Forensic palynology at the National Institute of Criminalistic and criminology of the National Gendarmerie

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***Abstract*—Forensic palynology is the study of pollen, spores and microscopic plankton for forensic purposes. This approach has been adopted by various countries' judiciary systems, and is being developed at the Forensic Fauna and Flora department of the National Institute of Criminalistics and Criminology of the National Gendarmerie (INCC/GN). Forensic palynology relies on the microscopic analysis of pollen and spores to demonstrate possible links between various objects of a crime scene, based on Locard's exchange principal.**

This article summarizes a preliminary test conducted at the Aquatic Fauna and Botany laboratory in its endeavor to adopt forensic palynology standard analysis method.

***Index Terms*— Forensic botany, Forensic palynology, Forensic science, Palynology, palynomorphs, Pollen analysis**.

I- INTRODUCTION

The forensic Fauna and Flora department of the National Institute of Criminalistics and Criminology of the Gendarmerie Nationale (INCC/GN), started the implementation of a new discipline: Forensic Botany, which consists in using plant material to assist forensic investigations, therefore taking advantage of the diversity of plants which constitute the country's flaura, and the affinity of some species to certain climatic conditions.

In order to fulfill this objective, a plan was set based on two axis; staff recruitment and training, and equipments acquisition. Meanwhile an exhaustive literature review is being performed in order to develop methods and standard operational procedures for laboratory analysis. This framework helped identify forensic palynology as the forensic botany sub-discipline to be developed first especially with regards to staff competency and equipments acquisition.

Palynology is the study of palynomorphs; microscopic particles of vegetal nature or origin which comprise pollen and spores, forensic palynology is then the discipline that studies palynomorphs as tools for forensic investigation.

Forensic palynology is a discipline based on ***Locard's exchange principal*** and considers pollen and spores as trace evidence, it studies similarities in pollen and spores composition between two or more objects/ samples to prove that there was contact between these objects, e.g. comparing pollen collected from a suspect's clothes with a sample from the crime scene might be useful in proving the presence of the suspect at the crime scene.

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Currently, forensic palynology analysis has been adopted in the juridical system of countries such as New Zealand, Canada, USA, and France, and pollen has proven to be a strong evidence in solving a variety of crimes such as burglaries, physical and sexual assaults, quality control and fraud detection of honey (meilissopalynology), and the study of fossil pollen in mass graves, ancient crime scenes, and ancient burial sites (paleobotany).

The application of this discipline was made possible by the development of palynological preparation techniques combined to optical microscopy and scanning electron microscopy (SEM). These techniques rely on the species specificity of pollen and spores, and their resistance to different variation of physical and chemical conditions, **acetolysis** (Erdtman 1969) being the most common technique used by palynologists.

The **acetolysis** method is a standard palynological preparation technique and a fundamental method for illustrating pollen grains by optical microscopy, which allows the extraction of information necessary for the description of a pollen grain (shape, size, color, outer wall ornamentation). It is used to remove the cellular content and **intine** (a component of the external membrane of the pollen grain). Moreover, it cleans pollen surfaces and colors pollen grains brown, which makes the pollen wall's detailed observation easier.

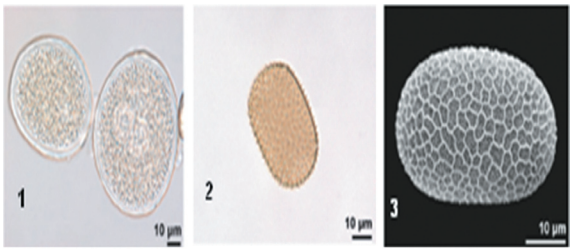

Fig. 1 Different treatments and observation techniques of pollen grains; 1: pollen grain in glycerin with LM, 2 : acetolysed pollen grain, 3: pollen grain under SEM

In order to assess the possible application of the technique at the Botany and Aquatic Fauna laboratory of the Forensic Fauna and Flaura Department, an experimental work simulating a physical assault which involves two individuals was planned and performed as detailed in the following chapter.

II. MATERIALS AND METHODS

A person wearing a lab-coat was asked to lie down in a ground section covered in grass and shrubs, for 1 min, the action is supposed to imitate the contact that could occur in case of a person –in this case the aggressor- falling on the ground, after an altercation or a fight.

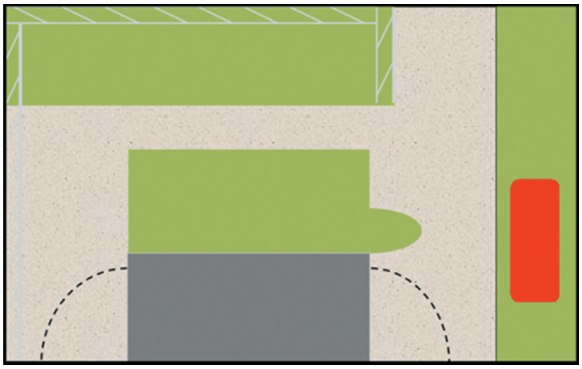

Fig. 2 sketch depicting the area in which the experiment was conducted (in red the area in which the person was laying down, in green: areas presenting vegetation).

The laboratory coat was immediately recovered in a Kraft paper envelope and stored at 3°c. Reference samples of plants from five locations of the area on which the experiment was conducted were also taken, in order to verify the capacity of this technique for result matching and therefore establishing a link between the location and clothes (the laboratory-coat).

The following day, the envelope containing lab-coat was opened and the content analyzed, acetolysis technique was then conducted and the results were mounted in glycerin jelly on permanent slides and sealed using paraffin, the slides were examined under an optical microscope at 400X and 1000X enlargement. Pictures of the different types of pollen observed were taken and their number counted for each type. Figure 3 shows the results of microscopic observation.

III. RESULTS

The examination of the lab-coat extracted pollen slides has revealed the presence of 130 pollen grains, distributed on 13 distinct pollen types; microphotographs of these types are shown in figure 03.

The results of counting for each pollen type are shown in Table I.

Table I.
Number of pollen grains counted per pollen type.

Pollen types	*Number of pollen grains per type*
Type 01	34
Type 02	29
Type 03	5
Type 04	5
Type 05	7
Type 06	13
Type 07	9
Type 08	5
Type 09	5
Type 10	10
Type 11	5
Type 12	2
Type 13	1
Total	**130**

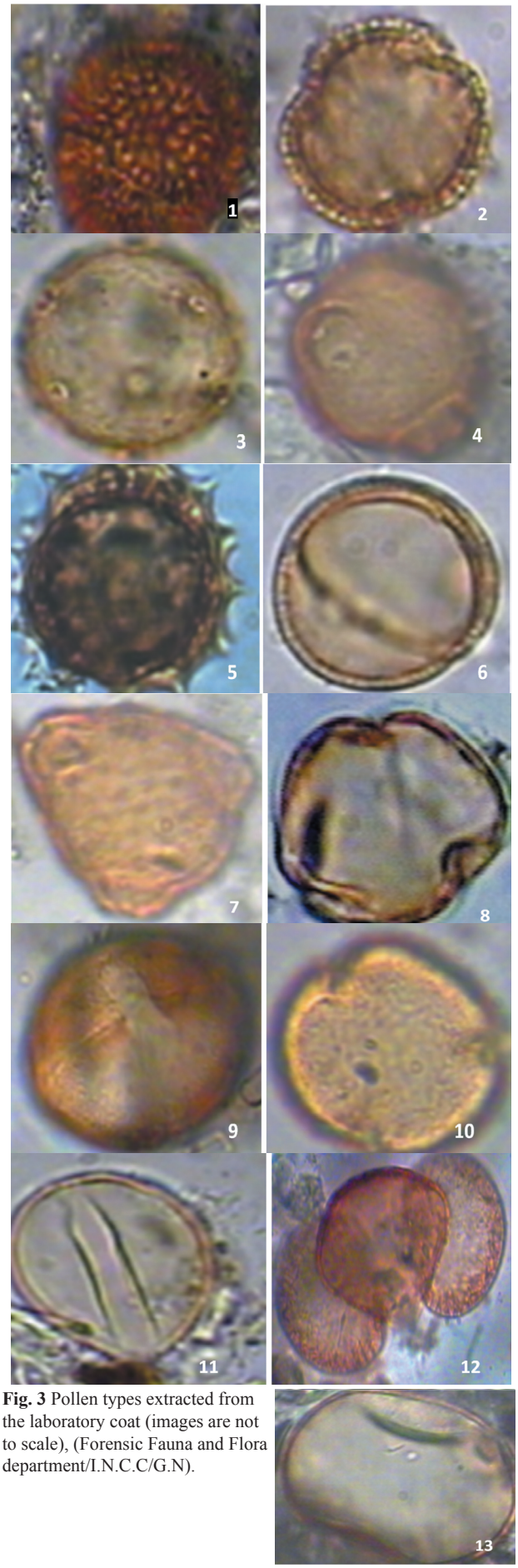

Fig. 3 Pollen types extracted from the laboratory coat (images are not to scale), (Forensic Fauna and Flora department/I.N.C.C/G.N).

A graphic representation of the distribution of pollen grains on the pollen types detected is shown in Figure 4.

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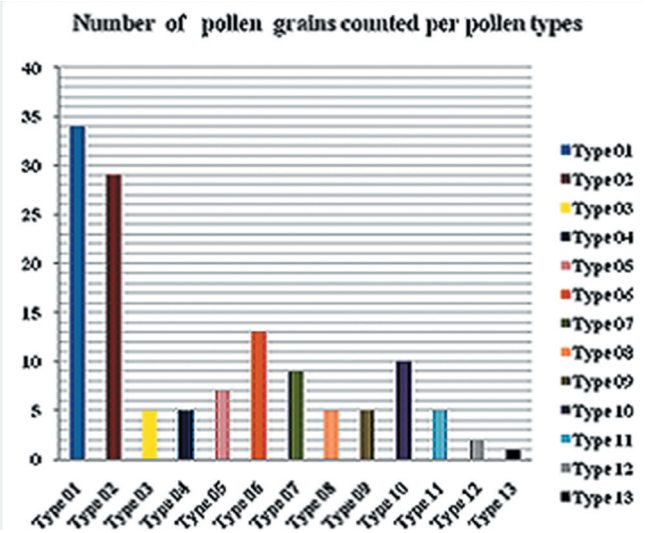

Fig. 4 representation of the distribution of pollen grains on the pollen types detected.

These results illustrate that the most common type of pollen encountered in the slide was the pollen of type 01, 06, 07 and 10; characteristic pollen of herbs and monocots, these numbers are explained by the predominance of herbs in the area of the experiment. The pollen type 12, is characteristic of coniferous trees, given that there are no conifers in the area of the experiment, the presence of this type is explained by the vicinity of trees to the area (approximately 50m) which was then transported by wind (note the presence of the two sacci the purpose of which is to help the air transportation of these pollen grains).

The analysis of samples taken from the area, and matching with the results of extraction from the laboratory coat, show that only one location possesses the same pollen assemblage extracted from the laboratory coat, the other locations present a unique and different assemblage than that of the laboratory coat

IV. CONCLUSION AND PERSPECTIVES

The experiment demonstrates that it is possible to extract or demonstrate the pollen composition of clothes which were in contact with plants; it is therefore a useful tool in proving or disproving the contact of objects, or in the matter: clothes, with plants at any given location.

The experiment also proves the possibility to match the pollen assemblage of an object with a location, which constitutes a useful and pertinent tool for proving or disproving contact between objects or the presence of suspects at a crime scene.

V. OUTCOME

This work demonstrated a perfect handling of the acetolysis technique by the personnel of the laboratory; therefore the department aspires to the development and implementation of this technique on the short term, and its standardization as yet another conclusive analysis method at the service of crime scene investigators and the judiciary system.

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