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EXAMINATION OF SCENT TRACES – THE EXISTING PROBLEMS AND THE CONTEMPORARY PERSPECTIVE OF PRACTICE DEVELOPMENT

Summary

The article presents a discussion of the existing problems related to the study of scent traces, the practice of conducting research and the prospects for the development of osmology by introducing new research methods. The paper presents the current methods of collecting traces, comparative materials, securing them and the course of the osmological examination. The problem of smell as a forensic trace is presented – its features and general characteristics useful from a forensic point of view are described. It also shows the dilemmas of the judiciary authorities in Poland related to the evaluation of evidence obtained on the basis of such a study and the evolution of the courts' approach to this issue, starting with the initial trust in the infallibility of this method, moving on to asking questions about its correctness, ending with high caution related to its uncertain character. The issue of scientificity of osmological tests was presented, as well as how to proceed in order to achieve the maximum possible objectivity of the test result. The development of osmological research in Poland and in the world was also described, as well as the prospects for the creation of such devices that would completely exclude the participation of dogs in the research.

Keywords: osmology, forensic identification, olfactory research, osmological expertise

Introduction

Osmology is a branch of forensic science which includes securing, storing and examining scent traces of people, often for identification purposes¹. In the course of osmological expertise, trained animals – dogs – are also used to determine the olfactory correspondence between evidence and comparison material. In addition to this, dogs in the police are involved in many other activities, such as tracking, patrolling or identifying illegal and dangerous substances. The variety of activities for which

¹ M. Gondowicz, *Wykorzystanie psiego nosa w kryminalistyce, czyli słów kilka o osmologii w Polsce*, Fourth Kennel Workshop “Dog in Service”, Goleniów Penitentiary Institution, May 18, 2018, p. 47.

the dog's sense of smell is used and the popularity of these methods (especially in the detection of substances) make it possible to believe that the use of animals in identification studies based on the scent trail is a diagnostically reliable activity: proven and with satisfactory results. However, osmological testing has been accompanied by a number of controversies over the years, and the doubts surrounding it have only multiplied over the years. This results in reduced confidence in osmological testing methods, which they are trying to counteract. The goal of developmental changes in the field of osmology has for some time been the development of a method by which osmological testing would meet more stringent criteria of scientific rigour than before.

Constant changes in the field of osmological testing and attempts to develop it justify addressing the subject in this paper, which aims to provide an updated outline of the modern practice of conducting osmological tests. The previous jurisprudential positions expressed toward osmological testing (particularly as to its diagnostic and evidentiary value) will then be juxtaposed with the most current state of developmental research aimed at improving osmology as a method of human identification.

Introduction

The scent is a characteristic of a chemical substance that evokes certain sensory impressions caused by “the stimulation of olfactory receptors by certain volatile chemicals”². In order for olfactory receptors to be stimulated, it is necessary for the molecules to be in the vapour state, i.e. a vapour of the substance in question, because in any other state of aggregation, they would not be able to reach the olfactory receptors and thus produce an olfactory sensation.

No universal classification of scents has been created so far. Also, it is not possible to measure scent because there are no measurement units to determine it precisely. In particular, the classification of scent is based on associations and attempts to describe the sensations experienced. However, despite the shortcomings of the scientific description of “smell” as a sensory phenomenon, previous work has established³ that a person's smell is an individual trait, determined primarily genetically. In particular, genes related to the human immune system (MHC/HLA) are responsible for a person's particular scent⁴, and external factors, such as the smell of the room a person is in or the smell of clothes, do not have a significant effect. The human smell is created by fatty acids, which are found in all human secretions, but also in hair or blood⁵.

² M. Wiśniewska, *Jak pachnie sprawca? Wartość diagnostyczna i praktyczne znaczenie ekspertyzy osmologicznej*, E-Wydawnictwo. Prawnicza i Ekonomiczna Biblioteka Cyfrowa. Faculty of Law, Administration and Economics, University of Wrocław, Wrocław 2014, p. 79.

³ M. Ciesielski, *Przegląd technologii biometrycznych, budowa typowych systemów, zastosowania, aspekty prawne*, “Zeszyty Naukowe Wyższej Szkoły Ekonomii i Informatyki w Krakowie” 2014, no. 10, p. 33.

⁴ M. Wiśniewska, op. cit., p. 85.

⁵ T. Bednarek, *What does Osmology do?*, online: <http://kryminalistyka.wpia.uw.edu.pl/files/2012/10/osm1.pdf> (accessed 12.08.2022).

According to research to date, it is recognized that human scent is immutable, indelible and unique. In terms of the uniqueness of the scent, it is pointed out that since it is due to the genes responsible for the immune system, the probability of repeating the scent is certainly no higher than the probability of matching a tissue-compatible organ donor⁶. The invariability and indelibility of the scent is caused by the genetic determinants of the secretions of the human skin glands and the so-called volatile metabolites produced, among other things, in sweat, sweat-fat secretions or exfoliating epidermis⁷. The human scent remains unchanged, and it is possible to distinguish it even when it is suppressed by another, more intense scent, such as perfume. Also, the change in scent due to human ageing is not considered a change in scent *sensu stricto*, and it is still possible to distinguish it⁸.

For the above reasons, in a forensic context, the scent left by a human being can be seen as a trace that allows for identification studies. The commonly accepted division of biological traces in forensic practice is the one centred on the anatomical-physiological view, distinguishing the following groups: biological traces of tissue origin (e.g. blood), secretions (e.g. saliva) and excretions (e.g. urine)⁹. Despite some inaccuracies and definitional differences, it is correct to classify a scent trace as a biological trace. However, it is certainly not a “classic” biological trace, as tangible organic substances are considered¹⁰.

After all, in particular, it is worth remembering that all biological traces are susceptible to external factors that cause their degradation. Moisture and temperature have a particularly negative effect, creating favourable conditions for microbial growth, leading to changes in the properties of biological traces¹¹.

Scent as a forensic trace

Scent traces are invisible. This makes it much more difficult to secure them in a way that guarantees their usefulness in osmological studies. Securing a scent trace is a unique activity, so in an investigative setting, a trained forensic technician is authorized to secure and collect scent traces. Only in special cases can this be done by another person who also has knowledge and experience in this area.

The securing of evidence is governed by the *Instructions for Securing Scent Samples from Sites, Substrates and Objects* accompanying the *Methodology for*

⁶ M. Goc, *Osmology*, in: E. Gruza, M. Goc, J. Moszczyński (eds.), *Kryminalistyka, czyli o współczesnych metodach dowodzenia przestępstw*, Wolters Kluwer, Warsaw 2020, p. 426.

⁷ M. Jędrzejczyk, *Analiza ekspertyzy osmologicznej – metodologia i wartość dowodowa w postępowaniu karnym*, “Młody Jurysta. Quarterly Journal of Students and Doctoral Students of the Faculty of Law and Administration of UKSW” 2017, no. 4, p. 21.

⁸ *Ibid.*, p. 21.

⁹ J. Moszczyński, *Badania biologiczne*, in: E. Gruza, M. Goc, J. Moszczyński (eds.), *op. cit.*, p. 391.

¹⁰ *Ibid.*

¹¹ M. Wiśniewska, *op. cit.*, p. 78.

*Osmological Testing*¹² dated August 14, 2013. It is used when performing a visual inspection of a crime scene and in laboratory conditions if an object on which there may be traces of scent has been provided by the trial authority appointing the expert.

In order to carry out an osmological test, the material is needed against which the scent traces taken from the scene will be compared. It is collected from either the suspect or the accused under Article 74 of the Code of Criminal Procedure¹³. The method of collecting a scent sample to be used as comparison material in an osmological test is governed by the *Instructions for Sampling Scent from Persons* attached to the *Methodology for Osmological Tests* dated August 14, 2013.

Supplementary material, on the other hand, is, according to August 14, 2013, *Osmological Testing Methodology*, a supplementary sample with a secured scent used to complete the selection sequence. It is collected from people who have no connection with the case. The material is selected due to its similar collection time, similar collection time, collection method and the type of absorbers used. Control materials are selected from these materials, which are later used in control tests within a given test cycle¹⁴.

Classical osmological tests

Osmological research around the world has a tradition of more than a century. They were initially developed by the Dutch in particular, but were relatively quickly joined by the Belgians, Hungarians, Russians and Germans. In contrast, the first facility to begin training dogs for police work was opened by the Belgians in 1899.

In Poland, osmological research began only in the 1960s. The first course in identifying suspects through comparative tests of the scent left on objects with the scent of people began in 1962 in Sulkowice.

However, only in the 1990s. In the 1970s, osmology became popularized and began to develop more dynamically than before, and comparative scent studies began to be used on a wider scale. This was due, among other things, to the transfer of comparative scent testing to the forensic science department from the training and criminal division and its classification as an independent forensic speciality.

Polish technicians began receiving training in Hungary, the Netherlands, Germany and Russia, which translated into the modernization of testing methodology in Poland and popularized training for officers in human scent trace testing.

A key element of osmological identification testing is the use of dogs. This is justified by the high suitability of these animals for scent recognition, determined by a number of biological traits. The number of olfactory receptors in a dog's nose is estimated at over 100 million on average, although this varies depending on size

¹² *Metodyka badań osmologicznych*, Central Forensic Laboratory of the Police, No. BJ-W4-Mb-1, August 14, 2013.

¹³ Law of June 6, 1997 – Code of Criminal Procedure, Dz. U. 1997, no. 89, item 555.

¹⁴ J. Dzierzanowska, *Methodology of osmological expertise*, “Annals of Legal Sciences” 2016, vol. XXVI, no. 3, p. 30.

and breed¹⁵. Compared to dogs, the scent recognition skills of a human, having on average about 6 million olfactory cells are far less¹⁶. Moreover, the dominant part of the dog's brain is responsible for interpreting smells. It is their most important sense, far more important than, for example, sight. Dogs have a highly developed olfactory memory and are able to remember about 600,000 smells that they associate with specific situations¹⁷. A dog's sense of smell is made all the easier by the fact that its nose is always wet due to mucous glands that produce a cooling secretion. The secretion dissolves the chemical compounds of the aromas that reach the dog, making it easier for the dog to pick up specific scents.

The course of osmological examination with the participation of a dog

The rules for the conduct of the osmological examination are regulated by the *Methodology for Osmological Testing* dated August 14, 2013. The entire process has been regulated to avoid any activities that could adversely affect the objectivity of the test result. It seems that the legislator was aware of the nature of the study and the multiplicity of factors that can affect its conduct and outcome.

The test must be carried out in a laboratory with the appropriate certificate issued by the Director of the Central Forensic Laboratory of the Police, confirming the standards of the unit, which are set forth in the *Standards for equipping osmological laboratories in forensic laboratories of the kwp/KSP*¹⁸. In addition, the studio must have at least four dogs trained to perform scent identification tests. An expert working on an expert opinion must be authorized in the field of osmological testing by the Director of the CLKP, in accordance with Order No. 3 of the Chief of Police of January 17, 2014, on the authority to issue opinions and perform activities in police forensic laboratories.

In the initial phase of osmological testing, scent traces are evaluated for their proper preservation and suitability for testing. If the traces are negative, the test shall not be carried out.

During the actual test, an independent selection sequence is prepared for each dog, with test samples lined up (min. five posts) or in the form of a circle (min. ten posts). Make independent test samples for each dog. Dogs should work in the new selection system, which includes not only scent tampons but also sanitized stoneware racks and jars¹⁹.

¹⁵ For example, German Shepherds, which are most often used by uniformed services, have more than 200 million of them. *Dog's sense of smell – how does it work and why is it so sensitive?*, <https://www.klinwet.pl/2020-11-12/psi-wech-jak-dziala-i-dlaczego-jest-taki-wyzulony> (accessed 12.08.2022).

¹⁶ Ibid.

¹⁷ Ibid.

¹⁸ *Standardy wyposażenia pracowni osmologicznych w laboratoriach kryminalistycznych kwp/KSP*, Central Forensic Laboratory of the Police, No. BJ-W4-St-1, August 14, 2013.

¹⁹ J. Dzierzanowska, *Methodology...*, op. cit., p. 31.

Proper osmological identification requires two test cycles, each of which consists of control and identification samples. Control tests are carried out to check the dog's readiness for work and whether other undesirable scents are interfering with its work. Each test cycle must start with at least three control trials, with the setting of the test samples changed each time²⁰.

Proper identification testing is undertaken only when control tests are successful. The identification test consists of comparing one piece of evidence with one piece of comparison material. Exceptionally, when the amount of evidence is small, it may be decided to compare one piece of evidence with two comparison materials in one test cycle.

Another extremely important way to prevent the dangers of unbiased testing is to require that the dog handler does not come into direct contact with the materials in the selection row, and that he not be familiar with the setting of the materials. This is associated with the so-called Smart Hans or Rosenthal effect. This is because it could happen that the handler, even unconsciously, suggested to the dog which material he "should point out", for example, by tensing muscles or holding his breath. In addition, after each identification test, the handler and his dog must leave the room where the test is conducted.

During the course of the osmological examination, it is necessary to continuously record its course in the form of records, minutes, and preferably by audiovisual techniques, which provide the best material for later analysis by specialists.

Previous doubts in case law

Among other things, the assessment of the suitability of evidence is made on the basis of two important values: diagnostic and evidentiary. Diagnostic value is a property of a research method, defined in terms of the factors of relevance and reliability: relevance determines whether the method used is able to determine what it should be in a given case, and reliability indicates its accuracy²¹. It is understood as the percentage of the number of correct, incorrect and inconclusive results obtained by a given method²². Evidential value, on the other hand, is determined on a case-by-case basis and applies only to a particular case.

The confidence of Polish judicial authorities in evidence based on osmological expertise has varied over the years. Initially, the courts viewed them positively, as evidenced by the Supreme Court's judgment of March 5, 1930 (II K 4/30), which stated that "evidence can be anything that is capable of forming the judge's conviction of the guilt or innocence of the accused and is disclosed in the course of the trial [...] the circumstance of the police dog's behaviour [...] constitutes for the court the same evidence as any other, subject to critical evaluation on a par with all the evidence." This view was gaining many adherents at the time, and the courts were often

²⁰ Ibid., p. 32.

²¹ A. Domin-Kuźma, *Wartość diagnostyczna i wartość dowodowa badań DNA*, "Homeland Security Review" 2012, vol. 4, p. 78.

²² M. Jędrzejczyk, op. cit., p. 27.

uncritical of the evidence of osmological tests, as presented in the judgment of the Supreme Court of August 22, 1996 (IV KKN 46/96), in which it was pointed out that “The osmological experiment, although it was conducted using only one dog [...], should be considered full-fledged, and this attribute is not deprived of it by the fact that it was conducted after the lapse of two months.” It should be recognized that the court, in its assessment, wrongly remained uncritical of the evidence in question, if only considering the fact that the osmological “experiment” was performed in violation of the rules described in the guidelines for this type of identification. It also seems that treating such a complex problem with little insight is extremely careless and can have far-reaching negative consequences, leading, among other things, to an erroneous assessment of the culpability of the accused²³.

Later, it can be observed that the courts began to be more critical of the phenomenon in question, noting certain inaccuracies and the possibility of mistakes when conducting osmological tests. This is reflected in the position presented by the Supreme Court in its judgment of January 30, 1998 (V KKN 44/97), in which the court held that “evidence from a scent experiment is evidence of a special nature, dependent on certain conditions, its positive result in the totality of evidence may constitute an additional important link, which does not mean that with the existence of specific [...] evidence prejudging the guilt of the perpetrator, the negative result of the scent experiment in any way casts doubt on the validity of the evaluation of this evidence.” It can be noted that this time the court approaches such evidence in a much more cautious manner than before while paying attention to “specific conditions,” by which it can be understood the conditions of the test, the distraction of the dog or other relevant factors affecting the outcome. It seems that the court, in referring to the evidence from the scent experiment as an “additional link,” is pointing out that such evidence should be treated in addition to the rest of the evidence, rather than as a basis for deciding the defendant’s guilt.

The Supreme Court, in its judgment of November 5, 1999 (V KKN 440/99), considered how the osmological examination should be classified – whether to consider it a procedural act carried out by the procedural authority or a procedural act carried out by the procedural authority, but with the participation of an expert or by an expert with the participation of the procedural authority, or to classify it as an expert opinion performed by an expert and specialists. The court notes that at the time, the most common form of procedural activity with the participation of guide dogs, of which a protocol was written. The entire activity was treated as an “experiment”, the minutes of which were counted directly into evidence without questioning the people who performed the “experiment” so that the court had no opportunity to supplement the issues that required it or learn about the methodology of the activity conducted. The court refers to osmological testing with great caution, noting that it is a new method and not yet well understood, and believes that it is a mistake to be uncritical of the results of its tests and to draw conclusions about the suspect’s guilt based on

²³ J. Dzierżanowska, *Identyfikacja osmologiczna w świetle orzecznictwa Sądu Najwyższego*, “Palestra” 2016, no. 51/5–6(581–582), p. 186.

them alone. Nevertheless, the court appreciates the value of osmological testing and considers it useful when specific standards are maintained. He is inclined to have these examinations carried out in the form of an expert report with the appointment of an expert whose opinion should meet the requirements of Article 200 of the Code of Criminal Procedure, during verification of the probative value – those of Article 201 of the Code of Criminal Procedure. In the following section, the court formulates criteria for assessing the value of osmological expert evidence:

- 1) proper selection of the group of scent donors for elimination – with the preparation of documentation of the activities of collecting comparative scent traces,
- 2) taking comparative scents for elimination from the adoptees and the scent from the accused simultaneously and using the same method,
- 3) the lack of knowledge of the location of the comparative trace in the selection row by those within the dog's senses at the time of recognition, and in particular by its handler,
- 4) conducting two “blank tests,” one of which should be done without a comparative trace and the other without an evidentiary trace, and possibly a “scent attractiveness” test – all of which must be documented,
- 5) it is sufficient to carry out two trials after changing the location of the comparative scent in the selection row,
- 6) recognition should be carried out by two independent dogs with a current certificate.

The court summarizes the listed criteria: “Only careful adherence to all the standards developed by several years of practice and recommended in the literature for conducting osmological tests could authorize acceptance – on a theoretical level – of the view that, in light of the principles of free evaluation of evidence, a conviction can be based on osmological expertise as incriminating evidence.”

The Court of Appeals in Warsaw, in its January 19, 2000 ruling (II AKa 436/99), refers to evidence from osmological tests with even greater caution. He draws attention to the specific nature of this evidence and a kind of impossibility of objectively knowing the methodology of conducting the survey: “In conducting it [osmological expertise], the odorology expert²⁴ uses a very specific instrument – a dog specially trained for these purposes. [...] one cannot overlook the fact that this ‘tool’ for the identification of scents, on the one hand – does not submit to objectification in the sense of the impossibility of peculiar calibration, and on the other hand is verified by an identical method – identification carried out with another dog, so still a method fraught with the same shortcoming. [...] the osmological opinion is based on unique and impossible to repeat under identical conditions consecutive identification attempts made by individual dogs.” What’s more, the court goes on to say that “The rulings and studies indicated [in the body of the judgment] point out that there is still a lack of sufficiently strongly verified both by various and independent scientific centres and practice of serious scientific studies that would give osmological expertise the value of irrefutable evidence leading to individual identification. [...] the achievements

²⁴ Another name for osmology.

to date in this area do not authorize the application of their [research] results in the procedural practice of law enforcement agencies and the judiciary with a guarantee of realization of the principle of material truth.” The court, in this judgment, as it were, rejects the possibility of considering evidence from an osmological examination as primary evidence even though the criteria indicated earlier by the case law are met. It firmly stands that the evidence of the osmological opinion cannot be considered significant in determining the guilt of the accused. At most, after conducting the osmological expertise with the greatest care, it can be considered circumstantial evidence, indicating that a person was in a certain place or had physical contact with a certain thing. However, in this view, such circumstantial evidence is of little relevance to the case, and devoid of a complementary chain of other circumstantial evidence, it can be considered – at best – to have a high risk of error. The court distrusts the methodology of osmological testing as being objectively untestable and not satisfactorily verifiable while noting that as “there is no unified view of the methodological canon of osmological testing,” the occurrence of any deficiencies during the testing precludes the value of the evidence in general.

In later years, too, the courts have taken a cautious approach to osmological evidence, as evidenced by the verdict of the District Court in Piotrków Trybunalski on November 17, 2015. (IV Ka 607/15), in which it was stated that “[...] in the current state of science, osmological evidence still does not provide the kind of conviction that can be derived from other tests.” He also cites the ruling of the Court of Appeals in Białystok on May 29, 2003 (II AKa 90/03), in which the court emphasized that “[...] this evidence in the process of proving constitutes only significant circumstantial evidence, which only supported by other direct or at least indirect evidence arranged in a closed circle, can constitute full-fledged evidence of guilt leading to the establishment of only one certain version of the event, from which it follows that no one other than the accused(s) could have committed the criminal act.” In this case, the court explicitly recognized that the evidence of the osmological opinion cannot equal in value to other evidence, that it is, so to speak, “weaker” evidence. Moreover, he concluded that the evidence from the osmological examination could only be categorized as circumstantial evidence, for as such, it confirms certain evidentiary theses only indirectly, indicating that something might have happened, not that it did. However, this time, too, the court does not deny the possibility of admitting evidence from osmological tests in the judicial process. It only draws attention to the far-reaching caution that should be exercised when evaluating them and seeking other corroborating evidence.

Nowadays, a distrustful approach to evidence from osmological testing in courts has become the rule. An example of such a procedure can be found in the ruling of the Warsaw-Praga Regional Court of June 11, 2018. (VI Ka 1525/17), in which the court explicitly states that “[...] osmological evidence does not, so far, provide such conviction as can be derived, for example, from DNA testing, hence the jurisprudence aptly indicates the need for far-reaching caution in basing judgments exclusively on this evidence, which at the same time should not be the decisive evidence in establishing

the facts of a given case.” The court bases its reasoning on both studies of the effectiveness of osmological expertise and the difficulty of conducting an osmological test in a satisfactory manner but mainly cites case law. It is noticeable that justice authorities in Poland have adopted a very cautious approach in recent years when evaluating evidence from osmological tests. It has become commonplace to treat such evidence as additional, corroborating evidence of a given fact, with great attention paid to the manner of conducting the test, i.e. to proceed in accordance with all the rules listed in the *Methodology of osmological testing*. Currently, it is virtually unheard of in case law for courts to take a different approach to evidence from osmological tests.

An important issue in evaluating the evidence of the osmological examination is the principle of free evaluation of evidence expressed in Article 7 of the Code of Criminal Procedure, according to which the bodies of the proceedings, taking into account the principles of sound reasoning and indications of knowledge and life experience, evaluate all the evidence carried out freely. The courts assess their belief in the value of a given piece of evidence on a case-by-case basis according to the facts presented and the circumstances of the case, according to Article 197.3 of the Code of Criminal Procedure. The courts have the right to question an expert in connection with the opinion he provides. Moreover, in addition to the results of the expert report, the expert should also present the methodology of the activity carried out, explain the circumstances that led him to these conclusions and answer the questions posed by the court. The news that will thus be provided by the expert is also subject to the free evaluation of the evidence by the court, which, knowing the rest of the evidence and the circumstances of the case, is able to objectively evaluate the evidence as a whole. It is not permissible to treat an expert’s opinion instrumentally as superior evidence because “[...] in a situation where the rank of an expert’s opinion would be higher than the rest of the evidence, or even treated as a ‘scientific verdict,’ there would be a breach in the judicial principle of free evaluation of evidence in favour of a legal theory of evidence”²⁵.

The number of pieces of evidence that would lead to the conviction of the accused is nowhere specified, also because it would be inconsistent with the aforementioned principle. In view of this, a conviction on the basis of only one piece of evidence is not excluded. However, in such situations, courts should proceed with extreme caution. In the cited judgment (II AKa 436/99), the Warsaw Court of Appeals outlines four criteria that this evidence should meet for such a conviction to occur:

“ 1. in the case of evidence that requires special knowledge and special testing apparatus, it must be based on proven, verifiable and generally accepted scientific grounds

2. the conduct of this evidence, both methodologically and procedurally, should be impeccable and thus allow for its review by both the litigants and the appellate instance,

3. there can be no contrary evidence in the case that would undermine or even make questionable the factual findings based on this unitary evidence,

²⁵ J. Dzierżanowska, *Identyfikacja osmologiczna...*, op. cit., p. 189.

4. inferences from this evidence must directly point to an act or omission by the accused that exhausts the elements of the type of criminal act (it must therefore be direct evidence, and not merely circumstantial).”

In light of the criteria enumerated by the court, which should be the only evidence on the basis of which the adjudicating authority would issue a verdict, point 4, which explicitly states the exclusion of circumstantial evidence as the only evidence leading to a conviction, seems particularly problematic. In the aforementioned judgments, the courts leaned towards the opinion that the evidence from osmological tests should be treated as a kind of additional evidence, confirming only what has been proven before. The Białystok Court of Appeals, on the other hand, explicitly recommends that the evidence from the osmological tests should be treated only as circumstantial evidence, which means that, in light of II AKa 436/99, the evidence from the osmological tests cannot be considered as evidence that, occurring in the case, would be the only evidence that could lead to the conviction of the accused.

Based on the case law presented, it can be concluded that the position of the courts in relation to osmological identification is becoming increasingly conservative. The initial belief in the unquestionable veracity of the evidence from osmological tests has given way to a certain distrust and caution in their evaluation and a desire to gain confirmation of the facts they indicate by other evidence that the scientific world has more confidence in and presents as more certain.

It is worth noting that currently, specialists estimate the diagnostic value of osmological expertise at 80% of correct indications, and through the prism of this result, the courts also assess the evidentiary value²⁶. It seems that the most questionable aspect of evaluating this forensic examination is the inability to fully understand how the dog works when trying to identify a scent. It, therefore, seems unfeasible to objectively assess the adequacy of the scent from the comparison material to that from the evidence, as well as to assess the quality of the scent. It is also important to remember that a dog, like any living creature, can be distracted and make mistakes because of this. The distrust of the adjudicating authorities is also caused by the fact that the method of communication between the dog and its handler is zero-one – the dog will lie down at a given sample or not. In a situation where a verdict was to be reached on this basis, the fact that it is impossible to logically argue and provide specific reasons for such an examination result seems incompatible with the seriousness of the case.

Also noteworthy is the fact that the courts have begun to attach much greater importance to ensuring that examinations are conducted according to precisely defined criteria and that the utmost care is taken to ensure the objectivity of the examination result. However, despite following all the rules, trust in osmological expertise should still be limited. Despite this, the courts, seeing the potential of osmological testing, are positively disposed to the development of this branch of science, hoping that in the future, it will be possible to dispel current doubts and answer nagging questions, primarily as to the methodology of conducting the test, as well as those concerning the diagnostic value of this evidence.

²⁶ M. Jędrzejczyk, *op. cit.*, p. 20.

Laboratory osmological testing

Osmology is developing all the time, and one of its goals is to invent a new method or device that identifies scent on the basis of objectively verifiable analysis. The first research in this area was centred around gas chromatography, during which substances and mixtures are broken down into simpler components to facilitate their analysis (both quantitative and qualitative)²⁷. In the following years, gas chromatography was combined with computer analysis to achieve better results. The scent test, in this case, involves passing the collected gas through a module that purifies it so that it can then go to the thermostat. In the next phase, the gas enters the detector, where it condenses and evaporates onto a plate made of crystalline quartz, which induces surface acoustic waves of different frequencies, which at a further stage allows us to determine the chemical compounds present in the gas²⁸. This method is now widely used, including in forensic science.

Later, research focused mainly on producing a mechanical device that would detect and name scents in the air on the fly. A prototype of such a tool may be the “people sniffer” created in 1965 by the US company General Electric. The device sampled the air and then analyzed it by extracting the chemical compositions of the scents it contained. However, the level of accuracy of scent detection has proved unsatisfactory for osmological testing. Its weight was also a big drawback – it weighed as much as 225 kilograms, which prevented it from being used as much as needed. Another significant drawback was that the machine’s range was only 20 meters²⁹.

In the following years, the potential of chemical sensors and sensor array-based designs was recognized, which could create a device that mimics the human sense of smell, the so-called electronic nose. The scientific world became more widely aware of the method in the 1980s. This was in the 1970s when it was recognized that the biomolecules on the surface of the sensors could be used to develop sensors whose scent detection would be at a very high level, comparable to that of dogs, only this time it would be possible to analyze them scientifically. The most important component of this device is a matrix of sensors that, when stimulated to varying degrees, create a characteristic “code” for a particular scent. It is then analyzed and qualified to a set of scents that were “coded” earlier. The advantage of this method is that it makes it possible to apply chemometric³⁰ analysis of the data by using an appropriate algorithm that matches the resulting scent to those already in the database.

Currently, there is an effort to specialize “electronic noses” to the specific field in which the device would be used. This is due to the fact that the machine’s

²⁷ K. Milkowski, *Zarys historii badań osmologicznych*, “Kortowski Przegląd Prawniczy” 2017, no. 2, p. 16.

²⁸ K. Chyżak, A. Fus, *Ślady osmologiczne*, National Scientific Conference, Faculty of Law and Administration, University of Lodz, Lodz, May 2015 https://www.researchgate.net/publication/276314546_Slady_osmologiczne (accessed 17.08.2022).

²⁹ K. Milkowski, *op. cit.*, p. 17.

³⁰ Chemometrics is the science that deals with the use of numerical, statistical and symbolic methods to analyze chemical data sets.

measurement capabilities depend on the number and type of sensors on the die. A large number of them increases the machine's measurement capabilities. However, it results in a great computational effort and thus increases the processing time. At the same time, a large part of the sensors in such a study would be unused. Therefore, by means of appropriate selection of scent groups, the aim is to reduce the number of sensors on the array so that a device specialized for specific purposes can be created.

“Electronic noses” process data in a fast way, and their operation is not complicated. In addition, due to their small size, they are suitable for portability and use in the field, which is extremely important from a forensic point of view.

“Electronic noses,” however, are most often unable to assess the concentration of individual compounds in the gas. Their operation is based on the extraction and presentation of the mixture of scents found in the sample being tested. However, it is possible to construct a device with implemented bio-sensitive materials, the so-called bioelectronic nose, whose operation is even more strongly similar to the human nose. To build such a device, olfactory receptor proteins were used as the active sensor component. The implemented biosensitive materials are immobilized onto a transducer that converts the biological signal into an analytically useful signal. Currently, nanobubbles are used to build such devices, which, when in contact with a substance, generate signals similar to those produced by cells. Such a “bioelectronic nose” was first introduced in 2012.³¹

The potential of “electronic” and “bioelectronic noses” is enormous, and it is likely that in some time, they will replace dogs when recognizing scents from a crime scene. This will represent a breakthrough in the identification of individuals based on their scent traces due to the greater objectivity of the test results and the possibility of verifying the various stages of the test. One guess is that with the introduction of professional scent recognition devices, courts will place greater trust in evidence obtained from such osmological expertise.

Summary

As you can see, despite being a relatively old research method, osmology is still widely used and thriving. However, it is a method that should be handled with care, and great importance should be given to carefully following guidelines and recommendations. When making osmological identification, it is not difficult to make mistakes, the detection of which in the later stages is not an easy task, which is why so much responsibility rests with those conducting the test and experts. Adjudicatory bodies are aware of the shortcomings of this research method, so they are cautious about evidence based on it. The tendency of the courts seems to be increasingly sceptical, especially when evidence from an osmological examination would be the only or key evidence prevailing on the outcome of a case.

³¹ T. Wasilewski, *Nowoczesne narzędzia analizy zapachów – elektroniczny nos*, “Laborant” 2017, no. 3, <https://laborant.pl/nowoczesne-narzedzia-analizy-zapachow-elektroniczny-nos> (accessed 17.08.2022).

However, it is possible that the attitude of adjudicating authorities towards osmological identification will change with the invention of new equipment and methods to analyze scent accurately. Research conducted in recent years offers hope for the invention of an “electronic nose,” which has been attempted for more than half a century. Analytical methods could replace dogs during scent detection and would allow control over the process of osmological expertise, the testing methodology and the subsequent accurate, scientific analysis of the results, which would instil greater confidence in the adjudicating authorities and definitely increase the evidentiary value of the evidence obtained from such testing.

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