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THE BRANCHES OF FORENSIC BOTANY

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ABSTRACT

Forensic botany refers to the application of plant sciences to the legal process. Hence, forensic botany involves gathering clues from plants to piece together evidence that will assist to solve serious crimes like the cause of death, kidnapping, and murder. There are several branches of forensic botany. Palynology refers to the study of pollen grains, spores, and microscopic plant bodies resistant to acidity to prove or disprove a connection between people, places, and objects that are under investigation in criminal and civil cases. Pollen, spores, and acid-resistant microscopic plant bodies can be used to tell whether a person or object was present at a particular place because different parts of a piece of land, countries, and regions of the world all have their own distinctive pollen and spore assemblage. Forensic dendrochronology refers to the scientific study of dating tree growth rings to determine the exact year in which these rings as a means of offering evidence that criminal activity occurred in this time span. Forensic limnology is the branch of forensic botany that examines the presence and type of diatoms on victims and samples from a crime scene. Plant systematics refers to the process through which plants are classified into different classes and families based on their morphological and genetic characteristics. Hence, forensic plant systematic is the application of this knowledge to the process of solving crimes. All these methods should be supplemented with other methods, such as forensic ecology, confirm the validity of the findings of the forensic botanist.

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INTRODUCTION

Forensic botany is a branch of forensic science that applies plant sciences to the legal process (Robertson, Vignaux, and Berger, 2016; Rosenblatt, 2015; Saferstein, Meloan, and James, 2014). Hence, forensic botany involves gathering clues from plants to piece together evidence that will assist to solve serious crimes like the cause of death, kidnapping, and murder (Aquila, Ausania, Di Nunzio, and Ricci, 2014). Some of the plant sciences that are applied include; plant anatomy (study of plant cells); plant taxonomy (study of types and families of plants); plant systematic (the study of the relationship between different plants); plant ecology (study of plants in their environment); palynology (study of plant spores and pollen) (Aquila, Ausania, Di Nunzio, and Ricci, 2014). Forensic botany is enabled by the indestructibility of plant cell walls that can be preserved for thousands of years even after the cytoplasm has decayed (Margiotta, Bacaro, Carnevali, and Gabrielli, 2015).

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Also, the walls of spores and pollen grains are composed of materials that are resistant to decay for thousands of years (Margiotta, Bacaro, Carnevali, and Gabrielli, 2015). Criminals may leave crime scenes with these spores and pollen grains attached on their shoes and clothes of a criminal, and if this is proved, these individuals are treated as culpable of the crime under investigation (Margiotta, Bacaro, Carnevali, and Gabrielli, 2015). Forensic botanists provide private consultations in criminal cases. However, for their evidence to be accepted by a court of law, these individuals are judged by their educational credentials and experiences (Margiotta, Bacaro, Carnevali, and Gabrielli, 2015). Many criminal and civil cases have proven the usefulness of forensic botany, and hence, this branch of forensic science is indispensable in the modern world (Aquila, Ausania, Di Nunzio, and Ricci, 2014). However, the findings from forensic botany should be supplemented with investigations into forensic ecology to validate the findings and ensure that the data collected is accurate.

Branches of Forensic Botany: Different branches of forensic botany are applied when deducing the identity of criminals.

These branches focus on either the composition of plants or the relationship of plants with their environment (Aquila, Gratteri, Sacco, and Ricci, 2018). For instance, a criminal may be charged because he or she had spores on their clothes (micro-scale) or because they left evidence within the environment that can make them culpable (macro-scale) (Aquila, Gratteri, Sacco, and Ricci, 2018).

Forensic Palynology: Palynology refers to the study of pollen grains, spores, and microscopic plant bodies resistant to acidity to prove or disprove a connection between people, places, and objects that are under investigation in criminal and civil cases (Laurence, 2018). Pollen, spores, and acid-resistant microscopic plant bodies can be used to tell whether a person or object was present at a particular place because different parts of a piece of land, countries, and regions of the world all have their own distinctive pollen and spore assemblage (Wiltshire, 2016). Additionally, pollen and spores can indicate the season in which a person or object was present in a certain location (Laurence, 2018). Also, pollen can be used to determine whether a body was moved after a murder. During the time of the murder, pollen and spores attach themselves to the body of the victim (Wiltshire, 2016). Through forensic entomology, it is possible to approximate the date and time of the murder. Hence, if the pollen grains or spores fail to match the environment in which the body was found, it indicates that the body was dumped there after the murder (Laurence, 2018). Therefore, forensic palynology can be used to trace the place in which a murder was committed. In fact, it has been used in several cases to determine the location of people and objects at the time of a crime. For instance, forensic experts gathered evidence from Bosnia mass graves to prove the culpability of Bosnia war criminals. Bosnian war crimes sought to cover up their war crimes by exhuming bodies from mass graves and transferred these bodies to smaller graves and claimed that these people had died in minor battles (King and Meernik, 2017). However, these forensic scientists found pollen grains on the exhumed bodies that did not match with pollen found on the sites of the small battles.

These pollen grains were traced to the regions in which these war criminals had massacred countless innocent individuals, including women and children (King and Meernik, 2017). Additionally, soil samples from the mass graves and the smaller grave sites were analyzed. The soil samples contained traces of the same pollen grains that were absent in the environment surrounding the grave sites (King and Meernik, 2017). This similarity indicated that the bodies were originally in mass graves but were later transferred to hide the activities of the war criminals that were involved in mass murders (King and Meernik, 2017). Hence, forensic palynology can accurately trace the location of crimes. Passarelli and Cortes conducted a study on the vegetation adjacent to Punta Lara Reserve over a period of four years to determine if the pollen grains unique to this region can be used as forensic evidence (Passaelli and Cortes, 2017). Eight botanical families were selected in this study because they had unique pollen characteristics that could be used to trace the plants that produced the pollen. The botanical families that were selected for this study were Pontederiaceae, Marantaceae, Malpighiaceae, Lytharaceae, Iridiaceae, Fabaceae, and Alismataceae. Soil samples from this region were screened in a laboratory for the presence of pollen spores from these plants. The results indicated that soil samples contained samples of pollen grains from these plants. Therefore, Passarelli and Cortes concluded that any crime committed in this region could be confirmed through the presence of these pollen grains on people or objects that had made contact with the soil. For instance, a person who had committed a crime in this area would gather these spores in their shoes. Hence, a forensic scientist can prove the culpability of the individual by analyzing the soil samples in the person's shoes.

Forensic Dendrochronology: Forensic dendrochronology refers to the scientific study of dating tree growth rings to determine the exact year in which these rings as a means of offering evidence that criminal activity occurred in this time span (Dormontt, Boner, Braun, and Gardner, 2015). It has been proven that different species of trees have different patterns of ring formation; with most trees producing one ring for each annual year. However, some species produce a ring over a longer period while some produce rings over a shorter period, and thus, the most important factor is to determine the average time for a tree species to produce rings (Pier-Matteo, Di Maggio, and Ferarra, 2015). Also, it has been determined that the thickness of these rings varies with age and the climatic conditions present at the time when the ring was formed. Outer rings are wider and more far-spaced while inner rings are more compact and smaller in diameter (Pier-Matteo, Di Maggio, and Ferarra, 2015). Rings that were formed when there was abundant water in the soil are lighter in color while rings that were formed when there was less soil water have a darker hue (Dormontt, Boner, Braun, and Gardner, 2015).

Additionally, the older rings are darker while the younger rings are brighter in color, a factor attributed to the sedimentation of mineral substances in these rings over time (Dormontt, Boner, Braun, and Gardner, 2015). The main criminal activity that is determined using this means is the determination of illegal logging. For instance, loggers who fail to meet the designed regulations in Chile have been apprehended through this means (Pier-Matteo, Di Maggio, and Ferarra, 2015). Logs acquired from forests are dated using dendrochronology to determine the spots from which they have been acquired. Logging of certain trees has been banned by government activity in different countries to protect some tree species from extinction (Dormontt, Boner, Braun, and Gardner, 2015). Also, logging in some forests has been banned as a measure to protect local eco-systems. Hence, anti-logging agencies that arrest loggers found with materials that are suspected to be from these forests conduct dendrochronological tests on these trees (Dormontt, Boner, Braun, and Gardner, 2015).

The culpability of illegal loggers has been determined using this means numerous times. More importantly, dendrochronology has been used to improve transparency in the timber trade through scientific verification of logs acquired from forests. Lowe et al. report that members of the United Nations passed Resolution 23/1 that aimed to combat illegal logging within these countries after they identified the importance of forest eco-systems in sustaining life on earth (Lowe, Dormonnt, Bowie, Degen, Gardner, and Thomas, 2016). In this conference, the delegates agreed to embrace dendrochronology and other technologies used to date and identify trees to combat illegal logging. These delegates also agreed to punish illegal loggers so that global climatic conditions will not change for the worse because of excessive deforestation (Lowe, Dormonnt, Bowie, Degen, Gardner, and Thomas, 2016).

Forensic Limnology: Forensic limnology is the branch of forensic botany that examines the presence and type of diatoms on victims and samples from a crime scene (Daria, Wojterska, Grewling, and Kokociński, 2015). There are different methods of collecting this data but all compare the diatom colonies present in the suspected crime scenes and suspects with diatom colonies present in samples (Daria, Wojterska, Grewling, and Kokociński, 2015). Diatoms are microscopic algae containing silica in their cell walls and are differentiated by their size, shape, and color. There are approximately 8,000 extant species of diatoms, without considering the different variations within these species because of differences in the conditions between different water bodies. Diatoms are mainly found in freshwater bodies and do not survive in domestic water sources because of the cleaning agents present in these sources (Daria, Wojterska, Grewling, and Kokociński, 2015). When diatoms die, their silica cell walls compose a portion of the water sediments. These organisms die at different rates throughout the year because of variations in the seasons (Carter and Chesson, 2017). For instance, during early spring and autumn, the number of living diatoms is higher than that of living diatoms. On the other hand, there are more dead diatoms than living ones during summer and winter (Medlin, 2016). Therefore, by calculating the ratio between living and dead diatoms, it is possible to determine the season in which the water sample had been collected (Medlin, 2016). However, using this method has several disadvantages. First, diatoms can only be used in cases where the victims have inhaled or ingested water samples into their blood or airways (Medlin, 2016). If diatoms do not enter the bloodstream or alveolar airways, the sample collected from the victim will not be reliable. Secondly, diatoms are not limited to water bodies but are also found in air, drinks, food, and clothes. The presence of diatoms outside water bodies compromises the accuracy of using forensic limnology to determine the culpability of suspects in criminal activities (Medlin, 2016). Finally, diatoms can be destroyed based on the chemical properties of the body that they encounter. Diatoms have an acidic cell wall that can be corroded by alkaline substances, and thus the suspect can interfere with evidence by ingesting and applying basic substances because such substances will destroy most of the diatoms (Medlin, 2016). Hence, forensic limnology has many challenges and makes the accuracy of evidence collected using this method very low (Daria, Wojterska, Grewling, and Kokociński, 2015).

Forensic Plant Systematics: Plant systematics refers to the process through which plants are classified into different classes and families based on their morphological and genetic characteristics (Huntley, 2016). Hence, forensic plant systematic is the application of this knowledge to the process of solving crimes (Kress, 2017). In the course of committing a crime, an individual may accidentally have plant residues attached to their body and clothes. For instance, a criminal passing through a bush after committing a murder may have blackjacks attached to their clothes (Kress, 2017). Because each blackjack plant has its unique genetic sequencing, DNA analysis of the samples of blackjack on the individual's body can help in the solving of the murder. In case the DNA of the blackjacks on the suspect matches the DNA of the blackjacks on the crime scene, the suspect is either the murderer, an accomplice, or witnessed the crime (Kress, 2017). However, this method should be used alongside other methods because the suspect may have passed through the bush earlier than or later than the actual time of the murder (Kress, 2017).

Forensic Ecology: Ecology involves the study of the relationship between different plant and animal species in a region (Chesson, Janette, Bowen, Brooks, Casalle, and Cook, 2018). Therefore, forensic ecology is applying this knowledge to the interaction of plant and animal species in a habitat to investigate the culpability of criminals. As stated earlier, forensic ecology should be used to validate the findings of forensic botany so that the findings can be proven to be as close as possible to the actual details of the crime (Chesson, Janette, Bowen, Brooks, Casalle, and Cook, 2018). Knowledge about the different species can help the forensic scientist to estimate the time at which a crime was committed. In this branch of forensic science, insects play the greatest role because of their mobility and their ability to pick up and respond to different stimuli in the atmosphere (Chesson, Janette, Bowen, Brooks, Casalle, and Cook, 2018). For instance, dead bodies transmit chemical substances into the atmosphere that attract insects such as flies into the body. When the flies land on the body, they consume juices from the body and lay eggs Because the life cycle of many fly species has been established, by noting the age of the larvae and pupae on the dead body can be sued to estimate the time of death. After complete decomposition, beetles are drawn to the dead body and thus the presence of beetles can also be used to estimate the time of death (Chesson, Janette, Bowen, Brooks, Casalle, and Cook, 2018).

In 1235 A.D., Sung Tz'u was the first person in history to document the application of forensic ecology to the investigation of crime (Wescott, 2018). A murdered individual in a small village had a serious wound that had been inflicted by a farming sickle. After finding that no individual was ready to confess to the crime, Tz'u asked all villagers to place their sickles on the ground. One of the sickles was attracting flies, and on closer examination, it was found to contain tiny pieces of flesh and blood. The owner of the sickle was forced to confess based on the evidence (Wescott, 2018). This shows that forensic ecology is reliable to track down the individuals culpable of a crime. Hence, this method can be used to complement the results obtained through forensic botany.

Conclusion

The application of the extant knowledge of plants into the legal process has grown exponentially since the 1930s and is now one of the branches of forensic science. It has been proven that plants have unique DNA traits that can be used to prove the innocence or guilt of suspects in a criminal investigation. Forensic limnology is applied to crimes that were committed in aquatic environments and can be used to show the time and duration of the crime. However, the presence of diatoms in the air takes away the reliability of this method and should be completed with other methods. Forensic dendrochronology is used to solve crimes involving illegal lumbering and has been used by many UN nations in a bid to fight climate change associated with irresponsible clearing of forest covers. Forensic palynology is the study of the relationship between pollen grains and spores and the events of a crime. However, all these methods of forensic botany should be supplemented with other methods to confirm the accuracy of the findings. For instance, through forensic ecology, it is possible to estimate the timeframe during which a crime was committed.

REFERENCES

Aquila, I., Ausania, F., Di Nunzio, C., and Ricci, P. 2014. The role of forensic botany in crime scene investigation: case report and review of literature. *Journal of forensic sciences. Journal of Forensic Science,* 59 (3), 820-824.

Aquila, I., Gratteri, S., Sacco, M., and Ricci, P. 2018. The role of forensic botany in solving a case: scientific evidence on the falsification of a crime scene. *Journal of forensic sciences,* 63 (3), 961-964.

Carter, J., and Chesson, L. 2017. Data Analysis Interpretation: Forensic Applications and Examples. In Food Forensics, 111-130.

Chesson, L., Janette, B., Bowen, G., Brooks, J., Casalle, J., and Cook, C. 2018. Applying the principles of isotope analysis in plant and animal ecology to forensic science in the Americas. Oecologia, 187 (4), 1077-1094.

Daria, B., Wojterska, M., Grewling, L., and Kokociński, M. 2015. Forensic botany: current state of knowledge and possible applications in investigative practice. *Issues of Forensic Science,* 288, 72-73.

Dormontt, E., Boner, M., Braun, B., and Gardner, S. 2015. Forensic timber identification: It's time to integrate disciplines to combat illegal logging. *Biological Conservation,* 191, 790-798.

Huntley, B. 2016. Plant Systematics World. Taxon, 65 (6), 1465-1468.

King, K., and Meernik, J. 2017. The Burden of Bearing Witness: The Impact of Testifying at War Crimes Tribunals. *Journal of Conflict Resolution,* 15 (3).

Kress, J. 2017. Plant DNA barcodes: Applications today and in the future. *Journal of Systematics and Evolution*, 55 (4), 291-307.

Laurence, A. 2018. Forensic Palynology in the United States: The Search for Geolocation. *Microscopy and Microanalysis,* 24 (1), 1186-1187.

Lowe, A., Dormonnt, E., Bowie, M., Degen, B., Gardner, S., and Thomas, D. 2016. Opportunities for Improved Transparency in the Timber Trade through Scientific Verification. *BioScience* , 66 (11), 990-998.

Margiotta, G., Bacaro, G., Carnevali, E., and Gabrielli, M. 2015. Forensic botany as a useful tool in the crime scene: Report of a case. *Journal of Forensic and Legal Medicine,* 34, 24-28.

Medlin, L. 2016. Evolution of the diatoms: major steps in their evolution and a review of the supporting molecular and morphological evidence. *Phycologia,* 55 (1), 79-103.

Passaelli, L. M., and Cortes, R. M. 2017. Pollen as a Forensic Tool in a Zone of Wetlands from Buenos Aires, Argentina. *Journal of Forensic Research,* 8 (366), 2.

Pier-Matteo, B., Di Maggio, R. M., and Ferarra, C. 2015. Forensic geo-archaeology in Italy: materials for a standardization. *International Journal of Archeology,* 3 (1), 45-56.

Robertson, B., Vignaux, G., and Berger, C. 2016. Interpreting evidence: evaluating forensic science in the courtroom. Hoboken: New Jersey: Joh Willey and Sons.

Rosenblatt, A. 2015. Digging for the disappeared: Forensic science after atrocity. Palo Alto: California: Stanford University Press.

Saferstein, R., Meloan, C., and James, R. 2014. Lab Manual for Criminalistics: An Introduction to Forensic Science. New Jersey: Prentice Hall.

Wescott, D. 2018. Recent advances in forensic anthropology: decomposition research. Forensic Sciences Research, 123 (3), 1-16.

Wiltshire, P. 2016. Protocols for forensic palynology. Palynology, 40 (1), 4-24.

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