ARSON ANALYSIS NEWSLETTER

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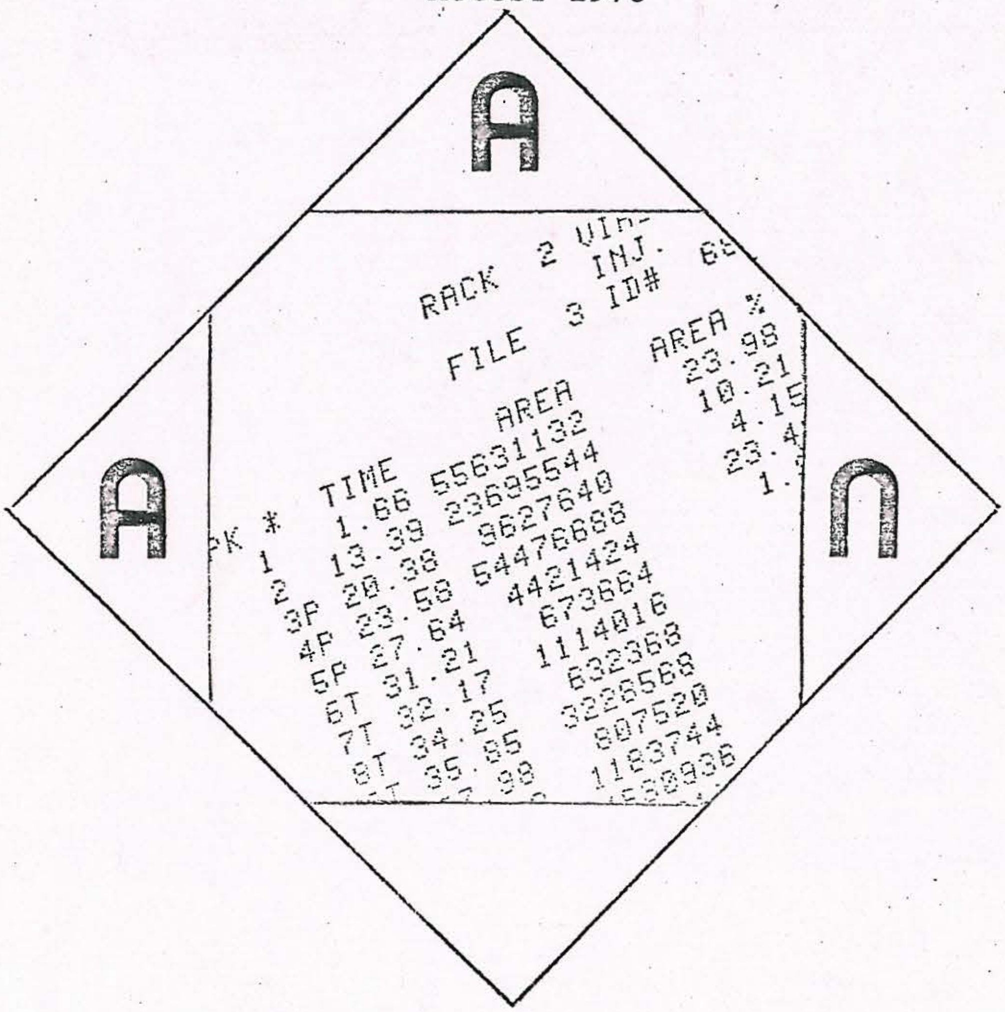

ARSON ANALYSIS NEWSLETTER (AAN)

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Attention: R. N. THAMAN

The AAN solicits contributions from forensic scientists, arson investigators, and interested parties which have some unique or routine analysis which helps in the identification of flammable liquid or explosive residues.

Laboratory Aspects of Arson: Accelerants, Devices, and Targets.

Introduction

Arson is one of modern society's most significant criminal problems. There were, by one estimate, 187,000 incendiary and suspicious fires in the U.S. in 1974 (the latest year for which data are available) resulting in property losses of $616 million, an estimated 10,000 injuries, and 1000 deaths. It is a crime of profit, of revenge, intimidation, or vandalism. It ranks among the fastest growing of criminal pursuits with an estimated increase of 269% over the period 1964-74 for structure fires.[1]

Commensurate with this dramatic increase in arson crimes is a significant rise in the number of cases submitted to crime laboratories in many jurisdictions. During the early 1970's, the author's laboratory would encounter perhaps two or three arson cases per month. During the period of this survey, the submission rate was on the order of five times that level. This increase reflects not only the increased public pressure to "do something about arson fires", but also the growing realization among investigators that the forensic scientist can provide much useful information in the investigation and prosecution of arson cases. Recent years have seen significant advances in the sensitivity of established techniques and the development of new ones which can provide more capability in detection and individualization of accelerants.

It was decided that the author's laboratory, which performs a large number of arson-related analyses each year, could provide some "controlled-environment" information as to the problems confronting forensic science with regards to arson. Since all of the arson cases over a period of three years had been worked by a small number of people, using the same equipment and under the general supervision of one individual (the author), the gathering and interpretation of technical data could be performed first-hand under optimum conditions. Dependence on third-hand responses to questionnaires would be held to a minimum to insure technical accuracy.

[1] John F. Boudreau et al Arson and Arson Investigation, NILECJ, Wash. D.C., 1977, pp 16-17.

Procedure

Laboratory case records for the period July 1, 1974 - July 1, 1977 were examined and the case file notes on every suspected arson or arson-related crime were evaluated. This procedure involved a total of 311 cases in which some types of flammable materials were involved as evidence. Cases involving the examination of electrical components, appliances, or fixtures for mechanical or electrical failures were not included. The laboratory results in regards to the presence or absence of an accelerant, the identity of the accelerant, and the nature of any device involved were recorded. The analytical data upon which identifications were based were re-evaluated by this author. All of the chromatographic runs were made on the same gas chromatograph (GC) with the same column packing and conditions (3% OV-101 on Chromosorb W-HMDS programed from 50°C - 250°C) a circumstance which greatly simplified evaluation. Quality control runs of various accelerants were available for comparison with contemporary case chromatograms. When sufficient quantities of volatile accelerants were detected as headspace residues in casework samples, steam distillation was normally applied. The recovered hydrocarbons were then subjected to infrared spectroscopy, flash point, and GC analysis. Final identifications of volatile accelerants were based largely on GC data supported by IR. Identifications of chemical residues were based on elemental analysis by EDX or emission spectroscopy, and chemical spot tests.

It was found that nearly one-half of all of the arson cases examined in the laboratory had been submitted by representatives of two state agencies - the Arson and Bomb Unit of the State Fire Marshal and the California Department of Forestry. These two agencies were contacted and asked to review their investigative records to obtain the following information:

1. Type of accelerant suspected.
2. Type of device used.
3. Whether the arson attempt was successful or not.
4. Other physical evidence found.
5. Type of target: dwelling, business, vehicle, etc.
6. Location of set.
7. Arrest and prosecution details.

Response to this request was quite satisfactory, with information on a total of 147 case histories returned to the laboratory. From the case histories, data on the type of target involved, the nature of the device (if any), and the final outcome of the case were available.

Finally, correlations were examined between various aspects of the cases: lab findings vs. arrests and prosecutions, type of accelerant or device vs. type of target.

Results & Discussion

Of the 311 cases examined here, all but eighteen involved examination for the presence of volatile accelerants or chemical incendiaries. The remaining eighteen involved other types of physical evidence and will be discussed later.

Out of 293 possible cases, a total of 144 cases (or 49.1%) were found to contain no identifiable volatile accelerants or chemical incendiaries. Whenever a specimen did not yield a sufficiently characteristic headspace chromatogram, it was reported as a negative, with indications of possible accelerants where justified. Pyrolysis products of synthetic materials and the volatile components of glues, varnishes, and plastic resins can make the identification of a light hydrocarbon mixture in fire debris as an accelerant somewhat risky, and is to be avoided. The findings of volatile accelerants or chemical incendiaries are recorded in Table 1.

Automotive gasoline was detected in a total of 87 cases, or 29.7% of all cases. It represented the only volatile accelerant present in all but five of these cases. The remaining cases included gasoline in combination with stove oil, fuel oil, and kerosene. No instances of the use of aviation gasoline were detected during the study period.

Petroleum distillates other than gasoline were detected in 37 cases, representing 12.6% of all cases examined. These distillates include cigarette lighter fluid, copier toner, charcoal lighters, paint thinners, kerosenes, and stove and diesel fuels. Petroleum distillate paint thinners, sometimes referred to as "mineral turps", were detected a total of thirteen times, representing 4.4% of the cases. These distillates closely resemble some charcoal lighters and kerosenes, which occasionally cannot be distinguished when they are present in minute quantities. These other products were detected a total of ten times. The petroleum distillate used in copier toners is also similar in its chromatographic properties. The toner detected in the one case occurring during the study period was stored in bottles in an office storeroom. It was used in large quantities to ignite the office and correspondingly large quantities of it were recovered from the debris.

Other volatile hydrocarbons were detected a total of eighteen times. Lacquer thinners and similar light aromatic hydrocarbon mixtures represented almost one-half of these cases. The remaining cases involved a wide assortment of flammable liquids, many of which appeared to be used simply because they were available at the scene: glues in schools, dye solvents in a shoe shop, plastic resin or turpentine in home workshops, etc.

As can be seen from Table 1, chemical incendiaries do not appear to have been used with any great frequency. Road flares (fusees) account for most of the incidents with flash powder (in the form of M80 "firecrackers") used occasionally. Chemical accelerants or incendiaries were suspected of having been used in two additional cases but were not detected during laboratory examination.

A total of eighteen arson cases (6.8% of the total) were submitted in which no accelerant appeared to have been involved. The majority of these cases were wildlands or grass fires in which the fuels were readily ignitable by match. These cases normally involved the comparison of paper matches and matchbooks or the reconstruction of charred, fire-damaged materials at the scene.

Since the information supplied with the evidence submission is often quite limited, it was decided that evaluation of the devices used and the targets selected would be limited only to those cases where the investigative histories were available. These details were supplied by State Fire Marshal and California Department of Forestry investigators for 147 of the 311 cases under evaluation. The results of the investigators' conclusions as to the manner of ignition are recorded in Table 2. It is interesting to note that almost two-thirds of the arsons involved no device other than a flammable liquid. In fact, ignition or timing devices of any kind were detected in only 11.7% of all cases. It was also noticed that arson related evidence was submitted in 222 successful sets and in only 17 cases where the attempts were not successful.

Other physical evidence was submitted to the laboratory in only 76 instances out of 311 arson cases. In most instances, the other evidence constituted restoration of charred labels or containers, reassembly of broken Molotov devices, comparison of matches, tape, and towels (wicks) with control materials, and occasionally blood or firearms evidence.

The types of targets selected for arson attacks covered the range of human activities - from dwellings to Navy destroyers. The frequencies with which various targets are involved are recorded in Table 3.

Upon evaluation of the wide variety of accelerants and targets encountered, there appeared to be little correlation between the target and the accelerant used. Gasoline appears to be the "universal accelerant", having been used equally on all classes of targets. Gasoline was detected in 16 or 36.4% of all vehicle fires (a total of 44) while no accelerant was detected in twenty cases, or 45.4% of the total. These figures compare quite well with those for all types of fires combined (29.7% involving gasoline, 49% not detected). Paint thinners were detected in only 6.8%, of the 44 cases. Road flares were used in one vehicle, flash powder (M80) in another, and at least one involved direct ignition of upholstery materials by matches.

More unusual accelerants are encountered in commercial, manufacturing, or "home workshop" scenes. The lacquer thinners and enamel reducers in auto shop fires, dye solvents in a shoe store, glues in schools and shops, copier toners in offices, and plastic resin in a home workshop have been documented as accelerants in their respective locations.

Of the 147 cases on which investigative data were available, only twenty-nine (19.7%) culminated in an arrest. Of these twenty-nine, twenty-three cases were prosecuted. This represents a 15.6% prosecution rate. (No results on conviction rates were available.) The results of laboratory analysis appeared to have little impact on whether arrests were made or not. No accelerants were detected in twelve of the twenty-nine arrest cases (41.4%) and gasoline was detected in another nine cases (31%). Of these twenty-nine, vehicle fires were involved in 24.1%, as compared to vehicles being involved in only 13.6% of all cases investigated. Dwellings were involved in about 37.8% of the "arrest-culminated" cases, which almost equals their involvement in 36.7% of all cases reported.

Summary and Conclusions

This study has revealed several features of the laboratory analysis of arson evidence which practicing forensic scientists long suspected but which had not been previously documented. First, automotive gasoline is the most frequently encountered accelerant. This may be due to gasoline being more easily detected as an arson residue than other fuels, thus occurring in a disproportionately large number of samples. It is more likely that gasoline is ideal for the purpose - it is <u>very</u> flammable; produces great quantities of heat; it is readily available; relatively inexpensive, and innocuous in the possession of most people.

Second, accelerants available at the scene are quite frequently used. The detection of unusual volatiles is greatly expedited when the investigator can offer the laboratory a list of flammable materials at the scene. This is most conveniently done by a thorough search and inventory at the scene and interviews with owners, occupants, or witnesses.

Third, devices for time delay or ignition appear to be used very infrequently. If such devices are being used, they are not being detected by the investigators. Since elaborate devices are so rare, is it cost-effective to spend long hours training investigators in their uses and effects? Simple "sets", excessive amounts of accelerants and private dwellings as targets may all be considered to be "trademarks" of the amateur arsonist. The predominance of such cases in our sample case population may be due to the infrequency of professional jobs or due to failure to detect the sophisticated work of such professionals. It is conceivable that subtle, effective sets with minimal use of accelerants are being used against industrial and commercial targets so successfully that the resulting fires are not being further investigated.

Fourth, arrests and prosecutions for arson crimes are quite low; however, the arrest rate for the 147 cases in the "investigator sample" of this study (19.7%) is more than twice the national arson arrest rate (9.0%) reported by the Aerospace Corporation in their 1977 study.[2] This may be ascribed to the intensive investigative efforts being expended by the two reporting agencies, the California State Fire Marshal and the California Department of Forestry. The higher arrest rate may reflect the potentials for more successful investigations which can result from such programs.

Fifth, it appears that lab findings are not crucial to the outcome of many cases. Laboratory results are often used to "fill in the blanks" of an investigation or aid in the reconstruction of the device or its environs. Arson is most peculiar in this regard since its physical evidence, unlike the paint, hair, blood, or bullets of other crimes, is consumed in the course of the crime.

This fact may result in very little evidence remaining for analysis. A "not detected" rate of almost 50% is to be expected under such conditions. It has been informally noted in the author's laboratory that the "not detected" rate for agencies having highly trained, specialized investigators who select only carefully screened specimens for analysis is several times lower than that for agencies which must depend on part-time investigators of less experience.

[2]<u>Ibid.</u>, p. 29

New techniques for evaluating smaller and subtler traces of materials (i.e., elemental analysis for the lead and bromine in residues of automotive gasolines) have increased our capabilities in some areas. However, the physical limitations of the evidence and its circumstances are such that technological threakthroughs alone will not be sufficient to solve the arson problem.

Acknowledgements

The author gratefully acknowledges the invaluable assistance provided by Mr. Joseph Halasz of the California State Fire Marshal and Mr. Richard Diltz of the California Department of Forestry. Without the case file information which they provided this study would not have been possible. The advice and support of A. Keith Smith of the Sacramento Regional Laboratory and R. J. Davis of the Santa Rosa Laboratory are also gratefully acknowledged.

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Table 1: Accelerants

Accelerant	No. of cases	% of Total (293)
Gasoline:		
Gasoline (alone)	82	27.9
Gasoline in combination w/other volatile hydrocarbons	5	1.7
Total	87	29.6%
Petroleum distillates other than gasoline:		
Cigarette lighter fluid	4	1.4
Paint thinner	13	4.4
Charcoal lighter	7	2.4
Kerosene	4	1.4
Coleman fluid	5	1.7
Copier toner	1	0.3
Stove oil/diesel fuel	5	1.7
	39	13.3%
Non-petroleum distillates:		
Lacquer thinner	8	2.7
Turpentine	4	1.4
Glues	2	0.7
Paint remover	1	0.3
Linseed oil	1	0.3
Dye solvent	1	0.3
Plastic resin	1	0.3
	18	6.1%
Chemical incendiaries:		
Flare	3	1.0
Flash powder	1	0.3
Explosive	1	0.3
	5	1.6%
Total	149	50.6%
No accelerants detected	144	49.1%
	293	99.7%

Table 2: Devices

Device	Number of Cases	%
Direct pour of flammable liquid	90	61.2
"Molotov cocktail"	7	4.8
Cigarettes/matches	4	2.7
Paper	6	4.1
Grass/hay	5	3.4
Open containers	2	1.4
Candle	2	1.4
Flare	2	1.4
Other	3	2.0
Not detected or identifiable	26	17.7
	147	100 %

Table 3: Targets

Target Type	No.	%
Dwellings	54	36.7
Stores or commercial buildings	36	24.5
Vehicles (road)	20	13.6
Mobile homes	9	6.1
Wildlands	8	5.4
Barns	6	4.1
Schools	6	4.1
Manufacturing plants	5	3.4
Motel/Hotels	1	0.7
Garages	1	0.7
Ship/Boats	1	0.7
	147	100 %

* Remember to renew your subscription to the AAN if you have not already done so.

* Walter L. Holz, Chairman of the Forensic Laboratory Services Committee of the IAAI writes the following concerning the IAAI meeting in Anaheim, California:

  A small, but enthusiastic, group of laboratory personnel gathered in my room on Thursday afternoon to discuss laboratory topics. These people (Grace Brouillette, Criminalist, Orange County; Ray Davis, Criminalist, Santa Rosa; John DeHaan, Criminalist, Sacramento; Bruce Ettling, Technical Fire Investigation Services, Vancouver, Washington; Charles J. Fuhrman, Fire/Electrical Investigation, Tollison, Arizona; Allan E. Gilmore, Director, Crime Laboratory, Sacramento County, California; and Lt. Nicolas Gonzales, Director, Arson Division, Albuquerque Fire Department, and I had a pleasant discussion regarding a program they would like to see accomplished at the 1979 meeting of IAAI in Williamsburg, Virginia. I will be contacting the Planning Committee Chairman soon to see if they would like involvement from the laboratory sector. I'll keep you informed of our progress.

The following photograph shows the Forensic Laboratory Services Committee.

FORENSIC LABORATORY SERVICES COMMITTEE -- March 30, 1978, Northville Regional Crime Laboratory, Michigan State Police, Northville, Michigan

From Left to Right: Dr. Juhala, Robert Kuntz, Walter L. Holz, Larry Presley, Dr. Plautz, Charles Thomas, Ron Thaman (Systems Engineering Associates, Columbus, Ohio), Dr. Burke, Dr. Quon Y. Kwan (The Aerospace Corporation, Washington, D.C.), and Tom Plotinski.

* A very interesting article appeared in the May 1978 issue of American Laboratory. The article, by Harry H. Hausdorff, dealt with infrared group - specific detectors for gas chromatography. Numerous chromatograms showing the utility of the new method are displaced. A dual-channel operation is shown where the sample, gasoline, is easily split into the 3.38μ band and 3.26μ wavelength. The aromatic and alkene components of gasoline are shown on one channel of a dual pen recorder while the other pen displays the hydrocarbon components.

* Please send articles and material that can be used in AAN notes.

NEW CONCEPTS SYMPOSIUM AND WORKSHOP

THE DETECTION AND IDENTIFICATION OF ILLEGALLY USED EXPLOSIVES

A symposium/workshop to **solicit new and imaginative approaches** for the detection and identification of illegally used explosives is being sponsored by the U.S. Departments of Treasury, Energy, Justice and Transportation on October 30, 31 and November 1, 1978 in Reston, Virginia. The purpose of this symposium is to desseminate to a broad range of currently uninvolved members of the scientific and technical community: 1) current needs and problems 2) state of current research and 3) interest of the federal sector in new ideas and approaches. General and poster sessions will be used to describe operational requirements and the state of current technology. Small workshop sessions will be utilized to explore new approaches. Registration will be held on October 29 between 6 PM and 8 PM.

Examples of current research which will be discussed include:

Vapor Detection Methods
- Natural vapor characterization
- Vapor tagging of explosives
- Detection instrumentation
- Animals

Non-Vapor Detection Methods
- Nonionizing; e.g., NMR, FIR
- Ionizing; e.g., X/γray, CT
- Deactivation of Blasting Caps
- Non-Vapor Taggants

Identification Methods
- Identification Taggants
- Debris Analysis

Taggant Incorporation Methods
- Microencapsulation
- Vapor Absorption
- Coatings/Alloying

Limited funds may be available to encourage the participation of a few researchers. Applications for travel support are currently available and must be returned to the Symposium Chairman by 1 August 1978.

Researchers are also encouraged to submit papers and poster session displays. A short outline of proposed papers or displays should be submitted to the Symposium Chairman by July 17, 1978. Anyone interested in attending, presenting papers or displays, or otherwise participating in this symposium should contact: A. Atley Peterson, Symposium Chairman, Bureau of Alcohol, Tobacco and Firearms, 1200 Pennsylvania Ave., N.W., Washington, D.C. 20226
(202) 566-7436.