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Review Article

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Current Trends in Forensic Palynology

Mohith S Yadav

Department of Forensic Science, Yenepoya (Deemed) University, Mangalore, India

***Corresponding author**
Mohith S Yadav, Department of Forensic Science, Yenepoya (Deemed) University, Mangalore, India

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Abstract

Forensic Palynology is the study of natural organic matter to establish a chronological or environmental history. It is often used in palynology (palynology being the study of pollen and spores) to reconstruct past climate and vegetation changes. If the stratigraphic setting is known, the deposition date can be determined by organic matter in the sediment. The primary factors which dictate the abundance of organic matter are changes in climate and vegetation. Modern forensic palynology has made considerable advances in examining environmental samples, with many studies now showing that the "structure of pollen grains, in particular, provides an indicator of a sample's environmental and occupational history." It, therefore, provides "a way of finding out what happened before and during an environmental exposure." The field of forensic palynology concerned with the study and application of plant and soil organic and biotic evidence objectively and scientifically in order to provide evidence of environmental and occupational processes and conditions".

Keywords: Botany, Crimes, Daubert's Guidelines, Forensic Palynology, Investigation, Legal Cases, Plant DNA, Pollen Grains, Palynology, Structure of Pollen, and Spores.

Introduction

In Forensic Palynology, the investigation of pollen and spores to prove connections in criminal cases or refute connections has been part of the forensic toolkit since 1959, when analysis of pollen spores stands first practiced in connection with forensic investigations in Austria. As a specialized field, however, the field has slowly gained global momentum. Palynology refers to applying the study of pollen spores in legal matters, which remains used to establish connections between objects, people, and places based on analysis and identification of pollen. Forensics and palynology are related applications of the pollen and spore investigation in legal cases, which remain used to establish relationships between objects, people, and places based on analysis and pollen identification. Palynology remains used in the examination of its sample types, which leads to acceptability in court. The possibility of forensic palynology based on the quality of pollen enables them to withstand the time and limitations in terms of the results [1].

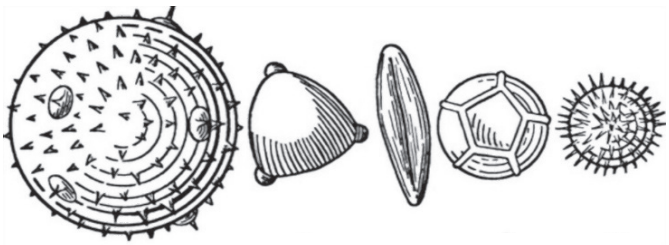

Figure 1: Image of Pollen Grains

Advanced Methods in Forensic Palynology

Pollen refers to a powder containing the male gametophyte, the seed-producing plant produced and distributed to pollinate and reproduce. The pollen grains have a hard coat that protects them from one plant to another and makes them resistant to destruction. Pollen is a powder containing male gametophyte seeds produced and scattered by plants to pollinate and reproduce. Pollen can remain classified by size, shape, colour, and characteristics (e.g., pollen opening, ornamentation) [2-9].

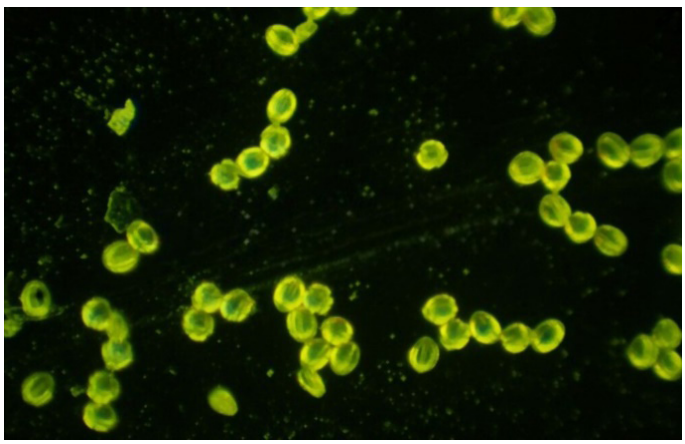

Figure 2: Pollen from Celandine Under a Microscope.

Pollen spores are tiny but can be produced in large quantities and distributed by various mechanisms, and are resistant to destruction. They are too small to be seen without the naked eye (7-200

m). It is why criminals often find themselves collecting pollen spores at crime scenes. Pollen spores can attach to most surfaces and settle in clothing, meaning that washing with detergents does not remove the grains [4].

The distribution mechanism by which plant pollen is absorbed is transfer. Pollen can reveal a person or object in a region of the world or a country, and different parts of a single garden can have characteristic pollen accumulations. A pollen accumulation is a pollen sample from which a variety of plant species emerge. Pollen can reveal a particular region of the world, a country, or even different parts of a single garden through a pronounced accumulation of pollen. Removing pollen from the crime scene may help identify certain plant species that may have contacted the victim or points to evidence that does not belong in the area [9].

Palynology is the study of palynomorphs, microscopic structures of animal, plant origin resistant to decay. Forensic palynology can be carried out by analysing pollen grains under a microscope and comparing them to so-called pollen morphology. However, the signature of the existing pollen grains is site-specific, as different plant species occur in different areas and over time and bloom at different times. Therefore, it is anything but an ideal biomarker for interfacing individuals and objects to clear places and times and is key to forensic examinations [10, 11].

Although DNA barcoding of pollen has not remained used in forensic palynology, similar techniques have stood used to test the quality of honey and determine the plant species that bees eat. The use of pollen DNA profiles in forensic investigations has also remained used. The forensic analysis of pollen grains remained used in a fictional crime novel titled Probable Cause (Pearson 1991) as a theme.5 They have a reference library of over 6,000 pollen species housed in the Customs and Border Protection Laboratory and access to 30,000 additional samples from nearby fields and the Museum of Natural History (Illinois, USA). There are more than 380,000 different types of pollen grains that palynologists must use microscopes to identify which grains they find in the eye [2].

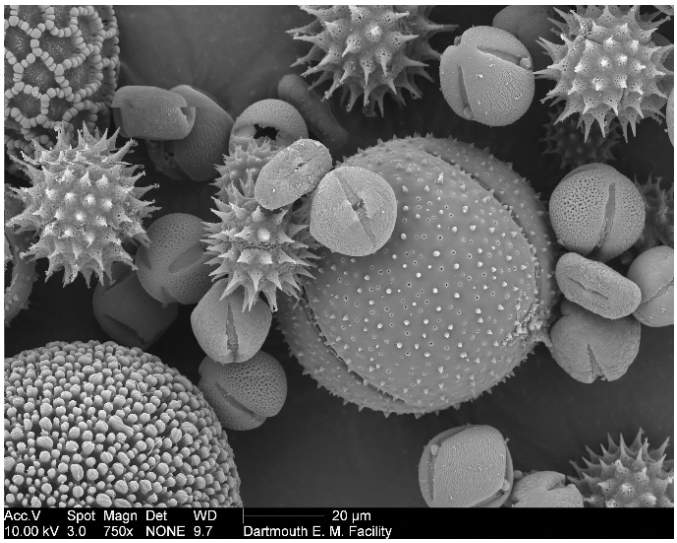

Figure 3: SEM Images of Pollen from the Electron Microscope Facility

The first report on forensic palynology to solve crimes was investigating a murder in Austria in 1959. The case remained solved by linking the frequency of a particular type of pollen found on the victim to that at the murder scene. Unfortunately, forensic palynology's potential benefits stand not currently exploited, as it relies on specialized experts to identify pollen under the microscope. Recently, researchers have developed new techniques to identify pollen using genetics. These new techniques will allow the identification of a large number of pollen samples, and we believe that this has the potential to change the field and allow us to harness the power of pollen to solve crimes [1].

For a good reason, forensic palynology, the use of pollen spores to solve both criminal and civil cases, is not obscure. It plays a recurring role in crimes that can stand seen in bones [1]. For example, it was instrumental in the widely-published investigation of the Iceman and helped convict Bosnian war criminals. Because pollen is tiny and abundant when present at the scene, it is a valuable tool for forensic investigations. Forensic palynologists have compared pollen spores collected as evidence to pollen from known plant species in the past. Computers can now identify several spores and pollen of different plant species in a sample. It has the potential to give a time-stamped geographical fingerprint to evidence contaminated with Pollen [7].

The pollen can remain classified according to size, shape, colour, Pollen opening characteristics, and decorations. A pollen composition depicts pollen samples of various plant species. For example, a body believed to be moving and carrying pollen grains can stand analysed to determine the most likely location. Palynology can likewise decide the area of a crime location, regardless of whether it is anything but known. Based on the type of pollen and spores found on the specimens, it can limit a piece of evidence to a specific place where a particular plant has grown in a particular season and not just weeks ago [12].

The signature of the present pollen grains is specific to this particular place, as different species of plant breed occur in different areas and over time and bloom at different times. It makes pollen an ideal biomarker for connecting people and objects to a specific place and time, central to forensic investigations. Pollen spores can remain obtained from a variety of objects, including the body [2].

Everyone knows the expected production and dispersion pattern of spores and pollen (pollen rain) of plants in a given region. One of the most common types of pollen fingerprint is the expected sample that comes from that region (Bryant, 1989) [10]. The use of trace evidence in pollen grains and spores has played a prominent role in court proceedings and has given forensic palynology a unique recognition in today's world. In addition, new evidence has come to light that pollen grains or spores can be deadly to pollen allergy, an important finding from the study of pollen used to kill allergic Pollen [6].

Techniques for collecting, processing, and analysing forensic pollen samples will stand discussed. The analysis examines the presence or absence of certain pollen types. Students use digital pollen databases and Google Earth to link pollen traces to evidence at specific crime scenes [8].

Pollen traces indicated that the suspect was at the scene, and the type of pollen found on the suspect's clothing matched the pollen found at the scene [10]. The use of trace evidence in pollen grains and spores has played a prominent role in court proceedings and has given forensic palynology a unique recognition in today's world. In addition, new evidence has come to light that pollen grains or spores can be deadly to pollen allergy, an important finding from the study of pollen used to kill allergic Pollen [7].

Discussion and Analysis

Boston police contacted National Centre for Missing and Exploited Children (NCMEC) and requested the evidence be analysed as quickly as possible. The NCMEC contacted Andrew Laurence, the chief U.S. Customs and Border Protection officer [7]. Forensic analysis of dust found on the stuffed lizard suggested it had stood assembled in Europe. Mainly pollen spores are beneficial due to the characteristics mentioned above. Pollen spores are tiny, produce enormous amounts, remain distributed by various mechanisms, and resistant to destruction. In addition, the pollen grains have a hard coat that protects them from one plant to another, making them very resistant to destruction [12-15].

The yellow powder clogs the windshield in spring, pollen from microscopic seeds. Since air is widespread on most surfaces, we inhale pollen and spores into our lungs, which stick to our clothes. During the 1960s and 1970s, other European criminal cases utilized dust as a forensic tool to interface presumed cases to crime locations. Forensic palynology root in America in 1975 when Bryant, a botanist who studied pollen on archaeological sites, began analysing it for forensic purposes. Petrified pollen, which can be brushed off or found in the dust at crime scenes, can be a valuable clue for forensic palynologists [16, 17].

Forensic palynology is the analysis of various types of pollen grains and spores in a legal context. It refers to pollen and other spores in court proceedings as evidence used to clarify criminal issues and prove or refute the relationship between people and the crime scene. In forensic palynology, the examination of pollen spores to prove/refute connections have been part of the forensic toolkit since 1959, when the analysis of pollen spores in connection with forensic investigations in Austria remained first practiced [18-20].

Conclusion

Advances in plant genomics have had a significant impact on the field of forensic botany. From an American perspective, New Zealand's assumption of pollen analysis is particularly impressive. In the USA, the Pollen examination can be utilized as an investigative device to satisfy Daubert's guidelines. In New Zealand, it stands accepted as evidence in court.

The lack of forensic palynology to solve crimes has led to widespread scepticism among the population about the usefulness of pollen and fungal spores as forensic tools. One reason for this view is that previous studies have shown that soil honey pads and the leaves of plants gather pollen and dust.

We have all failed to use the most effective tool in the forensic arsenal: pollen and mould spores to solve crimes. There are precedents for the use of pollen in support of criminal investigations. However, we need to rethink our preconceptions about the usefulness of microscopic structures and traces in solving crimes.

Today, palynology labs use the same pollen chart format. However, a University of Oklahoma student, Phyllis Draper, developed the first pollen chart to represent percentages of several species at different depths by comparing a sample of Curtis that is still in use.

Forensics and palynology are not well-known fields, defined as the use of pollen and spores to solve criminal, civil, and legal issues. The only federal agency with a forensic palynologist on its staff is CBP (United States Customs and Border Protection), which leads US law enforcement to use pollen analysis for investigations and intelligence.

Forensic palynology provides information on microscopic pollen spores contained in clothing and other items of interest that can stand used to solve criminal and civil cases of murder, terrorism, theft, rape, arson, illegal drugs, and more. Palynology laboratories and services can also help uncover new information during investigations that can link an object to a person. In addition, pollen samples found on objects can provide palynologists with information that conflicts with suspicious statements.

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