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Forensic Botany's Contributions and Contemporary Trends in Crime Scene Investigation

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ABSTRACT

The scientific discipline of forensic botany uses plant science's expertise, methods, and research to resolve legal issues. Since different plant species are found in the environment and are restricted to particular geographic locations, forensic botany demonstrates that plants can provide forensic evidence. In addition, each species has its distinctive traits. Because of these characteristics, plants can be used as evidence in criminal and civil disputes. The discipline of forensic botany is still underrepresented in forensic casework, nonetheless. Furthermore, the use of plant, animal, and insect evidence is still unknown, even though most forensic experts are familiar with techniques for testing human identities. This lack of understanding results in teams collecting evidence unaware of the value of gathering botanical trace evidence. As a result, this review paper includes case studies, appropriate methods for gathering botanical evidence, and several sub-disciplines of forensic botany. The value and uses of botanical evidence in criminal and civil case investigations are discussed in this article.

INTRODUCTION

According to the law of circumstances, every piece of evidence is significant and helpful when examining a series of events because "Facts do not lie, but man can do." Additionally, it shows that while spoken testimony can be manipulated or modified, the outcome of physical evidence and other corroborating evidence cannot, which clarifies the order of events. As a result, every piece of evidence must be carefully gathered and adequately stored. Similarly, the prevalence of botanical evidence at crime scenes increases its value in resolving legal disputes. So, the scientific discipline of forensic botany is the application of the understanding, methods, and study of plant science to legal issues.

Botanical trace evidence can connect suspects, victims, crime sites, and artifacts, among other things. This connection was made by contrasting the botanical pieces of evidence received from the suspects with the botanical pieces of evidence discovered at the crime scene. However, because of the few forensic scientists trained in this discipline through academic study, the application of forensic botany in criminal or civil proceedings is constrained. Additionally, while most forensic scientists know techniques for determining a person's identification, they are still unsure how to find evidence from plants, animals, and insects. This knowledge gap is brought about by evidence collection teams' ignorance of the need to gather botanical trace evidence.

Despite training in one or more specialized areas of plant science, such as anatomy, genetics, morphology, systematics, taxonomy, plant ecology, palynology, algology, victimology, and so forth, scientists who have studied in academic institutions frequently lack forensic science training. In order to get the plant scientist accustomed to the routine, it is the investigator's responsibility to advise them of everyday forensic practices, such as how to handle evidence, the crime scene, and associated issues. Although its most frequent use is limited to identifying plant species, especially allegedly illegal ones, this field of study is still underused.

BOTANICAL EVIDENCE FROM PLANTS

Because of the parts and structural makeup of their bodies, including the environmental requirements that are unique to each species, plants can give forensic evidence. Therefore, botanical evidence can be helpful in forensic investigations of rape, burglary, kidnapping, and plant poisoning. Plants can also help identify the cause of death, such as whether it was an accident, suicide, or homicide, as well as the season during which the burial was supposed to occur. Additionally, it aids in establishing the primary or secondary scenes, locating missing bodies, determining the timing and cause of death through examining the gastrointestinal tract, and tracking drug

distribution networks involving particular plant species. Alternately, wood comparisons and identification can help locate buried bodies, while fungus can identify a person implicated in unlawful logging. Plant bits in a shoe connected to the victim's clothing can also point to a specific area. The same is true for pollen grains from various species, which can link suspects to crime scenes by providing information about the time and place of a crime. Botanical evidence is also present in wildlife situations where plants that are endangered or illegal, or items made from them, are gathered or trafficked.

BOTANICAL EVIDENCE GATHERING, HANDLING, AND PRESERVATION

The process of undertaking precise and efficient evidence gathering and preservation is known as crime scene management. The entire plant is not the offender but is employed as evidence to catch the criminal. The crime scene contains a variety of botanical evidence. Pollen grains and spores, seeds, leaves, flowers, wood, the stem or root of a plant or tree, bryophytes or mosses, lichens, various fungi, diatoms in underwater crime scenes, fruit, the bark of a stem or wood, etc. are just a few examples of the various types of evidence that can be used.

Similarly, botanical evidence can be found under a microscope at a crime scene, where careful collection, documentation, and preservation are crucial factors in evaluating botanical evidence. Botanists' training, including their capacity to access recorded data on the traits of the species to which the sample belongs, is also essential to correctly and adequately identifying botanical evidence. Unfortunately, occasionally samples are taken by unskilled staff or law enforcement. Guidelines should therefore specify that plant materials must be gathered in addition to a control sample. The color and shape of plants and leaves and other physical characteristics of the botanical material should be observed and photographed before gathering botanical evidence.

Pressing the plant material between a newspaper or catalog and letting it air dry naturally can preserve botanical evidence. With this approach, the plant's entire morphological makeup is preserved. Additionally, paper or plastic bags, in addition to cardboard boxes or airtight containers, are employed for gathering and managing botanical samples since they aid in keeping and drying botanical evidence. The type and nature of the botanical evidence would determine the storage bag or containers to be used. Additionally, forensic scientists should ensure the best temperature for evidence preservation because many botanical pieces of evidence can deteriorate due to high temperatures, humidity, or moisture. Botanical samples exposed to heat and higher temperatures, as w as unfavorable climatic conditions, also decompose or deteriorate within two to three days due to fungi. Alternatively, it should be shot from several angles before being collected to capture the fungi's physical characteristics, including shape, color, and size. The evidence is then gathered and placed in pasteboard boxes or paper bags. Furthermore, fungi should be adequately dried during preservation so that these bacteria lose their color and develop more distinct morphological traits.

When pollen grain evidence is suspected to be present at the crime scene, palynologists should be granted access to the area first to prevent pollen information from being unintentionally altered, removed, or contaminated by the action of other parties. Other evidence, such as pollen grains, can be recovered from various sources, including victims' and offenders' clothes, as well as from their hair, respiratory tracts, vehicle tires, air filters in cars, surrounding objects, and mud. In order to prevent microbial damage to the pollen grains in the sample, a pinch of the control sample should be collected and put into a sterile container, with the location of the sampled area and the time the sample was collected noted. The collected samples can then be stored in marked, contamination-proof containers and later in cold storage at about 0°C. The botanical evidence is then separated for further study utilizing methods including sifting, centrifugation, and hot surfactant solution.

Similarly, various techniques can gather pollen samples from pavement materials, such as faux stone, tiles, bricks, wood, concrete slabs, etc. Transparent taping, lint rollers, and electrical tapes are some tape lifting techniques; cotton swabs moistened in sterile water or dust remover are used for swabbing. These samples can then, if necessary, be kept in cardboard containers as well as paper or plastic bags. After thorough drying, place in boxes or sealed containers.

SUBJECTS IN FORENSIC BOTANY

Various fields of study fall under the umbrella of forensic botany. They include palynology (the study of pollen and spores), limnology (the study of freshwater plants), bryology (the study of bryophytes), dendrochronology (the study of growth rings of tree stems, wood, and roots), plant ecology (the study of the growth pattern of vegetation), and plant systematics (the study of evolutionary relationships between plant species and taxonomy for the analysis of plant spec). Fig. lists the main branches of forensic botany. 1.

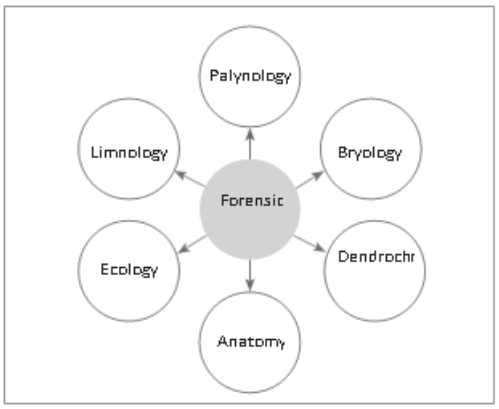

Fig. The Fields of Forensic Botany 1

PALYNOLOGY

The study of pollen grains and spores is known as palynology. The study of present-day and extinct spores or pollens and their application as evidence in criminal investigations is known as forensic palynology. In addition, due to their high abundance, persistence, identifiability, dispersal mechanisms, plenitude and stability to mechanical and chemical destruction, morphology, and the microscopic size of pollen and spores, they are well-established research tools in many scientific developments. Pollen grains contain morphological and genetic information that helps to specify the geographical location. Notably, in certain countries, forensic palynology has gained widespread acceptance and has been tested in court; nevertheless, neither of these developments is currently taking place in other nations. The significant uses of forensic paleontology are listed below.

1. It facilitates the connection between materials and objects found at crime scenes that can connect a scene to a suspect.
2. It connects a suspect to the scene of the crime or the finding
scene.
3. It connects the disclosure scene's materials or evidence to the crime scene.
4. It aids in proving or refuting plausible answers.
5. It reduces the number of potential suspects.
6. It aids in tracking the history of the drug movement.
7. It gives information on the materials' provenance discovered at the crime scene.
8. It successfully supports or refutes alibis.
9. It provides details on the geographical location of objects.
10. It aids the police in finding answers to their inquiries.
11. It aids in the discovery of hidden tombs and human remains.

Lockard's exchange principle, which argues that "whenever two objects come in contact, there is always a transfer of material" that will yield a pollen fingerprint, is followed by forensic palynologists. As a result, the forensic palynologist's initial step is to attempt and compare the pollen in a forensic sample to that from a known geographic area. Palynology also involves studying and identifying many classes of tiny bodies, the most significant being pollen, plant spores, and fungal spores. Palynologists should be knowledgeable about pollen dispersal, developmental responses, and phenology because these concepts influence the solution of case problems. Conifers and flowering plants produce pollen grains, while plant spores are produced by mosses, ferns, their associates, and fungi.

Pollen walls are made of interlocking coils and strands of sporopollenin, one of the most chemically stable inert biological polymers. Although its exine is composed of cellulose, various proteins, and lipids, pollen walls can lose all viability. This is because sporopollenin is a large, randomly cross-linked molecule with a carbon: hydrogen: oxygen ratio of 4:6:1. This polymer can shield pollen and spores from environmental hazards like rain, extreme heat, and soil-based toxins. Additionally, it aids in preserving all pollen characteristics and DNA, which constitutes the majority of pollen for up to many years. These qualities led to pollen and spores being crucial evidence in criminal investigations. In the incidents reported here, pollen and spores played significant roles and served as the primary source of evidence.

Case 1

New Zealand is where the case was reported. An enormous amount of hashish resin was discovered in the possession of a suspect detained in a port city in New Zealand. A chemical analysis of the various resin samples indicated a composition different from the hashish that law enforcement officers typically find. Determining

whether the new hashish samples represented a new importation type from a potential new foreign source or whether they represented a new type of hashish being produced someplace in New Zealand was, therefore, a topic of discussion. A pollen assemblage connecting the three samples of the seized hashish to a producing region in tropical Southeast Asia or Indomalaya was discovered after a New Zealand forensic palynologist examined them. Additionally, findings revealed that none of the three samples originated from plants growing in the New Zealand region and that all three came from the same imported "block" of hashish.

Case 2

A young woman was allegedly sexually assaulted at night in a forested area 120 meters from her home. The suspect refused her account, claiming that they had consensual sexual intercourse 130 meters away from the purported crime site, on a patch of short turf in a neighborhood park. Samples from each location and each party's attire and footwear were gathered for evaluation and analysis. Additionally, all locations pertinent to the case were looked into and visited. Additionally, lists of plant species were created. Results showed that the palynological and mycological profiles generated by both parties' footwear and apparel were comparable to those of the woodland region but distinct from those of the park. The palynological profiles gathered from the clothing and shoes of both parties matched those from the woodland more than those from the park, according to further analysis of comparator samples and displays. hence, the Palynological data overwhelmingly favored the woman's theory versus the suspect. Therefore, assuming that the girl's evidence was more reliable than the defendant's was more reasonable. The defendant afterward admitted that he had slept with the girl in the forested area, as she had stated.

BRYOLOGY

Forensic bryology is a field that uses the study of bryophytes in criminal investigations and legal concerns. Bryology is the study of bryophytes, which includes mosses, liverworts, and hornworts. Because they are so common in the wild, bryophytes exhibit their unique qualities. Additionally, their particles naturally remain in the dirt, detritus, and soil because they are little. They consequently conveniently attach to items like shoes, clothing, or cars. Bryophyte species have extensive geographic ranges because they aid in focusing a site or route. The microscopic bryophyte fragments are also helpful because, typically, this scale is utilized by professionals for identification and a tiny moss leaf that is less than a millimeter long suffices for precise identification. Bryophytes are clonal, which makes their DNA simple to extract and study. They can tolerate sporadic dehydration or other harsh conditions, as well as their resistance to decay and unacceptability to most herbivores. Plant clones have a single genotype that can be recognized using DNA marker techniques. The results can then be used as court evidence to connect a suspect to a crime. Typically, the bryophytes plant can grow to a height of between cm and meters. These plants develop as patches or mats on the ground, wood, etc. By studying segments on their stems, which have two development forms—the sympodial growth form and the monopodial growth form—bryophyte species can be identified by their growth time. When lateral buds grow in the following season after the apical meristems (growing tip) die at the end of the growing season, this is known as the sympodial growth form.

On the other hand, the monopodial growth form is when apical meristems continue to grow throughout the plant's lifetime and continue to grow from the previous year. Monopodial growth is more regular than sympodial growth. The annual segments are easier to identify because they are located in a region where side slings alter their size and position.

CASE STUDY

S.B. was a 22-year-old Caucasian female student at the University of Siena's Faculty of Medicine in Tuscany, Italy. The youngster was receiving both psychotherapy and pharmacological therapy for her severe depression. As a result, she was frequently exposed to consultations and visits at the hospital's psychiatry department in Siena. She steadfastly refuted having suicidal intentions during the most recent round of interviews. However, the girl was despondent during counseling. The teenager committed suicide by jumping off the roof of a shopping complex in the heart of Siena after undergoing therapy for a few months. The townhouse of a four-story structure that housed a shopping mall served as the crime site. Investigations established that the University for Foreigners of the University of Siena, this mansion, and the city's bus station were unavailable to users. As a result, there were no viable eyewitnesses or pieces of evidence to provide information about what occurred at the crime scene. Traces of mosses that had been removed were discovered on the townhouse's masonry parapet during the investigation of the crime scene. The victim's shoes' bottoms also had similar mosses, which were discovered. Medical examiners' further inquiries established no mosses on the townhouse's floor.

Additionally, mosses were discovered while investigating the walkway and service stairs leading to the property. Notably, certain spots between the walkway and service scale had damage consistent with trampling. As a result, a sample of moss was taken from these locations. After being collected, samples were kept in sterile test tubes. All moss remnants found on the townhouse's masonry parapet, including those found underneath the victim's shoes, were meticulously gathered and kept in a test tube for later study. After that, the samples were given to bryologists and plant ecologists from the University of Trieste's Department of Life Sciences for identification and comparison. Then, samples of botanical materials were put on slides for investigation and stereo microscopically seen. To

identify the sampled materials, dichotomous identification techniques were also applied. Two species—Tortula muralis Hedw and Bryum capillare Hedw—were identified as a consequence. The removal of bryophytes from the girl's shoes and the townhouse's parapet, as well as the discovery of new bryophytes on the steps, all contributed to the reconstruction of the accident. Therefore, it was suggested that the girl had gone up to the service stairs by herself and had tracked moss into her shoes as she did so. She then leaped onto the townhouse's balcony and hanged herself. It seemed unlikely that she was knocked to the ground during a brawl since if she had been thrown, she wouldn't have left a mark with the moss removed on the parapet.

LIMNOLOGY

Aquatic plants, such as algae and diatoms, can be beneficial to link suspects to a crime scene or establish that drowning occurred in freshwater. Limnology is the study of freshwater bodies and mainly focuses on the presence of diatoms in crime scene samples and on victims. Diatoms are unicellular, photosynthesizing algae with a siliceous skeleton found in fresh and marine waterways and soils, including significant moist environments. Diatoms are classed according to their shape, color, and pattern. However, diatom populations alter periodically in lakes, rivers, and ponds. Nearly any habitat that is moist and aquatic is home to living diatoms. Many of these diatoms represent the most prevalent and diversified class of algae. Diatoms can also be used for several different things. These applications include examining drowning cases and matching environmental samples with chemicals or materials that have come into touch with water. Finding and connecting the location of an underwater crime also falls under this category.

CASE STUDY

Two young boys were brutally attacked by adolescent attackers in 1991 while fishing at a Connecticut residential pond. The lads were brutally assaulted, restrained with duct tape, held at knifepoint, and dragged into the pond where they drowned and died. One of the two youngsters eventually broke free, saving himself and his comrade. Three individuals were in custody after extensive criminal investigations that lasted for hours. Investigators gathered sediment samples and crusted footwear from the victims and the attackers. They were then examined for algal and diatom species to determine how suspects were connected to the crime scene. The samples from each pair of sneakers as well as reference samples from the pond, were then examined under a microscope. Results demonstrated that the acquired samples contained the same species. Each species' distribution patterns were seen to be similar. Consequently, the findings confirmed that the samples came from a shared freshwater source.

ECOLOGY AND SYSTEMATIZATION OF PLANTS

Plant ecology is a branch of ecology that focuses on the distribution and growth patterns of plants, the influences of environmental factors on plant growth, and the interactions between plants and other organisms. Forensic plant ecology refers to the application of plant ecology to the investigation of criminal cases by identifying and analyzing plant fragments and their connection to the crime scene. Estimating the period of death can be done using growth patterns and plants' vegetative (non-flowering) part.

Examining plant debris can also assist in identifying people and the crime scene. Plant systematics is the study of evolutionary relationships between plant species and taxonomy, i.e., plant species identification, which is the first step in analyzing botanical evidence, and plant ecology are helpful in locating hidden graves. These plant fragments are proposed to be found inside vehicles, underneath the body, in the engine compartment, around the wiper blades, and so on, as identified during the investigation. Cannabis is recognized by the presence of cystolith hairs, which are seen on the plant's leaves. Systolic hairs are present in more than 80 different plant species. Hence their presence is not essential for identification. The "Duquenois-Levine color test" is a method for determining whether marijuana is present. Additionally, species identification can assist in the resolution of plant poisoning cases by identifying the kind of poison and its plant source. This test exhibits a purple color in the chloroform layer for a positive result.

CASE STUDY

Southeast Colorado was the location of the case. Her boyfriend fractured the jaw of the mother of Jacklyn Funderberg, a newborn. The ex-wife and the boyfriend then made their way back. Jacklyn vanished shortly after, and her body was discovered on the eastern prairie, buried in a small grave at the base of a rocky outcrop. A shrub was growing on the outcrop, which is exclusive to this formation.

Along with grasses that could only be found at the victim's burial, fragments of this plant matched those discovered on the victim's body. According to investigators, the body was hurled off the top of the outcrop and then buried at the bottom. Investigations revealed the former partner. No plant fragment was discovered when his car was examined, leading to the assumption that it had just had a thorough cleWhile in detention then. The boyfriend called his attention and asked her to wash some of his items and conceal a pair of shoes. Based on this knowledge, the investigators obtained a warrant using his recorded phone message, took his garments from his ex-wife's washing machine, and searched his home. Investigators examined the suspect's clothing and discovered that it was

contaminated with fragments of the unusual shrub growing at the top of the outcrop and fragments of the low-elevation grasses discovered close to the burial. The suspect changed his tale and said throughout the trial that they had both planned to leap over the top of the cliff but that he had lost his courage when it was his turn after seeing all of this evidence. Then, in terror, he buried her body to conceal all the incidents. As a result, this indirect plant evidence suggested that he was present at the crime scene or a nearby place, producing concrete evidence presented at trial and resulting in a first-degree murder conviction.

PLANT MORPHOLOGY

Plant anatomy is the study of plants' size, shape, and internal structure. Forensic plant anatomy is the study of plant species identification in legal proceedings. Each plant has a unique arrangement of cell types with varying sizes, shapes, and inclusion patterns. Since plant cells never lose their identifying properties while traveling through the human digestive tract, these traits enable identifying specific food plants in samples taken. Furthermore, plant anatomy employs numerous characteristics, such as leaf morphology and tree growth ring patterns of seeds, tree bark, flowers, and so forth, in order to perform physical matches of evidence and identify species, respectively. Studies have also shown that digested seeds, even a single tomato seed, can release enough high-quality DNA.

CASE STUDY

A young college graduate who was working in Denver in the early 1980s missed her nighttime flight home, where she was staying with her family. The next day, her body was discovered. Investigations revealed that she last ate lunch with heat noon r partner at a popular fast-food joint known for double all-meat burgers with lettuce, cheese, and special sauce, es at noon. However, the Jefferson County coroner discovered during her examination that the stomach contents included vegetable substances not available at this fast-food restaurant back then. He thus asked forensic botanists to look at slides of the stomach contents he had made to see if they could recognize the plant material there. According to forensic botanists, the woman had eaten another meal before she passed away since they found plants that were, in fact, not available at that restaurant. After more examination, forensic botanists discovered pieces of red cabbage, kidney beans, and onions—none offered at that fast-food establishment. Investigations also revealed that the boyfriend had an alibi for the remainder of the day, even if he didn't have one therefore, he was therefore eliminated as a suspect becausalloweden the chance to conduct the crime. But a few years later, it was revealed through the confession of a serial killer that she had been on her way home from work when the killer had encountered her a second time by accident, thinking this time that she was a friend of her brother. She had an accident at her brotleadingse, leading to the mix-up. She consequently consented to dine with the murderer in a restaurant with a salad bar. The stomach's contents served were identical to those discovered during an autopsy.

DENDROCHRONOLOGY

Tree ring dating is another name for this discipline. Dendro-chronology is the science that examines the annual growth increments and dating of tree rings on woody trees and shrubs. Each ring contains details about its environment at the time of growth, including the order in which it formed. This information can then be used to reconstruct critical historical events. This field was used to shed light on previous climatic conditions, which can also reveal the age and origin of trees. Visual dendrochronology, chemical dendrochronology, and genetic dendrochronology are the three approaches that can be used to conduct dendrological identification. Dendrochronology also has several uses in forensic timber analysis. While genetic dendrochronology incorporates DNA barcoding, population genetics, DNA fingerprinting, etc., chemical dendrochronology uses chemical analysis techniques like mass spectroscopy, near-infrared spectroscopy, radiocarbon, detector dogs, and stable isotopes. Visual dendrochronology involves the visual study of wood anatomy.

CASE STUDY

The kidnapping and death of Charles Lindbergh's infant son in 1932 marked the first instance of botanical evidence used in court in the modern period. Dendrochronology research played a significant part. A wooden ladder was employed in this case. To enter the nursery on the second floor and abduct, Li was employed. Bruno Richard Hauptman was later found guilty of the crime thanks to the assistance of Arthur Koehler, a wood identification specialist with the Wisconsin-based Forest Products Laboratory of the US Forest Service. Koehler had a stellar academic record and testified in a number of instances prior to the well-known Lindbergh trial. During an evaluation of the case, Koehler employed a microscopic study of the wood grain patterns to identify the four tree species used to build the ladder yellow pine, ponderosa pine, Douglas fir, and birch. He then examined the decisions made by the industry made l planning mill on the wood. He also recognized the hand plane Hauptman had used to build the ladder. Koehler also examined the plane patterns left on the wood under oblique light in a negative space.

Additionally, he linked the wood to a shipment of yellow pine supplied to the National Lumber and Millwork Company in the Bronx, New York, using the plain mill marks on the pieces. It was determined that Hauptman's hand plane made the same hand plane marks on the ladder. Finally, Koehler connected a piece of wood in

Hauptman's attic to the annual growth rings and knot patterns on rail 16 of the ladder. He saw that the growth rings and knots on rail 16 matched a piece of exposed wood in the attic precisely. The prosecution's claim that a part had been removed to build the ladder is supported by this discovery. This case serves as an example of how dendrochronology can be used to establish vital connections pointing to Hauptman's involvement in the Lindbergh kidnapping.

MYCOLOGY IS A FURTHER SIGNIFICANT BIOLOGICAL INDICATOR.

Mycology is not a part of the kingdom Plantae. However, it is a crucial piece of biological evidence because fungi have been used as evidence in numerous criminal investigations. Mycology is the branch that investigates, analyzes, and identifies identification of fungi found at crime scenes to resolve legal disputes. This includes studying all varieties of fungi, including molds, mushrooms, and yeasts. Multiple applications can be made from forensic mycology. It can offer traces of evidence for determining the cause of death, determining the time of deposition, and predicting postmortem intervals. Other uses include determining the origin of hallucinations or poisoning, locating buried bodies, identifying biological warfare, and connecting a suspect to a crime. However, they also benefit their hosts by feeding on dead and decaying matter. As a result, fungal palynomorphs are typically found on materials like stones, bricks, tiles, wooden objects, food, leather, plastic, rubber, etc. The primary places where fungi can be discovered during criminal investigations are soils, sediments, plants, plant litter, corpses, blood, etc. Spores, produced either sexually, asexually, or both, are used by fungi to spread.

There are millions of different types of fungi on Earth. According to theories, even healthy people can get fungal infections. Thus, fungi that infect people are those that can survive the body's natural defenses and human body temperature. These species can cause superficial skin infections (like ringworm fungi), invasive infections (like candidiasis or thrush), and more severe infections in the lungs (like aspergillosis) and other tissues (mycetomas, mycoses). As an alternative, various fungal species, including those found on edibles like Penicillium, Mucor, Aspergillus, Fusarium, and Geotrichum, are practical tools for determining postmortem periods. Mycology has established itself as one of the most crucial areas of forensic research. Its potential and practical applications have, so far, been somewhat constrained.

CASE STUDY

In Dundee, a young woman was killed after being raped. Investigations revealed significant fungal growth on her body's exposed areas. Photographs taken at the deposition location indicated these growths. A mycologist hadn't been contacted before the body had been destroyed. It was so determined that the body had been there for at least two weeks based on the recent low temperatures in the area. A suspect and the victim's deposition place were connected thanks to pollen and fungus spores. The estimated postmortem interval coincided with when the victim and suspect were captured on a security camera. The murder suspect was given a life term in prison because of prior sexual offense convictions.

CONCLUSIONS

An essential and reliable tool for crime scene investigations is forensic botany. A connection to a case of suspected criminal activity, such as a suicide, accident, or homicide, may yield botanical evidence. The same is true for botanical evidence, such as pollen grains, which can be found on both victims' and offenders' clothing, in their hair, or even in their respiratory tracts, car tires, air filters, and mud. However, the skill and experience of a forensic specialist are in arcollecting and analyzing and analysis of these botanicals. The abovementioned incidents show how crucial botanical evidence is to crime scene investigations. Microscopical, molecular, biological, and morphological identification techniques can be used to assess botanical data. Consequently, the genetic data gleaned from this evidence aids in predicting a potential crime link.

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