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Expert Testimony and Scientific Evidence in Arson-Related Cases

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ABSTRACT: The paper surveys scientific evidence in arson-related cases. In particular, accelerant-detection procedures are discussed. The admissibility of types of evidence and testimony is commented on, and an analysis of possible methods of attacking the weight accorded to the evidence is presented.

KEYWORDS: jurisprudence, arson, testimony

There is growing concern over the critical national problem of arson. It is estimated that the national direct dollar loss resulting from arson exceeds $1.3 billion [*1*]. Moreover, reports indicate that approximately 1000 persons are killed each year in arson fires [*2*]. Attempts to combat the problem have been hampered by the lack of interdisciplinary cooperation necessary for an effective antiarson initiative.

One obvious tactic to control the arson problem is to increase the rate of successful prosecutions of arsonists. A related goal would be to increase the incidence of successful defense of arson-related claims by insurance companies. To accomplish these goals, insurance defense counsel, prosecutors, and arson investigators must be aware of, and trained in, methods that will improve their capabilities to deal with arson-related cases [*3*].

The very nature of arson compels the conclusion that it is normally committed surreptitiously [*4*]. Eyewitness testimony is rare; therefore, the prosecutor, or insurance defense counsel, must frequently rely on circumstantial evidence in proving his or her case [*5*]. The courts have recognized this fact and have normally held that direct evidence is not required to establish the crime of arson [*6-9*], although an appeals court has reversed a conviction for arson because the verdict was based on suspicion and conjecture [*10*]. This is also true in civil arson-related cases [*11-12*]; in addition, the burden of proof required is less than that required in a criminal prosecution [*13*]. Circumstantial evidence may be used to prove the entire criminal offense or to establish the insurance company's affirmative defense to the civil claim for insurance proceeds. Therefore, the evidence proffered may be used to prove burning, incendiary origin, or the connection of the defendant or claimant to the willful burning [*6*].

In the field of arson defense and prosecution the most important type of circumstantial evidence is often expert and scientific evidence. Expert testimony is often called on in an attempt to prove the incendiary nature of the fire, the lack of possible accidental causes of

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the blaze, or that a specific individual—the defendant, the claimant, or a conspirator—actually was the cause of the blaze.

Types of Expert and Scientific Evidence

In arson-related cases the most common uses for expert and scientific evidence are to prove the incendiary nature of the suspicious fire and, to a lesser extent, to connect the suspect to the fire. Some of this evidence is not unique to, or even generally closely related to, the field of arson [*14*].

Fingerprints, probably the most common type of scientific evidence, may be used to show that the suspect had the opportunity to set the suspicious fire by indicating that the suspect had been in the specific area where the fire originated. Moreover, fingerprint evidence could be used to connect the suspect to certain physical evidence of arson, for example, a container for flammable liquids of the type used to accelerate the fire in question.

Tire-track and footprint evidence can also be used to attempt to prove that the suspect had the opportunity to set the fire. Similarly, microanalysis of the physical objects found at the scene of a suspicious fire may also be used by the investigating agency to connect suspects to the fire [*15*]. In addition, photography is becoming an increasingly popular tool among arson experts in their investigation and the photographs may be physical evidence [*16-17*].

Another common sort of scientific evidence relevant to the investigation and prosecution of arson-related cases is the analysis of the entry into the fire-damaged property. For example, toolmark evidence can be found at the point of entry. Often the investigation of the point of entry will indicate that the evidence was apparently arranged to confuse the investigator into thinking that there was a forced entry when in fact there was not. This would be the case when the suspicious fire was actually set by an "insider" [*18*].

Expert and Scientific Evidence of Arson

Most technical evidence concerning arson deals with the cause of the fire. Determining the cause of the fire—and thereby ascertaining whether or not it was of incendiary origin—is an extremely difficult matter [*19*] because the fire itself consumes evidence, fighting the fire disturbs evidence, and the debris makes it less likely that all remaining evidence will be located [*20*].

In certain cases it may be impossible to determine whether or not the fire was intentionally caused. Kitchen fires are a classic example of this problem. If a homeowner heats a pan of grease on the burner until it causes a kitchen fire it will probably not be possible to determine whether the pan was left there intentionally or negligently.

In the large majority of actual incendiary fires, however, a thorough investigation by trained personnel will uncover physical evidence of the intentional nature of the blaze [*21*], basically because it is not easy to successfully set a destructive fire [*19*].

There are numerous areas in which expert evidence and testimony can be proffered to convince the trier of fact of the incendiary origin of the fire. The more important and common of these categories are described below.

Presence of Flammable Liquids

The most important category of scientific evidence in arson-related cases is proof of accelerants at the scene of the fire. Surveys of fire-investigating organizations have indicated that flammable liquid fire accelerants are by far the most common fire-setting method used by arsonists and that gasoline is the most popular accelerant [*22*]. Gasoline is popular because other, often more suitable, liquid accelerants are more difficult to obtain and the purchasers of these items are often more likely to be identified later by the seller [*23*]. Flammable liquids are often used by desperate arsonists who have failed in their attempts to start a "successful" fire by other means [*19*].

Competent evidence concerning the presence of an accelerant in the burned structure is normally held to be adequate proof for the trier of fact to determine that the fire in question was one of incendiary origin [*7,8,15,24*]. This rule has logical appeal. Ordinarily, accelerants are not present at unintentional fires. The unexplained presence of accelerants thus strongly indicates a fire of suspicious origin. It is not surprising, therefore, that empirical data show a strong correlation between the presence of accelerants and arson. On the other hand, if the presence of the flammable liquid at the fire scene can be satisfactorily explained as being innocent—for example, the flammable liquid is used in the ordinary course of the business that had the fire—then the inference of incendiary origin will be negated [*25*]. Thus, proof of the presence of accelerants is an extremely fruitful area for scientific evidence in arson-related cases.

One method of determining the presence of accelerants is olfactory detection. Analysis indicates that the human sense of smell is sufficiently sensitive to detect the presence of gasoline in concentrations as low as one part per ten million [*22*]. It is not sensitive to certain other types of accelerants [*22*]. Testimony that one smelled the accelerant is not expert or scientific evidence but is merely the testimony of a witness relating what was experienced by one of the witness' own senses. Such testimony is, therefore, admissible [*26*].

Olfactory detection is often impossible at the fire scene, for several reasons. First, in an extensive fire the blaze quickly consumes most of the accelerant [*27*]. Any detection of the residual accelerant can be accomplished only by scientific means. Moreover, the odor of the burnt debris at the fire scene may mask the smell of the accelerant [*22,28,29*]. Finally, if the identification of the accelerant is done by scent alone, the trier of fact is more likely to discount the identification than if scientific evidence of the composition of the material is also offered, either in lieu of or, preferably, in addition to the sensory perception [*26,30*].

Separation and Concentration of the Accelerant

The first step in scientifically analyzing fire debris for the presence and identification of flammables is the separation of the accelerant from extraneous material and water [*31*]. It is intuitively obvious that most of the material found at the scene of a suspicious fire will have been in contact with the water used to extinguish the fire. Normally, the water does not interfere with the successful separation of the accelerant material. Moreover, if the firefighters apply the water before the flammable material has volatilized the water will usually seal the accelerant into any porous material with which it has been in contact, thereby preserving the evidence [*32*].

Separating flammable agents from the other fire residue is a critical step in properly identifying such material. An improper method of attempting recovery of the accelerant from the fire residue can result in the loss or contamination of the flammable material [*33*]. Therefore, the choice of method of recovery must be made carefully by laboratory personnel, taking into account the amount and type of accelerant thought to be present, the efficiency of the method of recovery, and the chance of contamination.

The extraction of the flammable residue in forensic science laboratories is most often accomplished by distillation or solvents [*34*]. Distillation methods that can be used are simple, steam, or vacuum. In addition, various types of extraction procedures have been developed but are not yet in common use [*35*].

In forensic science laboratories the most popular extraction and concentration technique is steam distillation; second most popular is the use of a solvent extraction [*34*]. The Federal Bureau of Investigation laboratory normally uses a pentane wash in conjunction with headspace analysis when it receives arson debris to test for the presence of accelerants.[2] Steam distillation is used by the Bureau of Alcohol, Tobacco and Firearms laboratory for the separation of accelerants from nonabsorbent material; separation from absorbent material, such as carpet, is normally accomplished by solvent extraction.[3] These common techniques, which are integral components of the eventual opinion by the expert that the fire scene contained flammable liquids, appear to be generally accepted in the field of forensic chemistry. Thus, even under the often-cited test enunciated in *Frye v. United States* [*14,36*], the results of otherwise admissible tests relying on these extraction techniques are admissible.

Attention should be paid to the choice of separation method and the actual performance of the procedure, in spite of the fact that less-than-perfect performance of the separation by the forensic science laboratory ordinarily will not preclude the admission of evidence identifying accelerants found in the fire debris. First, the selection of separation procedure and the actual technique used by laboratory personnel will determine to a great degree the amount of accelerant, if any, eventually recovered. Choosing an incorrect recovery procedure, administering the test carelessly, or using untrained personnel or improper equipment could yield insufficient residue to test and eventually testify about.

Improper or careless separation of the accelerant could also result in contamination of the suspected residue. Therefore, extreme care must be used in the separation process. It has been suggested that controlled samples of the extraction solvent alone be tested separately from the supposed accelerant residue to reveal any contamination created by the solvent and allow the chemist interpreting the test to make a correction for the problem [*34*]. Moreover, some separation procedures, such as steam distillation, can alter various physical properties of the accelerant, particularly low-boiling-point petroleum products such as gasoline [*31*]. These difficulties involved in the separation and concentration of accelerants suggest that unless adequate precautions are taken by the laboratory an opposing counsel may have a fertile area for cross-examination of the person performing the test. An effective questioning of the chemist could leave considerable doubt in the mind of the trier of fact (judge or jury) as to the weight that should be given to the identification of the accelerant. Obviously, counsel offering the testimony should make certain, in advance, that the expert has taken proper precautions to avoid incorrect results caused by separation procedures and is aware of this possible line of questioning.

Other Contamination Problems

A related difficulty with the results of testing for the presence of flammable liquids is contamination of the fire debris even before the separation stage. Often the fire debris to be analyzed for accelerants is brought to the forensic science laboratory by the firefighters or arson investigator. In some cases the protection of the integrity of the evidence is neglected during this transportation. Thus, the debris may be in the same cardboard box or plastic trash bag as some liquid, believed to be gasoline, found near the burned structure. In this case the possibility of contamination is quite clear [*37,38*]. Opposing counsel who is aware of these problems can attack the admissibility of any opinions or tests based on the poorly protected sample. Even if the packaging problem does not result in excluding the evidence, the weight of the evidence will most likely be seriously diminished. This type of poor storage practice can also result in the escape of flammable vapors and liquids present in the debris

[2]Stephen Allen, special agent and laboratory examiner, Federal Bureau of Investigation, Washington, D.C., personal communication, 14 Nov. 1979.

[3]Charles R. Midkiff, Jr., chief, Chemical Branch, National Laboratory, Bureau of Alcohol, Tobacco and Firearms, Rockville, Md., personal communication, 19 Nov. 1979.

sample. This problem can be simply cured by separately packaging all debris samples in their own unused, sealed paint can.[4]

Contamination is also caused by the presence in the debris of substances that may be, but were not, used as accelerants. For example, the arsonist may have poured some flammable liquid on a varnished wood table. The varnish innocently present in the wood debris can confuse the test results. Furthermore, common items such as carpets may contain hydrocarbons that are also present in liquid flammables and, therefore, these items alone can be mistaken for accelerated materials.

An adequate forensic science laboratory should be able to solve this problem of false positive results fairly easily. The laboratory should simultaneously conduct a control test with known unaccelerated samples of the same type of material believed to have had flammable liquids poured on it [*28,29*]. In this way the chemist can compare the results of the tests of the control and the debris sample and discount indications of accelerant that are present in both samples. Unless the expert has taken and tested an adequate control sample, a knowledgeable opposing counsel can legitimately create considerable doubt in the mind of the judge or jury about the reliability of that expert's testimony.

Tests for Accelerants

A number of scientific methods have been used to detect the presence of flammable liquids in submitted samples [*22*]. One inexpensive and simple method is the chemical color test. This test basically involves the spreading of certain dyes in areas suspected to contain accelerants. Generally, the dyes will turn red in the presence of hydrocarbons, the basic building blocks of accelerants [*39*]. This method is normally used by investigators in the field to make a preliminary determination of the presence of the accelerant. The chemical color test is not very specific for flammable liquids, and it may also interfere with other laboratory tests designed to identify the flammable product [*22*]. Evidence of a positive result with the chemical color test should not be admitted as proof of the fact that flammable liquids were present because the test is not sufficiently accurate and reliable.

The catalytic combustion detector is commonly used by arson investigators in the field. This device may give false-positive readings caused by such things as sewer gases [*40*]. Therefore, the results of this type of testing should be treated similarly to the chemical color test results and the test itself should be restricted to use as a preliminary screening technique.

Infrared spectrophotometry is also used to identify accelerants. The technique involves the measurement of the type and amount of infrared radiation absorbed by the laboratory sample [*41,42*]. The chemist first analyzes the infrared spectrum that passes through the sample material. A comparison is then made with the spectrum of a known chemical compound. This technique is very useful in identifying pure substances made from one compound. Samples containing more than one compound are more difficult to identify because each component will have its own spectrum. In that case, the final spectrum will be a combination of all the spectra emitted by the various compounds [*42*]. Since most accelerants contain numerous chemical compounds, the use of this technique is difficult.

It has been suggested that infrared spectrophotometry is generally suited not to the identification of the specific accelerant but rather to an indication of the functional groups of the material being examined.[5] There are opposing views [*43*]. Thus, because it is normally held that the admissibility of the results of scientific tests, and opinions based on those test, is based on relevancy, recognition of the scientific principle, and sound judicial discretion [*44*],

[4]Robert S. Levine, chief, Fire Science Division, Center for Fire Research, National Bureau of Standards, Gaithersburg, Md., personal communication, 14 Nov. 1979.

[5]Merritt M. Birky, chief, Program for Toxicology of Combustion Products, Institute for Applied Technology, National Bureau of Standards, Gaithersburg, Md., personal communication, 14 Nov. 1979.

the admissibility of an infrared spectrophotometric identification of the accelerant is questionable. Forensic chemists disagree about the reliability and accuracy of such an identification [*42*]. Neither the Federal Bureau of Investigation nor the Bureau of Alcohol, Tobacco and Firearms—two of the premier arson-evidence testing organizations—uses this technique to identify suspected liquid flammable samples brought to its laboratories for analysis. Currently the question is of academic concern only; the high cost of the equipment necessary to perform this test has resulted in its not being used by any forensic science laboratories for accelerant testing [*22*].

Surveys have determined that more than 95% of all forensic science laboratories engaged in work with accelerants use gas chromatography as their method of detecting and identifying suspected arson-related samples sent to them for analysis.[6] Both the Federal Bureau of Investigation and the Bureau of Alcohol, Tobacco and Firearms use this procedure exclusively in their testing for accelerants.

Gas chromatography has become one of the most widely used and accepted analytical methods for separating and identifying the various components of a multicomponent laboratory sample [*45*]. The gas chromatograph's ability to separate different compounds makes it particularly well-suited to the examination of suspected petroleum products [*19,22,23*]; such products are not specific chemical identities but rather are very complex mixtures of many different hydrocarbons [*33*]. These mixtures currently cannot be isolated and examined individually except by gas chromatography [*33*].

The technique of chromatography dates from 1850 when a German chemist developed it [*46*]. The term "chromatography" derives from its initial use: separating variously colored plant extracts. The basic theory behind the gas chromatograph's operation is that of differential migration [*42,46*]. Essentially, this means that different gaseous substances will pass through the given filter substance at different rates.

The proper use of the gas chromatograph requires that all flow rates, temperatures, and materials be kept at proper settings, since physical differences in the apparatus will lead to distortion of the test results. In addition, the proper substance must be used as the packing in the column where the chromatographic separation takes place. In essence, the degree of separation is based on the affinity of the compounds in the sample with the packing material at the particular physical conditions of the equipment at the time the procedure is run. Controlled conditions are, therefore, extremely critical because the laboratory must compare the results of the sample with reference test results.

In gas chromatography the sample introduced for testing may be in a liquid or vapor phase. Most forensic science laboratories use headspace sampling (allowing the substance being tested to evaporate in a confined space and removing the resulting vapor with a syringe) as the means of obtaining the vapor to introduce to the gas chromatograph. The normal range of sample size is 0.005 to 0.01 mL, with the optimum sample size being 0.01 mL [*33*]. Some forensic science laboratories report the use of a sample as small as 0.0005 mL [*45*].

The vaporized sample is carried from the injection port to the column and its packing material by a stream of inert gas, usually helium. After passing through the column the sample is analyzed by the detector portion of the apparatus. Currently, detectors are of several different types including thermoconductivity, flame ionization, and electron capture. The type of detector used affects the sensitivity of the test itself. The use of the ionization-detection cell with the gas chromatograph increases the sensitivity of the analysis by factors of 1000 to 100 000 over such conventional techniques as thermoconductivity [*47*]. The flame-ionization detector is not only extremely sensitive to petroleum-based samples but is also insensitive to water and is, therefore, the ideal detection procedure [*48*].

The ionization detector uses a small flame burning hydrogen and oxygen to destroy the

[6]Memorandum from Stephen Chesler and Stephen Wise, Analytical Chemistry Division, to Robert Levine, chief, Fire Sciences Division; National Bureau of Standards, Washington, D.C., 21 Nov. 1977.

component compounds as they elute (or emerge) from the column. The compound is thereby reduced to its component ions. These ions are then measured, and the ion levels and time of elution are registered by the chromatograph's recording device. A portion of the individual components of the sample can be collected as it is eluted to be used later in confirmatory procedures such as mass spectrometry.

The recording device prepares a graph indicating material concentration on the vertical column and time on the horizontal column. A peak appears on the graph each time a hydrocarbon compound elutes from the column and is ionized by the detector. The completed graph looks as though a person had traced the outline of his fingers on a piece of paper. (Because of the physical resemblance, many chemists refer to the chromatograph results as the chemical "fingerprint" of the substance being tested. It is the multipeak graph pattern that makes identification of petroleum products possible.) Analysis and comparison of this graph with a graph of a known product leads to the identification of the sample.

Fire accelerants, such as gasoline, are fairly unstable and contain numerous compounds. It would be unusual for the evidence sample to be identical to a fresh sample of the same product. Generally, the more volatile compounds of the sample will be lost as the substance ages; further, the loss of these compounds is increased at the fire scene by the high temperatures [*49*]. In spite of these problems, the use of gas chromatography by competent personnel should result in accurate determinations of whether or not the sample is an accelerant residue; if it is, compensating for the absence of the more volatile compounds will establish the type of the flammable liquid. The chromatogram that is produced by the sample missing the more volatile compounds will merely be missing the first groups of peaks. The flammable liquids being analyzed have numerous peaks that will allow the accelerant to be identified even if some peaks are absent. However, if a pure hydrocarbon had been used as an accelerant it could not be identified by gas chromatography.

Attempting to prove that two samples are identical and have come from the same source is much more difficult. It is also difficult to identify the brand of the alleged flammable liquid found at the scene of the fire. These two related types of comparisons could lead to valuable evidence in an arson case. For example, if the accelerant found at the fire scene could be matched to a liquid found in the possession of the alleged arsonist the case against the suspect would be considerably strengthened [*15,50*]. Similarly, evidence that the accelerant used in the fire was the same brand as that recently purchased by the suspect would be very valuable [*49*]. The problems with such identifications are that the volatile compounds often disappear when the liquid ages and that the way petroleum products are marketed in this country makes comparisons among products almost meaningless [*49*]. Because of these problems experts disagree on the question of whether scientifically valid identifications can be made as to brand [*49,51*].

The use of gas chromatography to identify a particular sample as being a flammable liquid of a certain type, such as gasoline or fuel oil, is well established. Studies indicate that 93% of all forensic science laboratories could correctly detect and identify an accelerant-contaminated sample. Experts uniformly agree that gas chromatography is a scientifically valid procedure to make such a determination.

Almost all reported cases in which evidence of the presence of accelerants was admitted do not even mention the test used to determine the fact that flammable liquids were used, much less discuss the reason for the admissibility of that type of test result [*7,15,52*]. One reported case [*30*] has discussed the type of test used to prove that an accelerant was present. The court expressly stated that gas-chromatography tests had been performed and were the basis from which a forensic chemist testified that gasoline was used to attempt to start a fire and that vapors of gasoline were present in certain articles found on the defendant's person. Unfortunately, even that court did not specifically address the reasons for the admissibility of the test; however, one must conclude that by its silence the court implicitly accepted the admissibility of evidence based on this type of testing.

The results of gas-chromatography tests used to identify the presence of an accelerant should be admissible because of scientific reliability of the procedure. There is a general recognition of this proposition [*42*]. The adoption of consensus standards for testing and acceptance of a standard method for performing the procedure would facilitate the presentation of evidence. The absence of court opinions on this subject indicates that such standardization would be valuable to convince judges that the results of the test are admissible and to bolster the weight accorded the test by the trier of fact.

Other Types of Expert Testimony

General

Fire investigation experts are also called upon to prove the incendiary nature of a fire in ways other than proving the presence of accelerants [*19*]. Additionally, valuable testimony by such experts may be used to fix the approximate time of the fire. This testimony can be used in combination with evidence of the whereabouts of the suspect at that time to indicate that the suspect had the opportunity to set the fire [*53*].

There are many indications of an incendiary fire that may be recognized by the expert investigator. For example, multiple, contemporaneous fires are considered by experts to be virtually conclusive evidence of incendiarism [*54,55*]. The fire spreading rapidly is also evidence of an intentional blaze [*54*].

It is generally held that all fires are presumed to have been started accidentally and that the side arguing that the fire was intentionally set has the burden of rebutting that presumption [*56*]. Evidence that tends to prove the absence of any accidental cause of the fire can rebut this presumption [*54,57*].

Finally, there are many other physical indications that arson investigators use in forming their opinion that a fire was intentionally set [*58*]. These other indicators are similar enough to those mentioned above that questions of the admissibility of testimony based on these indicators will almost certainly turn upon the same considerations as those involving the more common investigatory techniques mentioned above.

Admissibility

Testimony from a firefighter, or other investigator, at the scene of the blaze that, for example, two separate and unconnected fires were burning upon arrival at the scene would clearly appear to be admissible. Such testimony is merely a narrative of what the witness saw. This testimony could come from any witness of the fire and be admissible. After a structure has been destroyed it is more difficult for the witness to determine that there were multiple separate origins of the fire [*54*]. However, this testimony normally should also be admissible [*59*], and the difficulty in making the determination of two separate origins should go to the weight accorded the testimony [*60*]. Since the underlying facts in such a case are not commonly understood, the testimony should come only from an expert [*61*].

Generally the courts allow a sufficiently qualified expert [*62*] to state opinions based on facts known to the expert where the jury is unable to draw conclusions from the facts because analysis of the facts involved is beyond the capability of ordinary persons.

The most difficult question involved is how far may the opinions stated by the expert go? It would be most helpful to the side attempting to prove that the fire was incendiary in nature for the expert witness to state that the fire was set by human hands [*63*]. There is a great divergence of opinion by the courts concerning the admissibility of this type of opinion testimony [*64,65*].

Many of the courts that have refused to admit expert-opinion testimony on the incendiary nature of a fire have done so in reliance upon the "ultimate issue doctrine." This rule makes it impossible for an expert—or any other witness—to render an opinion as to a matter that embraces the ultimate issue in the case. That opinion is the province of the jury in a jurisdiction following this doctrine. This doctrine makes it critical to determine what is the ultimate issue in the case. In *Commonwealth v. Nasuti* [*66*], the court held that the ultimate question for the jury in an arson prosecution was not the incendiary nature of the blaze but the guilt or innocence of the defendant. However, in *Ramsey v. Commonwealth* [*67*], the court held that the ultimate issues in an arson prosecution are the incendiary origin of the fire and whether or not the defendant is the criminal agent.

The ultimate-issue doctrine has been considerably eroded or eliminated in many jurisdictions [*14*]. Indeed, the Federal Rules of Evidence and some states have expressly abolished the doctrine [*68,69*].

Expert testimony in arson-related cases should be admissible if the subject matter of the evidence is beyond the comprehension of ordinary persons and the properly qualified expert's specialized knowledge will assist the trier of fact in understanding a relevant fact or issue. This test would allow the admission of testimony concerning the origin of a fire in certain cases where the trier of fact would be unable to formulate an intelligent opinion even after hearing the facts upon which the expert would base the opinion.

Essentially, this test is currently being used by the Missouri Supreme Court. In *State v. Paglino* [*70*], the court reviewed the various cases concerning opinion evidence in arson cases and held that the admissibility of such evidence depends on the specific facts of each case. If an expert in fire causation would be able to draw an inference from the available facts while the average person would be left in doubt, then the opinion is admissible.

This rule still requires an analysis of the applicable facts and circumstances of the case to determine whether persons of common experience need the expert's opinion to draw an intelligent conclusion. Necessarily, this must be an ad-hoc determination. However, it is preferable to make this decision in each case rather than to resort to rules of convenience that automatically either reject or accept expert testimony of the origin of the fire without considering the need of the trier of fact for the opinion [*71*].

Conclusion

The use of expert and scientific testimony in arson-related cases is very often critical to the successful handling of the case. Surprisingly, forensic chemists working in this field use scientific equipment that is not the most up to date. Moreover, there is currently no program for training and certifying fire investigators [*3*] to aid in their being accepted as experts. Further, there is no general agreement among the courts concerning the admissibility of opinion evidence that specifically states the origin of the fire. Because of these factors, counsel for both sides in an arson-related case must exercise extreme care in preparing their cases. Familiarity with the scientific procedures used in this field is, therefore, a necessity. Similarly, counsel should be briefed by the expert to ascertain what tests were carried out, the exact procedure involved, and the reliability of the tests. Finally, the expert should be aware of the possible problems that could arise and, if possible, should be advised how to resolve these difficulties.

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