia Romagna, Northern Italy). Persons dead in the provinces of Parma. Aim of the investigation was to correlate pollen data from human bodies with the airborne pollen calendars of the same region. Sampling was monthly performed. Pollen samples were collected from hair, eyebrows, moustaches, beard, nasal cavities. Sampling and slide mounting followed two main methods, depending on the point of sampling: a) nasal samples were collected with spatulas and smeared on slides; after a preliminary heat fixation (50°C in oven), smears were Haematoxylin-Eosin stained and mounted in balsam; b) samples from hair, eyebrows, moustaches and beard were collected with swabs or brushes, and smeared on slides covered with silicon oil, stained with basic fuchsin and mounted. Pollen records from corpses were compared with airborne pollen calendars of the Emilia Romagna, especially with that from the two stations runned by the palynological laboratory of Modena (Modena-Osservatorio Geofisico and Vignola).

Altogether ca 4a corpses and ca 200 slides have been examined so far. Preliminary pollen spectra showed that eyebrows, moustaches and beard are good traps for pollen and fungal spores. Pollen flora was often sufficiently various to indicate the parent landscape of the pollen fingerprint. A good match between pollen spectra and airborne pollen calendars was observed. For example, *Corylus* was well represented in cases of death in February; in the region, hazelnut has an early flowering period, starting in February, and monthly sum concentrations in the air ranging between 100 and 400 p/m<sup>3</sup>.

The present results encourage to go on with the monthly sampling for a significant number of years to check the possibility of obtaining a "Reference Crime Pollen Calendar" for the region, which should inform about how many pollen grains and which pollen types are probably recoverable along the year on corpses of persons dead in the area. This calendar would be an helpful tool to interpret forensic pollen analyses, especially if it was also produced in other region.

MONTALI E., MERCURI A. M., CUCURACHI N., ACCORSI C. A., in stampa. **Pollen fingerprints as a crime solving tool.** Atti XIX IALM Congress of the International Academy of Legal Medicine (Milano, 3-6 settembre 2003).

### The combined use of pollen and Mineralogy in war crimes investigations in NE Bosnia on behalf of the United Nations International Criminal Tribunal for the Former Yugoslavia (UN-ICTY)

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From 1997-2001 the UN-ICTY undertook the exhumation of mass graves in Bosnia as part of the war crimes investigations aimed at providing evidence for the prosecution of war criminal by ICTY in The Hague. This involved the location and exhumation of 7 former mass graves which had been exhumed some 3 months after the initial execution had taken place following the fall of Srebrenica (primary sites) in 1993. Most of the bodies or

body parts had subsequently been transported and reburied in a large number of secondary sites (over 30) many of which were subsequently exhumed by ICTY.

The aim of the pollen and soil/sediment studies was to match the relocated bodies to the original mass graves thus completing the chain of evidence and providing evidence of the scale and organization of the original atrocities and subsequent attempts to hide the evidence related to them. All the primary sites were located in areas of contrasting geology, soils and vegetation and this allowed matching of the sediment transported in intimate contact with the bodies to the original burial sites, which in some cases were also the execution sites. In all over 24 sites were investigated, over 240 samples collected and analysed under low power microscopy and 65 pollen samples analysed.

The pollen and sediment descriptions were used in conjunction with the mineralogy (using XRD) of primary and secondary sites in order to provide matches. These matches were then compared with matching evidence from ballistic studies and clothing. The evidence has to date been used in the trial of Kristic and is now in the public domain. It is believed this is the first time so-called environmental profiling techniques have been used in a systematic manner in a war crimes investigation.

### Complexity in the forensic palynological record

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In their concern to establish links between people, objects, and places, forensic palynologists have a key role in criminal investigation. Classical pollen-analytical approaches can be part of this process, but the inferential bases of forensic research may be greatly more complex than is found in traditional palynology. The latter, for instance, will often involve a carefully controlled research design in which variables are held more or less constant (e.g. site type, deposition type, spatial factors, sampling procedures). Methodologically, the typical comparisons of peat or lake deposits in Quaternary palynology are relatively straightforward exercises in which palynomorph accumulations are often assumed to be reasonably regular. This simplicity might represent a tremendous strength in Quaternary science, but this is not a characteristic enjoyed in forensic investigation.

The palynologist may be brought into a case months after the event. There may be only small numbers of exhibits/samples for comparison. Each sample may produce small numbers of palynomorphs - and then only following special treatments. Soil and sediment may not be involved at all; palynomorphs may be picked up by victims, offenders, and their belongings directly from vegetation. If soil and sediment are involved, they may be present only as traces, and the nature of the accumulating surface can critically affect the nature of the final palynomorph assemblage. There may be police suspicion and inadvertent interference with the process, and there will often be limited funding.

As an aid to inference in the taphonomic complexities which forensic workers must address, the judicious use of multivariate techniques can allow an objective assessment of the similarity between samples. Such techniques, however, do not negate the necessity of critically examining the palynomorph content on a taxon by taxon basis.

In this paper, critical evaluation of the above issues and the ways that forensic methods can aid criminal investigation will be made and illustrated by recent case histories from the UK.