

Andrzej Zachuta

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FROM THE BARE FOOTPRINT TO POLLEN AND SPORES TRACE (SELECTED ISSUES OF FORENSICS)

JUDR. ANDRZEJ ZACHUTA, PH.D.

University of Public and Individual Security APEIRON in Cracow, POLAND

ABSTRACT

Article concerns the issue of trace as a part of investigation, its importance for detecting crime and perpetrators. Since the middle of 20th century, the palynological technique became a valuable source of information. For these reasons, the paper focuses mainly on the judicial (forensic) palynology. Briefly the phenomenon of pollen and spores spectrum is presented, ways of its' analysis, the value of obtained results and the scope of application. Examples of inquiry and judicial practices are given, although not only limited to the usefulness of palynology in investigations. In addition, scientific methods of palynology and the verification procedure are indicated.

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I
If a crime committer does not act with ostentation motivated by some personal reasons, or does not have the inner remorse and readiness to bear all the consequences of his behavior, generally adopts an attitude of negation of his/her participation in the crime or shall endeavor to understate the role played and the same reducing his liability. However, even the most cautious perpetrators, using sophisticated and unique masking techniques, and even after the crime preparing false evidences, cannot be sure of complete protection against leaving all traces of their behavior, which, in effect of skillful exploitation of them during the trials, lead to expose and bring the perpetrators to justice. This trivial ascertainment stems from the age-old observation and continuous experience

showing that the man resided in natural conditions and constantly placed side by side with the unlimited variety of elements of inanimate and lively nature, everywhere will be taking on some parts of the environment and at the same time leaving the deliberate or accidental, wanted and unwanted, traces of their whereabouts and activities. From this point of view it is relevant, especially when trying to reconstruct the course of specific historical criminal events, as well as in the identification activities¹, has both

¹ In forensic science, the term "identification" has a double meaning. The identification is, broadly speaking, all the steps to be taken in order to get knowledge about persons and things on the basis of common features found in what is known and what is the subject of research. Identification is also the final effect of the steps taken in the identification process, leading to assign to a particular subject specified role in the course. For the identification of significant importance may be both direct information from the people and that obtained through identifying the traces.

a statement at that point to the existence of a trace, or lack of it.

Traces usually conceal a large and, in some cases, still not fully recognizable, potential. There is no doubt that the role of forensic trace substantially rose with decreasing the use of torture in the trial, which were attributed the importance of universal evidence, effectively leading to self-incrimination and to grant guilt or unjust accusation on the other². After abolition of tortures, a vital means of evidence have become untethered statements of the accused and the witness, i.e. made without receipts and any pressures, even suggestions, and the memory traces and material traces have become one of the most important sources of information for the investigation services. No matter how narrow or broad definition of a trace will be used in trial³, its main feature is that, be-

cause of the connection with the event, it allows to draw conclusions about the same event and its perpetrator. Traces can explain the time of committing a criminal act, indicating its prima facie criminal character and time, behavior, and the roles of different people taking part in it, indicate the actions to smear, allow to reconstruct the course of events and circumstances related to it, as well as to establish the location of the event to the offender and the victim and vice versa from the offender and victim to the place where the event occurred transactions. Compositions of interactions of traces and people can give such a variety, that listing all of them is impossible.

It's easy to see that the traces inextricably merge with the act of finding and following someone or something. In forensic science and in the rules of criminal procedure, this last action is defined as a visual inspection of person, things, and places, that leads to the answer for "seven golden questions", that have been formulated, rather linked together in the 19th century, by Hans Gross, the investigating magistrate. Today these questions still constitute the fundamental rules of investigation, and did not lost actuality as they are still asked throughout the criminal proceedings. The investigator in criminal trials should keep these questions in mind and take such law allowed steps, on the basis of which it becomes possible to give the answer for each of them, and consequently fulfill the aim of criminal proceedings. The answer to any of these questions is rationed by the scope of information. This range, within the criminal process dynamics, is to broaden through continuous refinement and enrichment

2 In European legislation of the 19th century torture was officially abolished as a legitimate and legally acceptable evidence. Similar to torture were the "God's judgement" – called the *ordalia* evidence, which appeared in antiquity, and became very popular in Europe during the middle ages. These were the means by which a person suspected of committing a criminal act (then called the defendant) was to prove his/her innocence.

The most commonly the tests of water were used (scalding with boiling water, bathing etc.), hot (burning) iron and a judicial duel. In 1215 the Church forbade the use of "God's judgement" but even then, it was used in lawsuits for decades. In Poland *ordalia* disappeared at the beginning of the 14th century – earlier than in many Western European countries.

3 The basic forensic traces are classified as material objects, taking into account their characteristics, properties, locations, quality changes, as well as energy. See J. Sehn, *Ślady kryminalistyczne, Z Zagadnień Kryminalistyki*, vol. I, Warszawa 1960, p. 25–55. Traces are systematized on the basis of various criteria: according to connection with the event (divided into traces of the fact, and traces of the fact of the taking of evidence), according to origin (traces of evidence and comparative), according to the reasons of occurrence (mechanical, biological, chemical, and technical), according to relative to the surface (grazes and reflected), according to the lifespan (persistent and non-persistent), according to the relationship of the perpetrator to trace (genuine – indicating the deeds and perpetrator, and the falsified ones), by type (traseological, mechanoscopic, biological, fingerprint, osmological, firearms, written, thermal), by trial function (traces pointing a person as perpetrator on the basis of e.g. the offender's modus oper-

andi, the hypothetical motives of his behavior and traces for proving the person a particular behaviours and guilt), etc. See M. Kulicki, W. Kwiatkowska-Darul, L. Stęпка, *Kryminalistyka – wybrane zagadnienia teorii i praktyki śledczo-sądowej*, Toruń 2005, p. 345 and 350–352. Probably into forensic traces catalogue, apart from material ones, should be included the traces of intangible fixed assets, as well as leaving his rock in mind, psyche and consciousness, traces of the use of digital techniques etc.

of current news about what remains in the interest of these seven questions: 1/ what happened?, 2/ where?, 3/ when?, 4/ in which way?, 5/ what was used?, 6/ why?, 7/ who has made the crime? Characteristic thing is, that none of these questions cannot be answered “yes” or “no”⁴ but it is crucial to give each a specific answer. You need to know not only what to look for, but how to look for, being at the same time open to the traces of the previously unheard of. Then you need to make sure the observed traces have been considered, taken, preserved for future investigation, as far as these will be needed. Later you should take the right decision as to how to provide the investigation, and draw conclusions on possible and impossible relationship between particular trace and reconstructed event. So the traces science was founded, which is an element of evidence science and is closely linked to the law of evidence.

Summarizing what about the traces has been said in the literature, and taking into account their importance for each of the proceedings seeking to show an objective truth – it’s hard to resist the notion that the traces had, has and will continue to have great importance to the criminal process.

II

Into the scope of the traces of human activity aiming to injure another person, should be included bare footprint on sand or in swamp, shreds of clothing on the crime scene and way of escape, on which some items or their fragments were lost, loot stored in the safehouse, signs of combat on the body of the perpetrator because of the victim’s self-defense. Since the dawn of humanity, the caused harm to others was a clue, which was heading for revenge, but with the hope of compensation, unless the injured was someone of the beloved ones (fami-

ly, lineage, strain). As time passed, when social ties widened from family or strain, self-defense groups were organized, targeted at taking action against undesirable behavior, from the point of view of the common interest, that as historical and cultural society developed, started to be defined as a crime.

III

For centuries, when the perpetrator, wants to remain an anonymous figure (which happens to be the most common), and the seeker who wants to uncover him, an inevitable is the wit, ingenuity, skill, predictability and the knowledge confrontation of those who, in such a way, leaves unwanted traces, and those who seek to find the perpetrator, bring him to the judgment of others, and as a result – guarantee the accused a fair treatment. Both sides will remain together in a state of continuous confrontation, sometimes even bitter struggle with the fact that the only the fighting with open helmet has the obligation to respect the specific rules in this clash⁵. These conflict of interest creates a special reciprocal arrangement of three aspects of the human activity. The first designates the activity of the offender, the second the activity of traces seeker, which initially was a victim himself or a representative of his family, and after the formation of collective structure, an officer of the relevant State service. The third creates the current level of knowledge and skills that traces seeker must have, in a profession-

4 J. Woleński, *Siedem złotych pytań w świetle filozofii nauki*, [in:] *Nauka wobec przestępczości – księga pamiątkowa ku czci profesora Tadeusza Hanauska*, J. Błachut, M. Szewczyk, J. Wójcikiewicz (red.), Kraków 2001, p. 11.

5 In Polish legal system it is with regard to the rules formulated primarily in the code of criminal procedure, and with a particular focus on the so-called warranty standards and rules of professional ethics, relating to those who at various stages in the proceedings, also at the stage of pre-procedural obligations, are taking part in the process of investigation and searching for evidence. T. Hanausek’s ethical directives include: impartiality, honesty and loyalty to the enemy, not taking any side-benefit, the pursuit of truth, not inflict discomfort more than necessary and legally justified the need for the respect of human dignity and the rights of the individual, maintaining competence. Por. T. Hanausek, *Kryminalistyka, Zarys wykładu*, ed. V, Zakamycze 2005, p. 55 and following.

al manner to carry out the task. On the whole, complex grid of traces left by the perpetrator and improved ways to camouflage and other protective treatments, much more complicated and constantly modernized network of methods and techniques of prediction, disclosure, protect and interpret the traces are applied. Top importance there have the skills and then the use of traces. One must have the knowledge how the traces are left, exposed and perpetuated – all of these is needed not only not to overlook them, but also to preserve them from degradation or destruction, and protect against taking any suspicion by anyone doubting the credibility of the performed activities and their results. That depends on perception and ingenuity of prospector, his intelligence, knowledge, efficiency in terms of rapid, broad and logical pairing of seemingly minor and even apparently unconnected to each other circumstances, situations and facts. After finding the traces, you need to decide how and when to use them in further investigation, what role assign to it in likely, hypothetically adopted course of events. At this point it is to be decided who and with what techniques, often including the latest scientific advances, is to prepare an expert analysis and who has legitimacy to present, on the basis of the investigation, its own proposals, which may err on final verdict.

In the face of such needs, open space for the creation of specialization within disciplines developed, which, by their scientific interests, bring discoveries fully useful, also for direct use in combating crime. There is also a new form of expert, expert witness, having knowledge and skills, often belonging to a specific discipline, and at the same time having ability to use them in judicial proceedings, criminal cases, and in prosecutions.

As on background of reflection on collective and individual security, the institutions aimed at combating crime were founded, so on the basis of the need for new investigative trends, the foundations to forensics-scientific discipline

were formed⁶, without which the modern law enforcement would be helpless, acting rather superficially that effectively⁷.

IV

Trace, left by the perpetrator, associated with his deed, as formerly so at the moment, as far as it is perceived by the senses, at first glance, its general appearance looks the same as before and is potentially suitable for testing. Over

6 Forensic science as an independent scientific discipline was founded in the 19th century, and its existence comes from interests of doctors involved in investigations of killings and other criminal cases related to violation of the integrity of the human body. In the 19th century judicial medicine considered “the mother of forensic science”. Full development of forensic science peaked in the 20th century, finding a suitable place in the school curricula, including universities. T. Hanausek pointed out that already in the year 1786/87 to the Faculty of Medicine of the Jagiellonian University lectures on the prosecution of the perpetrators of killings were held, known as “As the killings assert, prosecute, innocent rescue (...)”; T. Hanausek, *Kryminalistyka. Zarys wykładu...*, p. 16.

For further information on the beginning of forensic science see J. Thorwald, *Stulecie detektywów – Drogi i przygody kryminalistyki*, Kraków 1971 and J. Thorwald, *Godzina detektywów – Rozwój i kariera kryminalistyki*, Kraków 1993.

7 Forensic science was founded, therefore, as a result of the investigation needs, thanks to civilization progress, thrive mainly applied sciences and technical progress. Basing on achievements of various branches of science, more and more developing new sections of far specialized knowledge and skills, quickly took on the multidisciplinary character. It's no wonder that it has wide practical application in the prevention of crime, as in the process of fact-finding, supporting, and preventive functions and well used for most widely understood public and individual security. Even now it is hard to imagine the material sphere of human activity, in which forensic techniques and methods, in some cases, would not be useful. The use of forensics methodology in Poland illustrates the scope of the research conducted in the Laboratory of Forensic Science of Police Headquarters, in which operates the Departments of Documents' Examination, Firearms and Ballistics, Mechanoscopy, Chemistry, Biology, Fingerprints, Audiovisual Techniques, Organization and Technical Progress. See B. Holyst, *Kryminalistyka*, Warszawa 2000, s. 484–487. The scope of forensic examinations conducted in Instytut Ekspertyz Sądowych im. prof. Jana Sehna w Krakowie (Prof. dr. Jan Sehn Institute of Forensic Research in Cracow) see A. Zachuta, *Ekspertyza jako dowód*, „Zeszyt Naukowy »APEIRON« no 3 Wyższej Szkoły Bezpieczeństwa Publicznego i Indywidualnego”, Kraków 2009, p. 132–145.

the years, the progress of knowledge and skills has changed only the meaning and scope of use. Traces primarily are used to prosecute criminals, having a similar function to the characters delimiting the clue for hunters, to this day did not lost the cognitive. Objectively, still they carry the same information, except that now, as a result of a much deeper knowledge of their origins, construction, structure, and properties, the scope of hidden information could be better used. It turned out that there are also many traces that formerly did not provide any utility, and now are well-suited to solve dilemmas about the cause-and-effect relationships.

Many of these originally destroyed or ignored traces, due to their characteristics or due to disposal of too simple test methods, using only "the naked senses", from today's point of view, the designated possibilities and prospects for the research, provide a rich source of information. In terms of individual identification to occupy the central position as a starting point for detailed forensic examinations. In terms of individual identification they provide central position as a starting point for detailed forensic examinations. Looking from the other side on this issue, it is difficult not to notice that to a set of traces made so far, as a result of invention process, there are new traces, as a consequence, such as the use of firearms, ammunition, explosives, gases, energy, chemicals, technical equipment etc.

The already mentioned bare footprint on the ground, being closer to hunting trace than to DNA evidence in today's sense of the word, now belongs to a group of intriguing dactyloscopic⁸ traces that make up for example lines on the fingers in the form of dermatoglyphs⁹, the slats of the skin on the palms and feet, where the test for the purpose of identifying is called chiroscopy¹⁰, and for bare feet or fragments – peltoscopy¹¹.

8 From Greek *daktylos* – finger and *skopeo* – to see.

9 From Greek *derma* – skin and *glyphe* – carving.

10 From Greek *go cheir* – hand.

11 From Greek *pelma* – sole.

This does not exhaust the possibility of individual identification. It is also based on the traces also other parts of the body left on any surface, for example the layout of furrows in the vermilion area (especially the lower lip) moved to the outskirts of glass vessels used, what is the cheiloscopy¹².

Both historically and now, feet, hands and mouth leave on different surfaces the same traces, not only as a reflection of the general outline on some ground, but reflections of the peculiar, individual, saturated the details moved to the surface of the skin. However, only developed and far advanced specialization and interdisciplinary efforts, allowed in scientific way to prove that this kind of tracks are suitable for specialized research, yielding results to such a degree of probability that approaches them for confidence, and hence, if not relied upon any particular circumstances at least bring investigator, and through it, the trial authority, sought to understand the truth. This happens in forensic science almost every step of the way. In the cognitive process in fact, new techniques and technologies are used. Working with complex and sensitive devices, but at the same time demanding from the experts a large professional experience and knowledge of the complex issues, often entering into many scientific disciplines – sometimes even requiring experimentation. New interest and research directions are bringing the results exceeding the limits of the imagination, allowing, with the latest technology and methodology included, the domination over the criminal world. This direction is essential to preserve the advantage, as the perpetrators, especially organized groups, criminal associations also undertake efforts to develop effective protective strategies, tactics, techniques and widely understood methods¹³.

12 From Greek *cheilos* – lips. See M. Kulicki, W. Kwiatkowska-Darul, L. Stępa, *Kryminalistyka – wybrane zagadnienia...*, p. 363.

13 Interested in these issues should refer to the relatively numerous forensics publications and many detailed stud-

V

Plant pollens and spores and their grains are present from the origin of life on the planet, and are essential for continuation of life. Since the dawn of history, the pollen and spores grains looked like today's, functioned and have, as now, in a specific environment, the same reproductive functions. It is not surprising that at a certain stage of development of biology, traces of pollen and spores have attracted the attention of investigators. It happened in the middle of the 20th century¹⁴, since some of the achievements of the latest branch of Botany – palynology¹⁵ – has been used. World in Botany emerge even a specific undercurrent of this scientific discipline, called the judicial forensic palynology¹⁶. In the literature generally is assumed that, for the first time the term “forensic palynology” was used in 1945, and the first palynological proof in criminal proceedings occurred in Sweden in 1959, for murder.

In the interest of palynology, as one of the youngest branch of Botany research, remain grains of pollen and spores of higher plants sporulated sulphite, modern and fossil fuels, and other organisms, their appearance, morphological features of the construction, content, composition as well as their residues, fate, in addition to the parent plant and spread them on the different areas of the globe (aeropalynology)¹⁷. The results of these tests are

ies, because it is too complex for the framework defined for this paper.

14 For more information about palynology see i.e. A. Zachuta, *Palinologia kryminalistyczna*, „Prokuratura i Prawo”, 2004, no 1, p. 120–145.

15 From Greek *palyno* – strew, sprinkle and *logos* – word.

16 Apart from Poland commonly used is the term: judicial palynology.

17 See i.e. J. Dyakowska, *Podręcznik Palinologii*, Warszawa 1959, p. 7. Addition is to be made, that in a number of academic centers in the world, among them the Institute of Botany at the Jagiellonian University, the work on DNA profiling of pollen and spores are carried out, which in the case of obtaining positive results, will allow to very strict classification of specific pollen and spores to a specific individual, and not only to its species.

used for scientific and practical purposes. Palynological pollen-spore method helps i.e. in monitoring of climate changes, learning about the history of the development of vegetation, human influence over the ages in vegetation, the settle order of the planet by human groups. Palynological method is also useful in medicine (allergology), to beekeeping (melisopalynology), geology, archaeology, climatology. The method has proved usefulness in historical research¹⁸, including the history of art, forensic science, military etc.¹⁹ On the background of such a broad application of palynology, it is hard not to mention that especially in the study of vegetation in past ages and aero palynology, Polish scientists have a leading position in the world, although in the field of forensics its' achievement are brought in occasionally, which puts Poland on one of the last places among the countries within the framework of the forensic (judicial) palynology²⁰.

The beginning for the palynology is the fact that plants reproduce sexually with egg and

18 The Shroud of Turin was put under palynology analysis. This expertise, of course, was not in a position to indicate the time at which the fabric was made, but the spectrum of pollen does not exclude that it comes from the Middle East.

19 During the Vietnam intervention, there were accusation in the media, made by the United States, that the Soviet Union and Vietnam are using in Laos, Kampuchea, and Afghanistan volatile toxic chemicals. Mycotoxins from trichothecenes group had to be dropped from aircraft in the form of yellow rain left on the surface, which has settled yellow spots. Apart from suspected, only a few scientists from Harvard University did not agree with this opinion. In 1982, independently of each other, in several research centers, in the yellow rain researchers found high concentration of pollen grains. The observations were carried out in Southeast Asia. It turned out that some of the Asian bees from the temperate climate, cleaning flights. Inhale then collected during wintering droppings. In Khao Yai National Park, northeast of Bangkok, whereas the yellow rain caused by endless swarms of bees that suddenly left their nests placed on trees and moments later resulted in the fallout of the yellow droplets with a density of 209 points on the square meter. The alleged chemical agent turned out to be a bees' feces that contain grains of pollen open pollinated plants by insects.

20 There are International Federation of Palynological Associations focusing on the Association of the individu-

sperm or asexually, for example using spores, shoots etc. In flowering plants, the flower has its feminine sexual organ – pistil and masculine organ – stamen. In the component parts of the head rod in pollen is produced, which in the mature form (grains) is a male reproductive element. When the pollen grains are ready to undertake the process of reproduction – theca breaks and the grain gathered in, individually or in groups on the rise outside, and if you come across it from the post, have a chance to meet their biological destiny. Cryptogam (fern, fungus, bryophyte, lichen, algae, bacteria) are flowerless and reproduce by spores. The formation of spores for reproduction, is provided by splitting stem cells.

Micron grains of pollen and spores have a characteristic construction (morphology) on individual species and on the basis of the construction of the outer layer of pollen (exine, built largely with sporopollenin – biopolymer) it is possible to determine the native plants, which produced the data. Their shape is different and unique for the species (spherical, round, a slightly triangular building etc.). Each species has a specific size of seeds (from about a dozen to two hundred micrometers), weight, color. Also the outer structure of grains of the

same species is differentiated. The surfaces can be smooth and take the shape of the spines, hooks, and sometimes sticky, variously arranged pores.

There is a close relationship between construction of grains of pollen of flowering plants, the ecology of their pollination, way to pollinate and transport of grains of pollen from a plant native to the procreative purpose. To fulfill his tasks for the reproductive behavior of the species, the pollen grains and spores must be released (fall out) from theca or sporangium and spread closer or further from the parent plants. Because neither the pollen or spores do not have the ability to move independently, they must, for transport purposes, use a variety of external factors, adjusting the mode choice of transportation. Transport problem is resolved just by the floral plants (polling), and crawlers (not polling). Pollen or spores of these plants can spread the by means of: water, wind, insects, mammals or the phenomenon of gravity.

Self-pollinating plants produce relatively small amounts of pollen (from a few dozen to several hundred seeds per year). Their way to dust is very short. Anemophilous plants produce countless amounts of pollen with a smooth outer surface, which are designed to overcome a long and uncertain road. Some of them have even the form of air bags, air bubbles for easier gliding in the breeze by the dozens and even hundreds of miles²¹.

Plants pollinated by animals have fewer (than anemophilous) pollen, but it is of such properties and instruments (sticky surface or spikes and hooks), which allow them to attach to the bodies of birds, insects, and mammals, and “at someone else’s expense” to reach the goal, according to the route of movement of the carrier. Because of that, their pollens overcome much smaller distance from those of pollen and spores that travel with the wind. In a more fa-

al countries. Organizes International Congresses every four years International Congress of Palynology. XI International Congress of Palynology in Grenada was held from 4 to 9 July 2004 and for the first time in the history of these meetings a separate sessions to discuss the issue, which deals with judicial palynology. See J. Madeja, *XI Międzynarodowy Kongres Palinologiczny (Hiszpania, Grenada 4 – 9 lipca 2004) – sprawozdanie*, „Prokuratura i Prawo”, 2005, no. 5, p. 173–176. Dynamic development of judicial palynology notes in New Zealand, Australia, the United States of America, England, and Germany, and in the last decade in China. Note also that although Poland judicial palynology only a few base cases is for the implementation of the objectives of the criminal process, it is on the court experts are experts prepared for the professional development of expertise with this field. To perform palynological expertise for judges and law enforcement services, perfectly prepared are universities’ institutes of botany. Recently, the websites also publish private laboratories and establishments offering readiness to carry out assigned palynological research.

21 As a result of such migration are recorded numerous cases of sensitisation of the inhabitants of Scandinavia on Polish birch pollen.

avourable situation, in terms of overcoming distances, are the pollens (similarly the spores) transmitted by birds, from those that for means of transport "choose" insects. Plants pollinated by insects or spores transported by them mostly lie down within a few meters from the plant. Pollen and spores with the greatest weight of the doomed are the use of the phenomenon of gravity or water. A special role in the transmission of pollen and spores plays a man, especially his body and clothing.

At certain times of year and in its individual months, depending on the latitude and climate, the world is covered by unique compositions of pollen and spores, forming a characteristic spectrum²². Any place where deposited, is characterized by the specific set of them, different for each climate zone and seasons vegetation, activating the plant species and various combinations thereof. The casual observer sees the pervasive presence of the individual grains. At most during periods of strong polling by wind-pollinated plants (from spring to autumn), reddish spots on yellow are noted on all kinds of surface waters and on the outskirts of puddles forming clumps. These pollen-spore compositions create grains that have not yet had time to play, and which for various reasons do not play a role in biological maintenance ritual. The set of the latter, useless for procreation, are grains of pollen grains and part of sporulated sulphite, fallen on the ground or accidentally encountered items and other objects, where they rot, moulder etc., and then become part of soil. The process of rooting needs a continuous direct contact with oxygen breaking the sporopollenin, which is the primary analytical material. It takes place despite the fact that pollen and spores, and their armour, are made of substances extremely resistant to destructive

22 Seasonality of pollen phenomena allows to create special pollination calendars, useful in different areas of human activity. For example, in our latitude, palynological year starts with pollination hazel and alder. Often we find out about this on the occasion of the publication of meteorological forecasts and warnings for people with allergies.

chemical and physical factors i.e. the sludge decomposition temperature (300 °C), crushing and rubbing. Only pollen and spores that lie on the surface of standing inland waters or on peat bogs and quickly escape into anaerobic conditions of so-called exine (sclerine)²³, may, hiding in the mule or peat, survive in very good condition by the thousands, and even millions of years, fully adapted for research.

Pollens and spores in both faster and slower degradable environment, can be relatively easy to find, collect, secure and then tested. It turns out that the diversity of pollen and spores in terms of species and how the spread makes samples just a few meters from each other may exhibit different characteristics²⁴. This, in turn, provides a very valuable guidance for the implementation of the objectives of the evidence.

VI

Once on the surface there are clumps of pollen grains and spores, since you can collect them, secure and test, it should be regarded as forensic trace²⁵. Aeroplankton floating in the atmosphere still is the proximal distance of native plants, the pollen carried by animals heavier than grains of pollen grains remaining spores of ferns and fungi, stem area just easily passing on clothing and footwear man, being able to prove an attractive material, useful for pur-

23 After J. Dyakowska, *Podręcznik Palynologii...*, p. 19 – palynology deals mainly with the construction of the sporomorph membrane, or sporodermis. In fact, it rather than in the plasma and the kernel are the characteristics that distinguish differentiation and systematization of sporomorph. Pollen's sporodermis grains consists of two main layers inside – intine and external sclerine (called also as exine), for protection of contents of pollen grains from the environment.

24 B. Holyst, *Kryminalistyka...*, p. 643.

25 T. Hanausek defined forensic trace as any fixed, identifiable consequences of these changes, that create any event or are closely associated with this event. By dividing the forensic traces due to their external form, among others, he pointed such things as those being present on particular place but were not there before the event occurred. See T. Hanausek, *Kryminalistyka. Zarys wykładu*, Kraków 1996, p. 30 and 67.

poses for investigation. The most important are the grains of pollen and spores are the ones that occur rarely and are related to a particular area. Mainly it is a biological material from lower plants – herbaceous, aquatic, ferns, fungi and mildew, falling directly under the plant or in the immediate vicinity thereof. Pollen or spore spectrum of such species may have far-reaching diversity in the samples taken from locations distant from each other just a few meters. This promotes the identifying processes and vice versa; little useful for identification are tree pollens, found just about everywhere and on distant areas (as mentioned), for example pine, birch, alder etc. Each season has not only a specific type of pollination, but also a different set of pollen and spores. Having specific set of pollen or spores, it can be clearly attributed to a particular time of year, and even a specific month, although not for a particular calendar year. This set, often supplemented with a characteristic substrate elements with which it is associated with (for example, from where they are in leap years), may have the same characteristics, which has another set, consisting of pollen or spores secured outside the place of events. Analysis of pollen and spores in samples taken from the soil of different location (different places) is often a valuable material in search of the ties between the suspected persons and things found on the site typed as the crime scene, can also, accurately to within a few steps, distinguishing the place of committing and given by the perpetrator places the emergence of evidence contamination soil on his body or clothes²⁶. Fundamental natural regularities relating to pollen and spores, with in-depth observation, suggests that a person can both collect pollen and spores, and left in a place where he stays some of those whose carrier he is (it can be a place of crime, events, as well as others relating to the offense of the characteristics of a crime). Mechanism for col-

lecting and leaving these traces is different. It is noted that while breathing, sporomorphes are absorbed to the cable and then penetrate the nasolabial throat and lungs space. They were found in the content taken from the gastrointestinal tract. They remain in hair (especially on the head and chin), where they can be stored much longer than on surface of body, from which they get easily flush during wash, eyebrows and lashes, and from the filth under the nail. The most common are disclosed on clothing, footwear, along with the remains of mud or soli and other objects in respect of which it cannot be excluded that had a relationship with a crime (including external elements of vehicles i.e. bodywork, tires, wheelhouses and interior: upholstery carpets, floor, clutch and gas pedal, brake pedal and lever manual etc.)²⁷. Pollen and spores also reported for purposes of proof, on valuable paintings, antique furniture, firearms, hangman's loop, document, when at the time of its drafting to no dried ink has stuck like specks of dust present in the air.

A relatively common is the palynology analysis of victim's stomach content, in order to determine, among others. What was the last meal and where it was to be consumed. Samples form clothing, skin, hair of the scalp, eyebrows and beard, mouth and under the nail of the suspected and victim, after examination of the palynological method, in many cases allowed to identify the place of murder, determine the route of movement of corpses and their place of hiding, the determination of the circumstances of the death, the road, which is on foot or by using a secured to research the vehicle move the perpetrator, categorically refute the alibi of the offender, and so on.

Judicial palynology proved that particularly valuable material for further research are mixed samples – including not only pollens and spores, but also other parts of plant, animal

²⁶ See B. Hołyst, *Kryminalistyka...*, s. 646.

²⁷ See scientific article 12 May 2004, Heather Catchpole, Pollen clues ignored, says forensic expert – ABC Science Online.

and mineral particles, dirt and microbes (microorganisms) – can be highly specific to the particular site²⁸. Anthropogenic pollution associated with human activities (all kinds of plastics, metals, glass etc.) are today not only within human habitats (the problem of illegal garbage dumps). These impurities can be specific to a given space, and became a relevant evidence²⁹. Making full use of information contained in the samples taken from site, usually requires multidisciplinary expertise, developed by teams of experts of different specialties, for example palynologist, geologist, chemist on the basis of the results of palynological analysis and physico-chemical analysis of soil or other substrates on which pollens and spores were found. Same palynology analysis may not always turn out to be sufficient for the court, even if on preparatory stages of criminal proceedings it proves to be helpful for the rational plan of the investigation.

Only establishing full compliance or approximate a particular kind of sporomorphes, their suitably and high proportion in the evidence sample, supplemented by fixing in both the identity of minerals and animal, from environmental backgrounds and homogeneous pollutions, can help to confirm or reject the adopted version of inquiry, confirm or refute the alibi of offender, it may serve to strengthen the circle of people, for which there is a suspicion of that have a relationship with committing the crime, and sometimes can directly lead to determine the perpetrator of such an act. Both interdisciplinary expertise involving pollens examination, as well as independent palynology researches, contributed to identify the perpetrators: killings, rape, abductions for ransom, accidents, robberies, theft, burglary, theft of horses, cows and

other livestock from rural farms, crops intended for the production of drugs, drug production and trafficking, and crimes of a terrorist nature.

As you can see, pollen and spores compose the kind of microprints that equally apply to perpetrator and victim. Both are quite randomly equipped with these traces along with other trace elements from environment, where the analyzed event occurred. On the basis of presence of these traces on perpetrator and victim, can be reconstructed where, sometimes when and as a result of whose behaviors the event, which is the subject of research happened, and how this event was going. Pollen-spore trail, developed by an expert, therefore, is able to facilitate a response to at least four of the seven questions aforementioned by Hans Gross³⁰. By providing these answers, one may not miss that evidence of presence on the crime scene is not a confirmation of causing the event and its consequences³¹.

VII

A fundament for palynological expertise and obtain valuable proof is the appropriate expert sampling, using professional techniques, with absolute exclusion of any pollutants, their virtuous describing and assuring the appropriate storage until the expert or a team of experts carry out examination, submit correct interpretation of the results and draw scientifically valid conclusions. The value of the proof will assess, at first the expert, and if it comes to Court – the judge.

While taking the sample, you have to generally understand what test methods may be used in further procedure. Knowledge of these issues allows you to protect the quantity and quality of relevant traces³². Each, especially

28 For micro-organisms include bacteria, protozoa, viruses, algae and some fungi. From the point of view of evidence important are the predator micro-organisms (heterotrophic). All mineralize (break down) organic substances.

29 See J. Zięba-Palus, *Ekspertyza fizykochemiczna*, [in:] *Ekspertyza Sądowa*, J. Wójcikiewicz (red.), Zakamycze 2002, p. 202.

30 Hans Gross was an Austrian investigating magistrate, called "the father of forensics", is the author of the first practical manual of 1893, intended mainly for magistrate.

31 See T. Hanausek, *Meandry osmologii*, „Prokuratura i Prawo”, 1998, no 1–2, p. 43.

32 In training materials is mentioned the case of preparation of the criminal Police officers in the UK for a proper palynology sampling. During the training course one of

mixed sample, should be taken not only from the right place, but also in such quantity that it will be possible to divide them. You have to take into account also how much of material will be used for destructive examination methods or destroying research material, and in addition with a margin for the possibility of the repetition of tests by another expert or their team. Because not always quantitative deficiencies will be able to replace the corresponding sequence of tests. So it would be best if all the samples were taken by the same expert, but sometimes this is not possible and this must be executed by an investigation officer. One should therefore know that during the palynological tests of pollen and spore grains, the whole background environment must be destroyed. The remainings of plants, protozoa and minerals contained in the sample are eliminated while necessary cooking in concentrated acids or alkalis. They do not destroy only the important for research – external carapace grains of pollen and spores.

Samples from clothing and feathers are collected by combing out, using special combs, that absorb grains of pollen and spores; samples from smooth surfaces are taken by adhesive tape (this way the pollen grains from the Shroud of Turin were collected). Soil samples are clods collected in the right size. For palynological analysis generally sufficient are a small amount – usually 1 cubic centimeters of soil, which has usually c.a. 600 grains of pollen and spores, about twice the amount necessary for research. For interdisciplinary work, carried out using various methods, especially destructive for material – the sample must be suitably increased.

If, in addition to grains of pollen and spores, the sample contains pollutions – on the surface of soil, mostly due to rain and bioturbation – to

the participants, wanting to demonstrate care and commitment, dug a meter down and took over one-kilogram “sample” from the bottom of the hole. The attempt proved to be totally useless, because a police officer did not know that the highest value, apart from specific exceptions, have the samples from the surface of the ground.

pre-treatment of material a chemical method of cleaning is used, easy and inexpensive, but the most invasive, destructing everything in the sample apart from grains. As an effect it gives a pure preparation for analysis under the sensitive microscope providing at least 500 times zoom (for many years the scanning microscopes have been used).

Rarely for purification (soil and clays samples) flotation methods are applied, using heavy liquids. During centrifugation of the suspension that was created from the sample mixed with heavy liquid, pollutions go down to the bottom, grains of pollen and spores, as lighter than the liquid, are floating and are suitable for further study under a microscope.

Each of the palynological techniques has the task to remove solids, minerals, plant tissues, which could disturb the tracing and counting the grains in the preparation. After such treatment, the sample is suitable only for palynological analysis; for other analysis is completely worthless. The study of prepared pollen grains and spores can be repeated at any time, an indeterminate number of times by the same or another expert, but another analysis of the same sample is excluded. Therefore, while collecting material for research and dividing it into samples, you should be aware that too small quantity will prevent other tests such as analysis of environmental background, if at the beginning the palynological test was made.

After the preparation is appropriately made, palynologist accedes to the most important steps. It is the microscopic examination, usually combined with the use of a special computer program. For the identification and counting of pollen the microscopes with 1 000 zoom are used. Generic similarity of pollen and spores is determined and their quantity in comparable trials, color, size, phase of development. Picture of samples obtained from microscope is then put under digital analysis using computer programs. The next stage is the interpretation of the results and to preparation of an opinion. In interpreting

the data, the expert use maps, atlases and developed for discipline pollen diagrams³³.

Soil samples with the content of dust and spores, are examined for example with OEMS-CAN method, where the image of soil samples obtained in the electron scanning microscope are put under analysis. Its result is the mineralogical data, characterized by statistical reliability and repeatability. This data is supported by the results of palynological analysis and analysis of microdust and allow to create a complete profile of the tested place that may be a place of crime³⁴.

It is worth noting that, in general, much more time must be spent on tracing the grains in preparation, than for preparation of samples submitted for testing. Not always the research results with identification of pollen grains and spores. The lack of grains of pollen and spores in the sample may be a consequence of fact that they never meet a specified ground or have been flushed out (i.e. by rain). It happens that low concentration of pollen precludes gaining an objective pollens profile, corresponding with its spectrum to the characteristics of particular place and the resulting profile that can be also referred to different locations, which disqualifies the result of the analysis in terms of evidence. Sometimes in a sample not catalogued pollens are discovered, this can happen for some rare species of tropical plants. Also an erroneous identification of morphologically similar pollen and spores cannot be excluded. For the above reasons the diagnosis can sometimes be ambiguous.

33 In the process of determination of individual grains a number of richly illustrated atlases of grains of pollen and spores are used; i.e. A. Kaarik, J. Keller, E. Kiffer, J. Perreau, O. Reisinger, *Atlas of Airborne Fungal Spores in Europe*, edited by Siwert Nilsson, Springer – Verlag, Berlin, Heidelberg, New York, 1983; P. D. Moore, J. A. Webb, M. E. Collinson, *Pollen Analysis*, Second Edition, Oxford, Blackwell Scientific Publications, London, Edinburgh, Boston, Melbourne, Paris, Berlin, Vienna (without date); W. Matuszkiewicz, *Przewodnik do oznaczania zbiorowisk roślinnych Polski*, Warszawa 2001.

34 See J. Madeja, *XI Międzynarodowy Kongres...*

Therefore, a negative result of the analysis or it's ambiguity does not mean anything either and, in particular, does not confirm an alibi for offender³⁵.

VIII

Examples of an effective use of palynological traces in the lawsuits are important for cognitive, educational, and inspiring in research taken as a part of any investigations. To the canons of the palynological casuistry there are a dozen of spectacular cases, mostly often quoted in the scientific literature as an example of using palynology for crime detection and to explain other social phenomena. A few of them are worth mentioning here³⁶.

1. A prostitute identified taxi driver as the rape violator. Scene of crime was to be a pathway between blocks of flats. The taxi driver claimed that he had no physical contact with the girl. He explained that the soil dirt from his trousers and jacket came from a nearby road, where he stopped his car. No footprints of suspected were detected in the crime scene, neither samples of his semen on victim's body or clothing. Using the palynological method, the soil from crime scene and from the road being an alibi was examined. The samples for analysis were prepared with using standard the method of potassium hydroxide to remove cellulose and organic particles from preparation and also hydrofluoric acid to precipitate the silicates in soil. Identification of pollen was carried out by using a binocular microscope with a 500–1 000 zoom. A portion of each sample was left for any examination by other persons. In the diagram the types of pollen were divided into three groups: conifers and flowering plants, ferns and other producing spores. To draw the diagram TILIA and TILIAGRAPH software packages were used. The analysis showed

35 A. Zachuta, *Palinologia – w poszukiwaniu sprawców*, „Edukacja Prawnicza”, 2005, no 1 (67), p. 23–28.

36 Examples are taken from the worldwide literature and materials of the National Conference of Palynologists.

correlations between types of pollen from sample of the pathway and the road where car was parked. Sample from pants and jacket showed great resemblance to a sample of the pathway (app. 80% of pollen and *Coprosma shrubs* less than 8% of other types of pollen). This allowed to claim that a sample from jacket, pants and the pathway came from the same place. Taxi driver's alibi turned out to be untrue³⁷.

2. In the case of murder of 29 years old Monica N., 23 November 2003 nearby Złotów (Poland), samples of mud from the body, the place where the body was found, and from other parts of the forest were taken for testing, as well as from the place where were the remaining traces of car tires (typed on the traces of a car belonging to offender). The analysis of samples carried out with using the palynological method have proven that the perpetrator attempted to drown the body in a forest swamp. When this proved impossible due to the specific characteristics of the environment of the swamp, he hide the body in another part of the forest.

3. When the perpetrator of the burglary noticed that he was spotted, started to escape by motorcycle – immediately a chase after him was set off. Fearing of recognition, motorcycle rider abandoned the vehicle at the edge of forest. Because the owner suited offender's description, was arrested. Search of the apartment did not reveal things that could come from this burglary. For the test were only taken a muddy owner's motorcycle shoes. The suspected explained that the mud came from his farm. The pollen spectrum, based on a mud sample from shoes and soil from the site the motorcycle was left and the farm, showed the convergence of pollens composition of sample taken from the shoes and the edge of the forest. The accused's alibi was overturned.

4. After causing a traffic accident, when the driver escaped, the owner of vehicle was suspected. Because he strongly argued that critical day he did not use the car, but on his pants the dirt that resemble the color of soil from the scene of the accident was noted, samples for testing from trousers and from the place of the event were taken. In each of the samples were identified the analogous sets of five species of different grains of pollen of non-wind-pollinated plants, characteristic for place of collision. The suspected claims have lost credibility.

5. The Australian married couple won a large sum of money on lottery, and soon after that, their son was abducted for ransom. After a few weeks, the boy's body was found wrapped in a blanket. On the blanket red brickwork plaster and pollen grains of Sawara Cypress (*Chamaecyparis pisifera*) and smooth Arizona Cypress (*Cupressus glabra*) were found. During investigation, as one of the characteristic features the distinctive color of plaster and two varieties of cypress were pointed. Soon the house with red plaster was found, around which the trees of two mentioned species grew. After presentation of the results of the palynological analysis, offender confessed the kidnapping and strangulation of a child.

6. In February 1994 in Magdeburg a mass grave containing thirty-two male skeletons was discovered. Since 1945 the area, in which the discovery was made had been under Soviet control and initially assumes were that the crime was made by Gestapo in the spring 1945 or that the victims were the Soviet soldiers stationed in East Germany rebelled in 1953, and the perpetrators were the officers of secret Soviet police. The suspicious fact was the location of mass grave in the center of the city, which the Gestapo did extremely rare. To clarify which of the versions is true, palynology was used. Pollen from skulls were sampled from nasolabial partitions of throat. Their analysis showed a large set of pollens characteristic for the summer period. The result of the test indicated that

³⁷ Casus quoted shortly after B. Holyst, B. Holyst, *Kryminalistyka...*, p. 646, taken by him from M. Horrocks, J. Ogden, *Modern pollen spectra and vegetation of Mt. Hauhungatahi, central North Island*, „New Zealand Journal Biogeography”, 1994, no 21, p. 637–649.

the grave contains the remaining of Soviet soldiers killed in 1953. This findings were confirmed by the relevance of the anthropometrical and DNA tests, which showed that the skeletons were of young people. In addition, it was found that the skulls had rotten teeth with no evidence of dental intervention, which would be unusual for the populations in Central Europe in the mid-20th century. Taking into account the total results of all the tests, it have proven to be compatible with the second version³⁸.

6. In May 2002, a girl aged 12 traveled by truck along with his father on the way from Las Vegas to California. In the Sierra Nevada Mountains the father was found shot, on the car. The adopted version was that firstly he killed her daughter and then committed suicide. The body of her daughter, however, was not found. The only evidence giving hope to explain the situation represented the dust collected from the floor of car. In the sample a botanist found crumbled leaves, and determined their species. Knowing the requirements of plants for light, water and soil, the expert even before palynological research, stated that car had to pass through the western slopes of the mountains at an altitude of between 800 and 1,200 metres – where coniferous forest goes in *chaparral*, which is similar to the the Mediterranean *maquis*. The expert found the countryside with a similar combination of the plants to a generic set of grains identified in the sample. The indicated location has proven to be accurate enough, that body of feral girl was located 20 meters from the road, which crossed the car³⁹.

8. At the end of the 50's, 20th century in Austria a man was missing. Police identified the person who might have reason to commit a crime. During the search of suspect's apartment a pair of muddy shoes was found. In clay palynolo-

gyst determined pollens of: spruce, willow, alder, and with more than twenty million years old hickory pollen. On the basis of this information, he pointed out a small area north of Vienna in the Valley of the Danube, where it could be found this kind of a mixture of pollens. During questioning, the suspected was told the results of analysis, after which he pleaded guilty and indicated the place of burial of corpse.

9. The suspected woman, in whose garage Police found a large amount of dried marijuana, not wanting to reveal their suppliers, claimed that she cultivated them on her own and indicated a place where there was a small field. Pollen analysis has revealed a mismatch between the generic set of pollen revealed in the garage and kennel. Marijuana from the garage contained in its composition of pollen, which did not include samples from backyard. Characteristics of the sample from garage pointed that the main crop should by nearby forest. It was found and identified 90 km from the garage.

10. In another case, concerning the cultivation of marijuana, before investigation has been started, the plantation was destroyed. The pollens from that place were sampled and analyzed. This showed so significant accumulation of pollens that could not be coincidental.

11. A woman going to sleep had left the backyard door (form the garden) open. After passing this route into house, the thieves had looted apartment, took the booty and decided to rape the sleeping woman. The victim awakened when one of the offenders proceeded to rape her. Fearing of identification, perpetrators started to escape. During the run, one of them hit profusely blooming St. John's wort. From clothing of the selected probable perpetrators the samples of micronutrients were taken. Samples of pollen from jumpers of one of the suspected revealed clumped together in balls pollens of St. John's wort. Their high concentration many times exceed the concentration of pollen of this plant in the air. In the area grew, although individual, shrubs of this plant,

38 See article by R. Szibor, C. Szubert, Er. Schoning, D. Krause, U. Wendt published in "Nature", October 1998.

39 E. Kołodziejak-Nieckuła, „Wiedza i Życie”, May 2003, p. 34.

but amount of their pollen in the air was small, and in New Zealand have never been reported such high levels of St. John's wort pollens in the atmosphere. Grain taken from the shirt also contained living cells, which indicated that they were young, so they had not been destructed so far. These findings suggested that the man wearing this shirt had had direct contact with shrub St. John's wort shedding pollen. Further investigation has typed that person as a suspect of abetting was relevant.

12. In the proceeded examination it was carried out whether honey is of national or foreign origin and what is its quality. According to the assurances of the manufacturer it was lime tree honey and of national origin. Because each honey contains pollen grains, their analysis shows both the geographical area on which bees gather the honey and from what plant species. The palynological test was provided. The result has determined that the spectrum of pollen in the samples contained not a single grain of lime trees, and found a grain of flowers characteristic for vegetation of plants from a different geographical area.

13. Palynological test has been used to the diagnose of the place of origin of a large part of apricot. There was a suspicion they had been illegally transported to New Zealand. From the analysis of samples of pollen grains and spores collected from the fruit, it came out that the set could not occur in native fruit.

14. Because testing the scripture gave no answer to the question whether the signature drawn in ink pen could come from spring period, which indicate the date and the content of the document, as well as testifies of some witnesses, the signature was taken to palynological examination. Expertise revealed in the slipstream pollens grains ink typical for early spring, which may have had fallen into open inkpot and with the ink to the pen used for signature. In this way, accurate to the part of year, the time of the signing of the document was verified.

IX

Since the detection of the crime and its perpetrator is a complicated "charade" and solving cases requires special messages and increasingly complex surveys, in which the scientific method must be used i.e. certain, verifiable, standardized, giving no substantive objections. When a new method comes to use, you need to answer the question whether it is sufficiently reliable and if it has the features allowing to classify it in as a scientific method.

Since our decades of experience have proven that in determining facts of various criminal event, an important independent or supporting role in detection of crime, reconstruction of its course, finding offender and victim, testing pollens and spores can play significant role – still remains the question whether the palynological method is a scientific one?

Polish scientific legal literature indicates the usefulness of each method designed to have value in judicial proceedings. This views are provided on basis of American doctrine of evidence and methods of evaluation criteria, first formulated by the Supreme Court of the United States in Daubert's case⁴⁰. The use of six criteria for the evaluation of methods was proposed: falsification, reviews, publications, diagnostic value, standardization and common acceptance. Some of the Polish authors were skeptical to the first and last of these determinants and on the basis of Polish doctrine at least two schools can be noted, of different views on conditions of indicators to be taken into account in assessing a particular method. Each of them proposes taking into account of four criteria as a whole, except that the previous directly refers to the American concept and accepts four of the enumerated criteria, excluding the first and last, and with granting the priority for evaluation of diagnostic value of method, based on

40 See J. Wójcikiewicz, [in:] *Ekspertyza Sądowa*, Zakamycze 2002, p. 20–23; for the scientific evidence requirements see also T. Tomaszewski, *Dowód z opinii biegłego w procesie karnym*, Kraków 2000, p. 121–125.

the quotient of percentage of correct and erroneous indications⁴¹. The latter school lists four criteria, but in a slightly modified approach by pointing out: a) the possibility of empirical verification of method or technique including checking whether such control has been provided so far, b) review – that is, to determine whether the method is under to scientific review and publication in scientific literature, c) error numbers and existence of scientific possibility of designating standards check results, d) universal acceptance, exclusively among the specialists⁴².

Regarding these criteria to palynological examination method of pollen and spores, it should be noted that, as was mentioned above, there is a full possibility of application of experimental methods and techniques used to verify it. The palynological method has been under such tests for the passing several decades, and the results of palynological scientific research resulted in numerous reviews published in the scientific literature around the world, and also contained in accepted expertise, underlying the state organ's decisions.

The level of obtaining incorrect results using the method is minimal on condition that the procedure is precisely followed, according to standardized and relatively complex research activities, which, with the right research material sampling and keeping, always gives the possibility of repetition of tests and checking the results. The value of obtained results rises up to certainty, when the palynological test results are supplemented by the results of aeropalynological analysis and the results of tests of microorganisms and inorganic microdust from the ground, on which examined grains have been found. It must be noticed that in significant scientific literature there has been no cases of defying methods. In palynology pollen-spores method belongs to the statistical methods because essentially involves determining and counting of pollen and spores in the prepara-

tion, stressing the structure of walls of grains for comparative purposes. In the case of testing for the court, it is always enhanced by comparisons between data obtained in the evidential preparation and the comparative preparation.

In conclusion, it should be noted that regardless from different view on criteria for evaluation of research methods and techniques – they both accept palynology as a useful scientific method in forensic science.

A separate issue, which is not to be missed, is the fact that, in accordance to the rules of Polish investigative procedure, that each state institution using a proof has a duty to regard it freely, with regard to the principles of valid reasoning, and indications of the knowledge and life experience. So when the investigation authority shall assess an evidence in the form of expertise, it was he, and not the expert, independent assessment of the value of presented evidence, also the methodology and research techniques applied by its development. The institution must not only assess the usefulness of the scientific evidence for a particular procedure, but also pay attention to this, if methodology applied by an expert, from a scientific point of view, is valid and whether it was actually used.



The photographs present pollens preparation seen under microscope, shared with the author by Jacek Madeja, Ph.D., Institute of Botany, Jagiellonian University.

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41 J. Wójcikiewicz *op. cit.*

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