International Journal of Law in Changing World

Volume 1 Issue 2 (2022) ISSN 2764-6068

Research article
Journal Link: https://ijlcw.emnuvens.com.br/revista
DOI: https://doi.org/10.54934/ijlcw.v1i2.26

DNA EVIDENCE, NEW TECHNOLOGIES, AND JUSTICE'S APPLICATIONS: AN INTERNATIONAL COMPARATIVE OVERVIEW

Eugenio D'Orio
Bio Forensics Research Center, Italy
Chiara Lucanto
Bio Forensics Research Center, Italy
Genaro Francione
Bio Forensics Research Center, Italy

Article Information:

Received
October 4, 2022
Approved
October 20, 2022
Accepted
November 17, 2022
Published
December 29, 2022

Keywords:

DNA evidence,
technologies,
justice,
comparative law,
international law

ABSTRACT

Modern technologies represent an increasingly useful tool in the justice system, and their direct application affects practically every single branch of justice, from the civil trial to the criminal trial, to the computerized organization of judgments and their availability to legal practitioners, to applications of artificial intelligence (AI). In the field of criminal trials, DNA examination technologies represent an important tool for acquiring scientific information that is increasingly useful for a proper search for historical truth. These technologies, which are constantly evolving, have characterized trials and investigations all over the world since the early 2000s. However, this technical evolution is often not followed by a regulatory evolution, the purpose of which would be to assist and maximize the use of these new technologies in the justice system. This article will highlight, in a comparative manner, the current European and extra-European laws on the regulation of genetic evidence. An in-depth focus will be made both on regulatory aspects both on aspects related to the new scientific methodologies and how their use can affect human rights, with particular regard to the protection of citizens' basilar human rights.

FOR CITATION:

D'Orio, E.; Lucanto, C.; & Francione, G. (2022). DNA Evidence, New Technologies, and Justice's Applications: An International Comparative Overview. International Journal of Law in Changing World, 1 (2), 84-102. DOI: https://doi.org/10.54934/ijlcw.v1i2.26

1. INTRODUCTION

Genetic evidence in the modern justice system is the result of a far-reaching regulatory and technological development that has taken place in the last twenty years worldwide. In order to properly introduce the subject of genetic evidence, its evolution - scientific and legal - over the years and the related regulatory developments, it is necessary to divide this paper into the following sub-chapters.

2. SCIENCE IN THE CRIMINAL PROCEEDINGS: INTRODUCTION

"To judge the expert's advice the judge should know what he not only does not know, but that with the expert's call he confesses to not knowing" [1].

This is the paradox of the evaluation of scientific evidence, a paradox that has generated considerable reflection, changing doctrinal contributions and jurisprudential interventions; in the background the complicated and elusive question: how can the judge, as a non-expert, subject the expert's work to critical scrutiny? The problem of the evaluation of scientific evidence arises with increasing current, given that the evidentiary reconstruction of the fact, much more often than in the past, is entrusted to the resolution of technical-scientific questions, hence, to results that scientific evidence composes and conducts in criminal proceedings with the help of experts.

It has been observed in doctrine that a decision that is based on an expert response that is indecipherable or in any case insusceptible of review by the judge resembles dangerously resembles the ancient ordalic rites: yesterday there was divinity, today science [2].

But such a consideration undeniably suffers from a link to a concept of science understood in unitary, stable terms: an infallible science. And, thus reasoning, it would delineate scientific forensic evidence in the criminal trial. One will reflect shortly on what one may call an evolution of the positivist conception positivist conception: not a single, stable science, but several sciences, as such surmountable and therefore fallible.

More often than not, the concept of science evokes not so much what science is, but rather what derives from science: the technical-scientific discoveries, the complex advanced technologies, the fruits

https://doi.org/10.54934/ijlcw.v1i2.26

of specialized knowledge. Yet science is a process, a complex system of processing the natural world and of continuous discoveries about it: the essence of science is the scientific method [3].

Likewise, what characterizes scientific evidence, its specialized connotation, is the epistemological basis on which it bases its conclusions, founded, therefore, on statements, formulations and methods subjected to the experimental control of the scientific community scientific community of reference.

According to the most widely followed definition, scientific evidence is understood as that complex of "evidentiary operations for which, at the moments of admission, assumption and evaluation, instruments of knowledge drawn from science and technology are used, i.e. and technique, i.e. scientific principles and methodologies, technological technical apparatus whose use requires external expertise" [4].

It is frequently the laws scientific laws that constitute the prerequisite for scientific proof, as the results are

based on the application of them to the concrete case; but it is also true that what characterizes scientific evidence is not the interference of scientific laws for the purpose of its evidentiary use, but rather, the evidentiary use, but rather, the adoption of the scientific method "i.e. the method that reconstructs the event with the analytical examination [...] of all the segments of the event, arriving at its explanation with the use of the scientific method.

its explanation with the use of the inductive method that allows us to recompose the fragments of reality into a single picture' [5].

The scope of scientific evidence extends to both the field of substantive criminal law and procedural law. Substantive criminal law as well as to the field of procedural law: on the one hand, it can affect criminal cases when reference is made to specialized knowledge within it [6]; on the other hand, undoubtedly represents a useful tool for the evidentiary reconstruction of the fact at trial.

In recent times, in fact, we have witnessed an increasingly intense and massive use of science in criminal proceedings; on the other hand side, it is undeniable how fundamental and productive the contribution of scientific knowledge is to justice by means of useful, sometimes indispensable, for the reconstruction of the fact; achieving, the scientific evidence an almost undisputed privileged claim over other findings (G.Sprangher, 2011): "a kind of scientistic primacy scientism [that] tends to oust both

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declarative evidence and the maxims of experience as its instruments of evaluation, from the central position they tradition and in the trial-criminalist imaginary of an accusatory matrix [6]".

There is no lack, however, of doctrinal voices of relative criticism towards a spasmodic and and unconditional use of science in the procedural field [9], also taking into account the difficulty related to the very nature of science, i.e. what is both the foundation and together a limitation to the proper use of scientific evidence in criminal proceedings: science is not infallible, it is continually surmountable, not therefore capable of providing an immutable method of knowledge, because scientific results can as such be disproved.

3. FORENSIC GENETIC ANALYSIS: TECHNOLOGICAL AND METHODOLOGICAL DEVELOPMENTS

Forensic genetics, as well as forensic biology, is a branch of forensic science and therefore deals with individual identification from the analysis of biological traces, but unlike forensic biology, it finds its beginning and end within specialized laboratories.

The fields of application of this subject are multiple such as:

• Criminal cases: suspect/victim-trace

• Paternity testing: controversial paternity

• Immigration: family relationships

• Identification: mass disaster (DVI), missing persons, historical identifications

Throughout history the techniques and obviously the knowledge of forensic genetics has been modified and increased. In 1900 there was the discovery of the first genetic polymorphisms, AB0 blood groups, by Landsteiner15, and in 1915 the first tests, based on antibodies, were performed for blood groups. In 1910 Locard stated the principle that "every contact leaves a trace" revolutionized the method of operation in the field of forensic science [10]. Between 1920 and 1950, other blood groups and serum proteins were discovered and used. In 1953, the discovery of the double helix structure of DNA allowed the beginning of forensic genetics research at the molecular level [11]. In 1960, British geneticist Alec

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Jeffreys developed the technique of multilocus DNA fingerprinting which led in 1986 to the first use of DNA in criminalistics.

Jeffreys discovered some hypervariable regions in human DNA, called variable number of tandem repeats (VNTR) minisatellite regions, which are dispersed throughout the human genome and are tandem repeat regions. The variability is due to the fact that many of the minisatellite regions are highly polymorphic due to allelic variation. A probe based on this tandem repeat of the core sequence can detect many highly variable loci at the same time, and with this technology it is possible to provide a specific fingerprint of individual DNA [12].

The technique developed by Jeffrey required first the extraction of DNA and then the use of restriction enzymes. Each enzyme cuts the DNA molecule at a precise site composed of repeated nucleotide sequences. After that, electrophoretic running on agarose gels of DNA molecules appropriately hybridized with probes for polymorphic loci was carried out. In this way and depending on the number and position of the different restriction sites we can have fragments of shorter or longer length. A large fragment will run slower than a small fragment, depending on the molecular weight. The result was a series of black bands on the X-ray film [13].

Although this technique was completely revolutionary in the forensic field, it had limitations. For an efficient VNTR analysis to take place, since they present repeated sequences composed of up to 20 nucleotides, it is essential that a relatively large amount of DNA is available. This condition makes the technique inefficient when samples with degraded DNA are analysed and the analysis took a long time to complete [14]. These limitations have only been overcome with the development of Polymerase chain reaction (PCR); a technique that allows multiple copies of a specific DNA sequence to be obtained in a short period of time (K.Mullis, 1993). In addition, fluorescent probes have supplanted radioactive probes and capillary electrophoresis has taken the place of the agarose gel; these are the major changes Jeffreys' technology has undergone [15].

With the discovery of the polymerase chain reaction (PCR) technique, a new generation of DNA markers were identified, such as microsatellites (STR), single nucleotide polymorphism (SNP) and mitochondrial DNA (mtDNA).

Currently, the most widely used genetic markers in forensics are microsatellites short tandem repeat (STR), which are polymorphic sequences in the population. STRs have polymorphisms of different

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lengths, so there are no changes in the nucleotide sequence, but in the number of repeats of a sequence within the microsatellite. STRs are composed of repeat motifs (2-6 bp) resulting in shorter overall length fragments (<500 bp) that could also be detected in degraded (i.e. highly fragmented) DNA, which is often present in forensically relevant samples [16]; they can be classified according to the number of bases present in the repetitive unit: dinucleotide, trinucleotide, tetranucleotide, pentanucleotide, and hexanucleotide sequences.

Microsatellites, in the forensic community usually referred to short tandem repeats, especially sequences defined as tetranucleotide have demonstrated to be ideal for forensic applications [17]. STR typing is more sensitive than single locus restriction fragment length polymorphism (RFLP) methods and less susceptible to allelic dropout than VNTR (variable number of tandem repeats) systems [18].

In 1990, the FBI began a test DNA databasing program with 14 state and local laboratories. ("Combined DNA Index System (CODIS)". On October 13, 1998, the Federal Bureau of Investigation (FBI) officially introduced its nationwide DNA database. As early as 2006, this database, called the COmbined offenders DNA Index System or CODIS, contained over 5 million STR profiles and linked all 50 states in the United States with the ability to search for criminal DNA profiles [19].

Marker characterization was completed in November 1997 with the selection of 13 loci: CSF1P0, FGA, TH01, TPOX, VWA, D3S1358, D5S818, D7S820, D8S1179, D13S317, D16S539, D18S51, and D21S11 (J.M.Butler, 2006). In 2009, the European Network of Forensic Science Institutes (ENFSI) and the European DNA Profiling Group (EDNAP) selected 17 STR loci that define the European Standard Set (ESS). The selected loci, partly shared with CODIS, are: D1S1656, D2S441, D2S1338, D3S1358, FGA, SE33, D8S1179, D10S1248, TH01, vWA, D12S391, D16S539, D18S51, D19S433, D21S11, D22S1045, and amelogenin (L.Welch, 2012).

Forensic DNA database technology is divided into three parts: (1) the collection of known samples, (2) the analysis of these samples and entering their DNA profiles into a computer database, and (3) the subsequent comparison of the unknown profiles obtained from crime scene evidence with the known profiles in the computer database.

One of the greatest challenges in maintaining a DNA database is the issue of privacy and security of the information stored in the database. Blood samples contain genetic information that could be used against an individual or their family if not handled properly. The issue of privacy is approached in two

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ways. First, the DNA markers, the 13 STR loci in CODIS, are in non-coding regions of DNA and are not known to have any association with a genetic disease or any other genetic predisposition. Second, no names of individuals or other characterizing data are stored with the DNA profiles. Case-specific data are protected and controlled by local law enforcement agencies. Thus, only the crime lab that submitted the DNA profile could link the DNA results to a known individual. Another important aspect to the privacy and security of information in DNA databases is the fact that access to CODIS is for law enforcement purposes only.

Currently, there are kits on the market that allow simultaneous amplification of multiple markers: there are reliable and validated commercial kits that allow amplification of 24 STRs, including both CODIS (Combined DNA Index System) and European Standard Set (ESS) markers.

A typical STR typing kit consists of the following five components: (1) a mixture of PCR primers containing oligonucleotides designed to amplify a set of STR loci (one primer pair islabelled with a fluorescent dye); (2) PCR buffer; (3) DNA polymerase; (4) an allelic ladder with common alleles for the STR loci to be amplified to allow calibration of the allelic repeat size; and (5) positive control DNA sample to verify that the kit reagent is working properly.

The first step in forensic DNA analysis is sample collection and sample preservation. The next step is DNA extraction followed by DNA quantification. We proceed with PCR, in general it is a multiplex PCR amplification, then we need to separate and size the alleles with STR typing by capillary electrophoresis. At the end, we have interpretation of the result for comparison with the reference sample, or for DNA database search. If we have a match, we need a comparison between the DNA profile and the allele frequency of the population, to generate a case report with a value, which means the probability of a random match with an unrelated individual. This is a critical information, so a statistical evaluation is the most important aspect, because with the statistical evaluation we can understand if our profile is rare or a common profile, in general these regions are so variable that it is almost impossible to find 2 individuals with the same profile, but we always need the statistical evaluation, we need numbers to explain the meaning of genetic compatibility. So, in every relationship we need genetic compatibility plus a number to explain the value of this compatibility (P.Schmitt-Kopplin, 2008). STR analysis, however, does not bring good quality results when forensic biological samples contain too little template DNA or are too degraded [20].

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One class of genetic markers that may prove useful, particularly when we are in low template conditions, or degraded samples, are SNPs [21]. Single nucleotide polymorphism refers to a change of a single base in a DNA sequence. SNPs are commonly biallelic. Precisely because of this characteristic, SNPs are less informative in identity testing than STRs. In fact, many more SNPs are required to achieve the same level of discrimination achieved by the 13 STR loci [22]. However, the use of SNPs is very useful for obtaining information about the phenotypic traits of a person who has left their biological material at the crime scene. An example isthe commercial kit IRIS Plex for accurate prediction of blue and brown eye colour of an individual, starting from a sample on the crime scene.

Applying IRIS-PLEX we can combine all the information of eyes (3 categories: blue, intermediate, and brown), skin (5 categories: very light, light, intermediate, dark, very dark) or hair (4 categories: red, blond, brown, and black) colours, to obtain a sort of identikit, to associate for example with a STR profile [23].

Lineage markers have special applications in forensic genetics. Set out the analyses of the Y chromosome it is possible to have a lot of information, especially in cases where there is an excess of DNA from a female victim and only a low percentage from a male perpetrator.

This condition is very frequent in cases of evidence that have mixed profiles involving more than two male subjects (the analysis allows to determine the number of such subjects) and in cases of heterosexual sexual violence (the DNA of the perpetrator is not subject to contamination by the DNA of the victim). However, the analysis of STR on the Y chromosome have limitations, first of all that being transmitted only from father to son, male relatives all have the same Y profile [24].

Furthermore, a genetic profile can be obtained not only from nuclear DNA but also from mitochondrial DNA especially in cases of analysis of low-level nuclear DNA samples, particularly from unidentified (typically skeletonized) remains, rootless hair shafts, or very old specimens where only highly degraded DNA is available (R.Loewer, 2013).

Mitochondrial DNA is present in multiple copies per cell unlike nuclear DNA. It is inherited exclusively from the mother and is a single circular chromosome only 16kb long (contains 16,569 bp), coding for 37 genes. It contains 22 genes that encode tRNAs and 2 rRNAs. It also encodes 13 proteins that are subunits of oxidative phosphorylation. It contains only exons, no introns, and has no repair system, leading to high mutation rates in the D-loop [25].

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4. INTERNATIONAL COMPARATIVE LAWS: FROM THE FRYE'S STANDARD TO THE DAUBERT'S CRITERIA

The US judicial experience, initially timid and not very open to new scenarios and new resources of science and technology, sees its most important rethinking in the transition from the leading Frye case of 192327 - which established the criterion of General Acceptance, centred on the appeal to the general and shared consensus of the scientific community - to the Daubert case of 199328.

In the famous Frye pronouncement, it is stated: "[the scientific principle or discovery on which on which] the [evidential] inference rests must be sufficiently well established to have received general acceptance in the particular field to which it belongs" [26].

In other words, the lack of acceptance by the reference community of the validation of a hypothesis, means scientific uncertainty, therefore a proof can be accepted only insofar as it is based on a scientific principle or discovery sufficiently stable to be generally accepted in the field of research to which it relates.

The ruling states, first of all, that the court, when faced with elaborating of innovative theories or in scientifically controversial situations, is called upon to assess the relevance of the evidence with reference to the case at hand, being otherwise inadmissible; having carried out this preliminary verification, it will be called upon to assess whether or not a given thesis has achieved a high level of consensus in the relevant scientific field.

The Frye standard, centered on majority opinion, however, left unresolved a number of problems.

The criterion, in addition to seeing a judge subservient to the more or less established theories scientific theories, and thus subservient to the assessments offered by the expert community; was preclusive to the entry into the trial of new scientific evidence generated by technological progress; as well as reductive for all those areas in which the boundary between good or bad science appears difficult to trace even within the scientific community itself.

As has been correctly pointed out, the Frye standard - by claiming only the evidentiary criterion of general acceptance by the community of the criterion proposed by the expert - does not take into account the existence of intermediate disciplines between exact sciences and pseudosciences, "i.e. disciplines in

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which, for the same specific problem: there are several competing criteria of judgement (e.g. psychiatry, economics); there is a criterion, yes, a single one but with a broad rather than general consensus (e.g. oncology, toxicology); there is a criterion, yes, unique, but newly discovered and therefore shared by a very limited number of experts (e.g. genetics, toxicology) [26].

The Frye test therefore generated problems in identifying the scientific community of reference for all those scientific tests that embrace multidisciplinary fields, not allowing a full understanding of when a generalised consensus can be said to be reached or not reached a generalized consensus.

Moreover, referring to the sole parameter of general acceptance, could make sense only if science represented a granitic and unchangeable entity, and was not, as in fact it is, in continuous movement and overcoming.

Some seventy years later, that single criterion of admissibility of scientific evidence is therefore expanded and reconstructed in an ancillary key with respect to the other parameters set out in the famous Daubert v. Merrel Dow Pharmaceuticals, Inc.

This judgement has undoubtedly increased the role of the judge in the matter of the admission of admission of evidence, taking into account that the US trial process assigns to the judge the task of deciding, in an adversarial process between the parties and in the absence of the jury, whether evidence may be admitted, based on direct review of the reliability of the scientific instrument.

In attempting to provide guidelines to bring clarity to the, at times, unclear blurred boundary between science and pseudo-science, the Daubert judgment takes note that the sole criterion of the majority opinion of the scientific world causes an impasse in the system; consequently, the scientific solution must be admitted which, in addition to adopt generally accepted and recognized methodologies, is or can be verified, and thus falsified, by providing control standards and indicating possible margins of error.

The Court, based on the premise that it is methodology that distinguishes science from other fields of human enquiry, argues that in the judgement of admissibility one must take certain aspects into account, namely: Verifiability of the method. The first characteristic that scientific knowledge must possess is that of verifiability: a theory is scientific if it can be checked by means of experiments. Falsifiability, the second criterion, requires that the scientific theory be subjected to attempts at falsification. Submission to the control of the scientific community is the third criterion, in it, the method is required to be published in

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journals to be scrutinized by the scientific community. Knowledge of the rate of error is the fourth criterion. The judge must be made aware, for each proposed method, of the percentage of ascertained or potential error. The presence of constant verification standards and general acceptance of the method, means that the judge must take into account, as an auxiliary criterion, whether the method proposed enjoys general acceptance by the expert community. It is worth to specify, in relation to this last criterion, that the general acceptance of the methodology within the scientific community enjoys an entirely different reading from that proper to the Frye test: it remains a criterion to be considered, albeit neither necessary nor exclusive.

In other words, it is stated that in order to be admissible, scientific evidence must be examined not only on the basis of the explicit requirement of evidentiary relevance, but also on the basis of the requirement of the 'reliability' of expert testimony, reliability assessed not exclusively by that one criterion set out in the case Frye.

As to relevance, the Court states that scientific evidence, insofar can be helpful in resolving a dispute of fact, insofar as the expert's theory is sufficiently related to the facts of the case: the scientific method, or the technology to be intended to be used must have an adequate connection with the individual fact to be proved, such that which it is not sufficient that the principle or method is valid, but it must also be useful for the purpose of reconstructing the fact in the individual case.

The validity of the scientific principle on which the theory rests requires for it to be so that it is based on scientific knowledge that as such is supported by valid scientific arguments and foundations, and are not rather fruit of speculation devoid of any corroboration or of personal convictions of the expert disassociated from data.

A suitability for ascertaining the concrete fact that is, therefore, inextricably linked to the reliability of the method itself: it would, moreover, be pointless and unnecessary to question the admissibility of technical-scientific resources if these, however, would not bring usable results within the process.

Both the Daubert case and the subsequent case law interventions that have led in the US trial to the amendment of Rule 702 with consequent adaptation of the rules to these selective criteria in the field of expert testimony, tend to to prevent unverifiable and unscientifically grounded material from enter the trial and frustrate or distort the trial ascertainment. It remains that - we repeat - they are essentially aimed at the admission phase, since in the US adversary system, the actual role of 'trier of fact' is left to the jury.

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The criteria of the Daubert judgment have undoubtedly influenced the Italian experience, to the extent that they are considered to have been transposed into Italian law even by the most recent case law.

How the adjudicating body can perform this critical mediation, and thus how to approach with such criteria, in the light of which the critical scrutiny can be said to be exhausted, will be the subject of further reflection.

But one must first ask oneself what is the place in which to carry out this operation, i.e. the level at which the judge implements this filter.

Jurisprudential contributions on this point are mostly projected to the final stage of the evaluation of scientific evidence, failing to consider the usefulness that an approach tending to isolate and deal with the individual phases of the evidentiary process is able to offer.

On the other hand, the misunderstanding of providing a reflection on scientific evidence addressed solely from an evaluative point of view, one would obtain a reflection that is devoid of the logical-procedural path that scientific evidence, like all evidence, takes in the stages preceding phases.

It is therefore necessary to highlight the close dialectical connection between the phases that characterize the evidentiary procedure, from admission to the formation of the material, following the rational logical-procedural development, the former being – the admission and acquisition - serving the orderly and proper unfolding of the later: the problem of the evaluation of scientific evidence can only be first the problem of its admission and acquisition.

Solving the paradox of the evaluation of scientific evidence will mean first resolve when and how scientific evidence will be respectively admitted and acquired respectively.

5. POPPER'S THEORY AND THE SCIENTIFIC PROCEEDINGS

"What are the remedies for a truly fair new justice?"

In this period some striking judicial cases (e.g. Meredith Kercher, Melania Rea, Elena Ceste, Guerina Piscaglia, Roberta Ragusa, Yara Gambirasio, Sara Scazzi, Chiara Poggi etc.) have brought to the limelight the suspects who continue, although arrested, to proclaim their innocence. The deficiency of certain evidence and the founding of processes on purely clues have generated on the network and Face

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Book opposing groups of innocents and guilty parties. A real cult where everybody becomes judges, criminologists, experts, stimulated by press and especially television media that dedicate 70% of their programming to the to the criminal show.

The first investigation that must be carried out by a fair judge in the search for a procedural truth is that on the method used and on its effectiveness. Here modern epistemology, in particular the philosophy of Karl Popper, helps us.

In science, conjectures based on clues are valid to create a scientific thesis but this must be submitted to the scientists to experiment in the laboratory. The thesis is valid only if all the scientists reach the same conclusion. Mutatis mutandis the procedure also applies to judges. If a conjecture leads to different results on the part of the analyzers, then that conjecture is fallacious or at least it is not known to what extent it is true.

The judge in the analysis of the evidence must merge with the traditional criterion of verification, based on the search for data confirming the incriminatory conjecture, the most modern devised by Popper in the epistemology of falsification, i.e., going to research, even beyond the evidence sometimes, facts that could contradict the main statement. "The criterion of falsifiability maintains that an assertion, to be empirically informative, that is to say scientific, must be falsified principally and not denied in fact, despite the most severe attempts to make it fall".

We must abandon the lethalness principle of the "free conviction of the judge". It is necessary, therefore, that the magistracy models a new scientific methodology, avoiding confusion as it has sometimes happened in the past. Only by distinguishing legal science as a conjecture (based on clues) and legal science as a result, based only on strong evidence of proofs, can we have a real guarantee of a criminal justice free from prejudice and truly egalitarian.

Using these principles, Mr. Gennaro Francione, Judge of the Criminal Court of Rome, Italy, has raised, in vain the question of unconstitutionality of the process based on the clues but the Constitutional Court with Ordinance no. 302 of 2001 rejected my request in a brusque way. A noted journalist, Gigi Trilemma, wrote in his article "The Constitutional Court has lost an opportunity to abandon permanently the literary processes and give definitive space to the scientific process based on certain evidence and not on clues. I am sorry the hasty system with which the Constitutional Court has solved the epistemological question, avoiding tackling the crucial matter about the so-called war on the proof versus the clues. The

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criminal judge, on the other hand, demanded just to do this, that is to decide not with the tautological criteria of legal formalism but based on the principles of modern epistemology, which can only define what is certain and what is false in any proceedings to collect evidence on facts".

The trials are made for strong proof not for clues that only serve to create conjectures, invalidated if no evidence is found. This is the popperian scientific process, not a mediaeval novel. The clues only serve to open investigative tracks but then if there is no strong evidence the process fails. A thousand clues do not form a single proof, not like 1000 rabbits which form a warren and certainly not a lion!

Discovering the authors of the crimes is anything but simple. Detective stories say that no crime is perfect. Indeed, perfect crime does exist! A big number! And justice enjoys finding culprits at all costs to show that it works.

To limit the judicial freedom of the judges in a scientific way, together with the late professor Imposimato we came up with a list of legal evidence to be followed. In this regard the judges must demand not only confession and / or smoking pistol, but also unequivocal telephone tapping, crisscrossed testimonies, reconstructed paths with CCTV cameras, post delictum markings with bugs, applications antistalking as Mytutela, scientific surveys done properly and 100% safe. Certainly not as in the cases Cogne, Melania Rea, Meredith, Bossetti. Not to mention the case of Elena Ceste where you do not even know how the woman died, or Guerina Piscaglia and Roberta Ragusa whose bodies were not even found not knowing if they died or not, if they were killed and how and by whom. If you do not go through strong proofs, all you can do is trigger indictment trials against alleged perpetrators, keeping them out of jail anyway. If then the clues do not lead to proof, serious, precise and concordant, the process has failed.

Nowadays trial based on clues is required by law but it is irrational because in itself it always creates reasonable doubt so much so that these striking cases create the faction of the guilty and that of the innocentists, thus lacking upstream certainly of the final verdict. We continue to fight to make the declaration process unconstitutional. Also, because against the expression of the norm what was supposed to be an exceptional process has become the rule by putting the weaker subject in jail and setting him up as a scapegoat. According to statistics, 90% of the processes today on a clue basis would be wiped out, remaining only 10% of processes to be carried out until the possible sentence. A quick but right way to dispose of the backlog.

https://doi.org/10.54934/ijlcw.v1i2.26

We use DNA as a model of study, which is even considered in some striking processes (Bossetti case) as a proof, being, instead, a simple clue. Both the facts of the media and the positions of various "insiders" show us that the genetic test is not infallible as is believed. With the rigorous Popperian method, the first notation is that DNA sampling and analysis must be guaranteed by the creation de iure condendo of a national sampling service and investigations with super parties experts, depending on the magistracy (we believe to exhume the investigating judge) and not of the Public Minister. At the time those delicate acts of investigation must be guaranteed by the presence of a defense counselor also for the unknown murderer otherwise all is nil (article 111 of the Constitution). It is necessary to provide a legal defender and a legal advisor for the unknown to avoid the formal flaw of the control and verification procedure. It is not pure theory given the problems created by the scientific police in the Meredith Kercher case, which ended with the acquittal of Amanda Knox and Raffaele Sollecito.

Besides the criterion of detector neutrality it is necessary to guarantee a supervisor in the key stages of the collection of exhibits, the correct chain of custody, the laboratory analysis to ensure the right assumption (procedures, instruments, etc.), conservation and analysis of data.

The currently dominant static criminology is Aristotelian, apodictic and is aligned with the clue process. The dogmatic omnipotence of DNA is part of it.

Dynamic criminology, on the other hand, requires a rigorous answer to the questions: "Quis quid ubi quibus auxiliis cur quomodo". This is of corse a latin phrase, which literally means "who, what, where, by what means, why, how, when?". It is an hexameter elaborated by Cicero (quoted by St. Thomas Aquinas) which contains the criteria to be observed in the conduct of a literary composition: to consider the person acting (quis); the action, what he does (quid); the place where it happens (ubi); the means that he uses in executing it (quibus auxiliis); the purpose it has (cur); the way it's done (quomodo); the time it takes him to execute it (when) [28].

So, we use the brocardo with the addition of the "quantum" to implement the reconstructive sequence of a crime in a criminal key.

And therefore, we have built a complete sequence of a crime in terms of dynamic criminology, strict response to every single question in verification and falsification of data according to the teachings of Popper.

https://doi.org/10.54934/ijlcw.v1i2.26

The scheme described above in the Bossetti case admitted and not granted that the DNA is his. This element is not enough to attribute the crime to him. It is necessary to establish precisely "how", but it must be considered that with the possible homicidal action, it cannot rule out accidental or artful contamination. It's possible that the suspect has left traces not because he's the murderer himself but because he has touched the corpse post delictum accidentally or to conceal the dead body.

Before wrapping up, the fair trials are done by science and strong proofs. Certainly not by fictional clues [29].

6. CONCLUSIONS

In accordance with the above-mentioned issues, scientific publications and legal rulings and guidelines, it is evident that the international scientific and legal community is very attentive to the subject of scientific evidence. However, it is equally evident that, nowadays, very different orientations and approaches on this issue continue to exist in different nations. This certainly represents a major limitation in the justice system; in fact, the existence of different standards and/or different legal orientations, in practice, conflict with an objective application of scientific data in trials. In addition, these divergences also have an important impact in terms of guaranteeing the fundamental rights of citizens, as they will have different possibilities - depending on the country in which they find themselves - to make use of scientific evidence in order to protect their legal position and/or legitimate interests. This study aims to offer a comparative view of scientific evidence precisely in order to highlight the merits and shortcomings of an international legal system that must necessarily evolve both in terms of the rules of law and in terms of access to modern technologies precisely in order to effectively guarantee citizens' rights and the holding of a fair trial.

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https://doi.org/10.54934/ijlcw.v1i2.26

ABOUT THE AUTHOR

Eugenio D'Orio – Bio Forensics Research Center, Italy
e-mail: eugenio.dorio@bioforensics.it
ORCID ID: https://orcid.org/0000-0001-7861-3243

Chiara Lucanto – Bio Forensics Research Center, Italy

Genaro Francione – Bio Forensics Research Center, Italy

ABOUT THIS ARTICLE

Conflict of interests: Authors declare no conflicting interests