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Fire Fatalities -A Review

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ABSTRACT

(English)

Fatal Fire Investigation is a multi-agency task and the expertise of the relevant professionals should be recognised and understood by all who are involved in the process.

This document is intended to assist those members of such a multi-agency team. Lancashire Fire and Rescue Service in the North West of England, has introduced a team approach to fatal fire investigation with partners in Lancashire Police and the Forensic Science Service. An appreciation and thorough understanding of each departmental responsibility is fundamental to the success of any such operation.

Keywords: Fire fatalities, fire and arson investigation, forensic science services, pyromania

In most countries specialist fire investigators from the Fire & Rescue Service have the responsibility to investigate the cause and origin of fires. Their specific role and authority varies throughout the world, however any team approach that did not include such experienced specialists would be seriously compromised.

It is important to introduce community fire safety plans with the specific purpose of reducing fire deaths and injuries. In the UK such plans have been incorporated into local Government community safety plans prepared by all local authorities with the specific goal of making Britain a safer place to live and work.

Data from Geographical Information Systems (GIS) allows the areas of risk to be targeted by community safety programmes. Statistical information is very important but it should be recognised that any form of statistical analysis can be uninteresting and meaningless if its purpose

is not clear. Many different systems are available and this has highlighted some problems in sharing appropriate information. Data warehousing systems are emerging in the UK, which should rectify this problem. They will facilitate the sharing of data by all interested parties and more importantly they will be able to utilise the appropriate data for individual needs.

Fire and Rescue Services in the UK publicise their efforts to reduce fire deaths and injuries, which enhances the effectiveness of their community fire safety plans. The British Government has provided Fire and Rescue Services with target reductions in the area of fire deaths and injuries [1].

Certain categories of fire deaths cannot be readily influenced by these plans. Some of these fatalities are attributed to fires caused by road accidents. Others result from self-immolation, which are difficult cases to deter, and indeed can prove difficult to investigate. Suicide by fire is not unusual in Lancashire and tends to be the method chosen by some cultural groups although this is not exclusively the case.



Figure 1: Vehicle fire following a road traffic accident. Lancashire Fire and Rescue Service personnel extricated the two victims. Identification was formalised by the use of DNA technology

Many suicidal individuals consider their methodology with some care, for example those using knives or razor blades often make tentative cuts to experience pain levels and the degree of difficulty [2].

For those using flammable liquids there is little opportunity for a change of mind. Once the lighter is "flicked" or the match struck, the end result is almost inevitable, especially when petroleum (gasoline) is used. Some attempting suicide use less volatile flammable liquids probably because of their availability. These include white spirit, methylated spirits and paraffin (kerosene). Paraffin is not as readily available in the UK as it once was. Domestic paraffin heaters were commonplace in the UK 30 years ago and paraffin was sold at most local shops. This is not the case today and domestic heaters fuelled by paraffin are quite rare.

Homicides using fire both as a weapon and as a cover for crime are not uncommon and this author has seen many examples. One crime took place at a sewage works where three men were shot dead with a 12 bore (gauge) shotgun and their bodies burned using an accelerant. Every room in the building was ransacked to suggest burglary and then the building was set on fire.

Fire officers and other professionals spend their careers attending and investigating such fires. As techniques and methodology improve so does the expertise of the professionals. Incidents can be almost mapped out and the patterns of such tragedies can be recorded almost exactly as they occurred. At the other end of the spectrum however, constant attempts to persuade the public of the need to take great care of fire are high on the community safety agenda.

The need to raise awareness of community fire safety and highlight the commitment of community fire safety professionals is clear. It demonstrates the value of high quality fire investigation and accurate recording of information in Fire Investigation reports. In the UK a standard fire investigation data form (known as the Fire Data Report form or FDR1) is completed for each property fire. Electronic completion of the FDR1 is now being introduced in the UK. This will facilitate speedier and more professional use of UK fire statistics. The Fire Service Crew Commander completes these forms.

More detailed Fire Investigation reports are produced for fatal fires as well as for criminal (arson) and high cost fires. These reports are usually written by more senior ranks or by specialist Fire Investigation Officers.



Figure 2:Community Fire Safety work is a vital part of Lancashire Fire and Rescue Service's work.

The use of the media is a vital part of any community fire safety strategy. Television advertising is a powerful medium. Unfortunately such publicity is expensive in the UK and centrally funded projects are only televised once or twice a year, usually during holiday periods. Consideration should be given to convincing television companies of the importance of this publicity. They should ensure that this exposure is part of their core work and is provided without cost to Fire and Rescue Services as a duty to society. The Government should consider the possibilities of influencing these companies.

Private companies are now involved in the provision of community fire safety activities. They enter partnerships in Lancashire and provide funding for projects such as:

Advertising poster campaigns on the rear of all Lancashire Fire and Rescue Service's fire engines. A service, which attracts funding for the Fire and Rescue Service

Smoke alarm provision and replacement of battery campaigns

A domestic sprinkler campaign is just beginning with a private company providing funding. A domestic sprinkler system will shortly be fitted to a property, which is considered to be at high risk

Provision of funds for Young Firefighter groups attached to Lancashire's Fire Stations. The fire safety education of Lancashire's children is a most import part of the community fire safety plan

Anti-arson campaigns in partnership with Lancashire Police

Smoke alarms remain one of the most important single contributions to life safety and especially in the area of "reaching the hard to reach". These are the sectors of the community that are most at risk from fire, and include:

Lone parent families

Old people

Handicapped persons

Low income families

Alcohol and drug users

There are of course some people who fall into all of these categories and efforts must be made to specifically target them specifically.

There were sixteen fatal fires in a sample year in Lancashire, which claimed the lives of twenty-two people, who all fell into the above categories.

Only five of these households had smoke alarms and two of these did not have live batteries installed in them.

Chip pan fires cause a considerable number of serious domestic fires in Lancashire. Chip pans and other pans containing cooking oil or fat are frequently left unattended whilst they are being heated in preparation for cooking. This type of fire is responsible for a disproportionate number of serious injuries and deaths in Lancashire.

A pilot project in partnership with the Home Office was introduced in 1998. The aim was to test the reaction of the public to a high profile, concentrated publicity campaign to highlight the dangers of chip pan fires. A chip pan fire demonstration unit was purchased and was used at every possible public venue. Local publicity was a priority and regional television, along with other forms of media coverage, saturated Lancashire with campaign details. The Home Office invested £500,000 to provide the television advertising and publicity leaflets. Posters were displayed on buses throughout Lancashire so as to maximise the publicity effect.

This month-long pilot study, headed by Lancashire Fire and Rescue Service was most successful and led to a national campaign.

A most powerful national television advertising campaign resulted which featured a young woman who was severely burned by a chip pan fire. She appeared in the advertisement feature and explained what had actually happened to her and showed viewers her serious facial burns.



Figure 3:Lancashire Fire and Rescue Service's chip pan demonstration unit in action.

Lancashire was chosen to pilot the original campaign because the county sees the highest number of chip pan fires in the UK, with its Firefighters attended 427 such incidents in the year immediately prior to the campaign launch. These are of course, only the fires that are actually reported to Lancashire Fire and Rescue Service; the numbers of incidents must be much higher.

In one-year, chip pan fires in Lancashire injured 177 people and killed three. Some of the injuries were of a serious nature.

It is not just the elderly that are at risk; in fact young males are in the greatest danger usually after the consumption of alcohol. This is illustrated by the fact that 46% of chip pan fire casualties and 33% of chip pan fires took place between 2000 hrs and 0400 hrs.

Chip pan fires cause the largest number of house fire casualties; Home Office statistics show that 46 people died in the UK because of chip pan fires in the sample year. This is an increase of 58% on the previous year. Chip pan fires account for 20% of all accidental fires.

Britain is aiming to educate its communities into understanding the dangers of chip pan fires and how to deal with them.

Lancashire Fire and Rescue Service's continued commitment to all aspects of community fire safety has become a day-to-day feature of Fire and Rescue Service work.

It is through this project work that we soon hope to see a significant drop in fire related injuries and fire fatalities.

When the media report stories of fatal fires, statements such as "died in a fire" or "overcome by smoke" are often used which tend to give the public the wrong impression of what actually occurs. It should be clear to everyone that to die in a fire or as a result of fire must be a most terrible suffering. Those who have experienced even the most minor burns, know only too well how painful they can be. The long-term medical effects of relatively minor smoke inhalation are often not considered. The effects may only become apparent after many years and consequently they may well not be attributable to the fire.

The fear and horror of being trapped in a fire is a terrifying prospect: unable to help loved ones, whilst being aware of their suffering. To be slowly denied all logic and clear thought as the effects of the fire fumes take their hold is a horrible concept.

A recent call taken by one of Lancashire Fire and Rescue Service's Fire Control Operators illustrates this process. A young man made a call from his smoke-filled flat. The Fire Control Operator skilfully and professionally, talked him through the time it took for the fire crews to arrive and rescue him. The time was protracted because the crews had first to fight the fire and rescue two other people before reaching the caller. The effects of smoke on the young man are clear, fear and panic along with his constant coughing and struggle for breath. What is not so apparent at first is his transition into self-blame and anger. He believed that he would not survive and his joy was obvious when he is rescued by two Firefighters wearing breathing apparatus. All emergency calls to Lancashire Fire and Rescue Service are recorded and this taped call illustrates the plight of those trapped in fire.



Figure 4:Lancashire Fire and Rescue Service Control Operators at work.

The Mechanism and Causes of Death in Fire

1. Inhalation of Fire Fumes

In many fires the victim inhales fumes, which contain a variable percentage of carbon monoxide (CO). Carbon monoxide is absorbed into the blood via the lungs.

Haemoglobin in the blood cannot pick up and transport oxygen because it is saturated with carbon monoxide that binds to haemoglobin forming carboxyhaemoglobin. (COHb).

The level of COHb in the blood is expressed as the percentage of the total haemoglobin, which is bound to CO.

Even a relatively fit person would be likely to feel "drunk" and confused as the level of CO in the blood begins to rise. The decision-making processes are soon affected and, as the carboxyhaemoglobin level approaches 50%, unconsciousness and then death may well occur.

Table Illustrating the Effects of Carbon Monoxide [3]

Carboxyhaemoglobin Saturation Level	Effects
0 -10%	Slight headache, slight confusion.
20% -30%	Headache, slight nausea, lack of concentration, similar effects to slight drunkenness.
30% -40%	Nausea, possible vomiting, faintness, loss of visual acuity, dizziness, slide towards stupor or coma begins. Loss of consciousness may be induced by activity.
40% -50%	Weakness, convulsions, incoordination, coma progressing to collapse and death in some people.
50% -60%	Similar to above but more pronounced effects. Most healthy adults would die.
60% -70%	Convulsions, depressed heart action, death.
70% - >80%	Respiratory failure and death.

When interpreting such figures the investigator must be aware of their variable value. It is perfectly feasible for some fit young adults to reach 70% saturation or more before death occurs. It is also likely that older people and those with chronic conditions such as heart disease may well die with much lower levels of saturation. Heavy smokers could already present a carboxyhaemoglobin level of up to 10%.

Fitness, age and personal susceptibility are all important indicators that influence the physiological effects of CO.

The toxicology of fire effluent gases in general is complex, and in some cases the expert interpretation of the circumstances by a Forensic Pathologist and a Forensic Toxicologist would be valuable.

It is clearly useful for the fire investigator to obtain the percentage value of carboxyhaemoglobin as it can assist in the assessment of the fire situation and indicate the activity of the deceased immediately before death.

The usual process is for the Pathologist to take a sample of blood during the post-mortem examination. This sample is forwarded to a hospital or university toxicology department for analysis. If crime is suspected the analysis is carried out by the Forensic Science Service (Except in Scotland), which can inevitably result in further delay. The Pathologist then includes this information when reporting the cause of death to the Coroner.

Fire Officers in Britain have no legal access to this confidential information and difficulties are sometimes experienced obtaining such details. With a professional approach and a high degree of interpersonal skills, the relevant information can usually be obtained from the Coroner, Coroner's Officer or Clerk.

Fire Investigation Officers should also consider the impact of alcohol levels and drugs. This includes both medicinal or/and unlawful drugs. Other relevant medical factors that may have played a part

in the victim's actions (or lack of them) should be discussed with the Pathologist. This information should form an important part of the Fire Investigation report.

An area that is not clear to us is the effect of other fire effluent gases. Levels of 0.3% hydrogen cyanide (HCN) for example, are rapidly fatal [4]. It is possible that in many cases HCN may cause unconsciousness, and then CO is responsible for the actual death. It is also possible that this mechanism could operate the other way round and HCN is responsible for the death. Post-mortem toxicological blood and tissue analysis will usually not include any fire effluent gases other than CO. This is mainly because HCN tests are more expensive to conduct. It may also be that Coroners consider it to be unnecessary.

This author has seen a number of cases where a body was found in bed with urethane foam pillows under and in close proximity to the head. These pillows had decomposed due to heating. In all these cases the cause of death was recorded as "CO poisoning" which may well have been inaccurate. The de-polymerisation of the foam produces a lethal cocktail of chemicals including free toluene diisocyanate (TDI, also known also as tolylene diisocyanate), which would rapidly cause death. The threshold limit value [5] of TDI is 0.005 ppm in air.

Interestingly, the carboxyhaemoglobin value was extremely low in these cases.

Other toxic gases such as hydrogen chloride (HCL), hydrogen sulphide (H2S), and carbonyl sulphide (COS), are difficult to measure in any meaningful way.

2. The Effects of Heat

In some fatalities the following factors may all cause or contribute to death: a) Heat. b) The pain of burns, which causes "shock". c) Shock due to fluid loss from the exposed surface of the burn. d) Asphyxia. e) Heated gases being inhaled - which causes burning of the respiratory tract. f) Carbon monoxide. g) Other toxic gases and chemicals.

Persons often survive for some time after suffering burns but may well subsequently die in hospital due to: i) Septicaemia, often due to infected burns or chest infection. ii) Multiple organ failure including kidneys. iii) Toxaemia, due to absorption of substances from the burned surfaces. iv) Toxicity, polyurethane pyrolysis products for example, cause delayed respiratory distress.

The fire investigator must be aware that important indicators could be confusing under these circumstances. Alcohol will be metabolised by the body and carboxyhaemoglobin levels will slowly return to normal during oxygen therapy. Any alcohol, carbon monoxide or drug values taken after the death of such a patient will be unrepresentative of the fire situation.

The results of any analysis of specimens taken during hospital treatment or after death have to be interpreted in the light of the length of survival. One should also consider any treatment given during this period.

An example might be the use of hyperbaric oxygen. During such treatment the body is pressurised in a chamber whilst oxygen is administered. Under these conditions a considerable reduction in the "half life" of carboxyhaemoglobin is achieved. Hyperbaric oxygen treatment is not routinely given in Lancashire due to the unavailability of suitable hyperbaric chambers. Aberdeen in Scotland has Britain's best examples but this is because of the North Sea petroleum industry requirements for divers rather than smoke inhalation medical provision.

In the past it was sometimes difficult to persuade hospital doctors to provide details of any samples taken from patients even when their chances of survival were non-existent. This has changed in more recent years, however it is useful to recognise such sensitivities. In special circumstances such as a suspected attempted murder, a joint approach with the Police may well be more successful. Advice on these issues should be taken from the Forensic Pathologist.

3. Fitness and Effects of Illness, Alcohol and Drugs

Of the 26 people that died from fire in a sample year in Lancashire, 38% were aged 54 or older. This group often present various physically debilitating conditions, such as arthritic degeneration, which may well hinder or prevent escape from property fires.

Although older members of our society form a smaller group in actual percentage terms, they are at a much greater risk from fire. This group is also growing rapidly in the UK.

Respiratory conditions such as asthma, chronic bronchitis and emphysema are likely to influence the survival time during the early stages of a fire. It is important for the Fire Investigator to establish if any such medical conditions exist, as false indicators may be presented. Such victims might also be expected to present lower levels of carboxy-haemoglobin.

A significant number of Lancashire's fire fatalities had consumed alcohol and some had taken drugs, although exact details remain unknown. This lack of important statistical information may exist because:

a) Blood alcohol analysis is not routinely requested from child victims at post-mortem. The age that defines "child" under these circumstances varies with area. In England, Wales and Northern Ireland it is the Coroner who orders this analysis.

There are no doubts that very young children do consume alcohol and it is likely to be more common today due to the introduction of alcoholic soft drinks, generically known as "alcopops". The alcohol content of these drinks is around 5% and can be higher. Worryingly, they are designed to appeal to young people. Most alcoholic drinks such as beers, whisky, vodka, gin etc, are not normally palatable to young children. Alcopops are very much so and it would be easy to entice very young children to consume them.

Some adults do administer a variety of drugs to children to subdue them. In Victorian times laudanum (opium mixed with alcohol and sometimes saffron) was used extensively. More recently, legal preparations for this purpose have been sold routinely to ease such conditions as "teething". The author has known alcohol to be used for this purpose and for it to be given to babies by their parents to quieten them and induce sleep.

b) Fire Investigation Officers do not request this information from Police.

It is also apparent that some members of the Police see no reason to disclose this information to Fire Officers. There is no legal obligation to do so as the responsibility to investigate any fatality rests with the Coroner and the Police act as agents to the Coroner.

The Police and Coroners in Lancashire are most supportive of Fire Investigation Officers and they are keen to utilise our expertise.

Procedurally, it is the Police who take the lead when dealing with a suspected criminal event, but the Fire Investigation Officer should be of considerable assistance in the information and evidence gathering process.

The Fire Investigation Officer therefore walks through a minefield, dealing with complex problems for which no statutory powers are devolved to the Fire & Rescue Service in the UK at present.

The "exploding mines" have occasionally come from middle ranking Police Officers, which leaves the Fire Officer somewhat vulnerable with no other course of action but to withdraw. Both Fire Officers and Police Officers alike then transfer this experience into the next investigation resulting in a flawed investigation.

It has even been known for Fire Investigation Officers to be excluded from the scene by the Police in some areas of the UK. Indeed some countries do not involve the Fire and Rescue Service at all in the investigation of cause and origin. These countries include Germany, Sweden and the Republic of Ireland.

The Police and Fire and Rescue Service in Lancashire have forged excellent relationships and this can be achieved in other areas provided effort and commitment is made.

Fire Investigators in the UK have no powers to interview witnesses, regardless of whether fatalities are involved. Lancashire Fire and Rescue Service's Fire Investigators act as de facto Coroner's Officers whilst collating evidence and information for the Coroner. Under these circumstances the Coroner empowers a Fire Officer to take witness statements.

Lancashire Police have stated that an increasing number of motorists involved in accidents are under the influence of drugs. This is considered to be so serious that they are taking part in a roadside drugs test trial with three other British Police forces.

Lancashire Police have also noticed that over the last few years there has been an increase in drug-related driving deaths. They report that in one in five fatal car crashes the driver had taken drugs.

These findings by the Police must indicate a direct correlation with fires and fire death and injury victims as they represent a fair cross section of our society.

More and more property fires now involve the use of drugs and often alcohol as well, which clearly exacerbates the problem.

It would be useful to briefly examine part of the relevant statute regulating the availability of drugs in the UK:

The Misuse of Drugs Act 1971

This legislation is intended to prevent the non-medical use of certain drugs. It controls not only medicinal drugs but also those with no current medicinal use.

An important feature of the Misuse of Drugs Act is that it also prohibits unlawful possession. Drugs subject to this Act are known as 'controlled' drugs.

Generally, drugs are grouped into three categories:

1) Class A. Examples-opium, heroin, morphine, hallucinogens, cocaine, and interestingly, MDMA also known as ecstasy. (This drug is often wrongly trivialised by the media).

2) Class B. Examples-cannabis, less potent opioids, barbiturates. Note - any Class B drug prepared for injecting counts as Class A.

3) Class C. Examples-Tranquillisers, dextropropoxyphene and some less potent stimulants.

The use of non-medicinal drugs was confirmed in 7.7% of Lancashire's fire deaths in the sample year and involved the class "A" drug heroin.

The use of the class "B" drug cannabis was strongly suspected in at least a further 19% of deaths, however blood analysis from all victims was not requested at post-mortem and so this figure remains unknown.

The above evidence illustrates clearly the problem that society faces and indeed the problem that Lancashire Fire and Rescue Service's fire investigators encounter.

It is not thought that the situation will improve; in fact everything seems to point towards it becoming much worse. Drug abuse and especially alcohol use are all part of life today in the UK and so will continue to play a part in fire deaths and injuries.

The overlap with many differing areas of scientific and legal investigation and interpretation complicates the difficulties that the Fire Investigation Officer encounters during the investigation of fatal fires.

If we examine the other organisations and professionals that are involved in the process:

Coroner. Can be a doctor or a lawyer. All the Coroners in Lancashire are lawyers at this time. They usually utilise the services of Coroner's Officers who are serving Police Officers in Lancashire at this present time.

Police. Uniformed Officers and Detectives.

Scenes of Crimes Officers. Some are still serving Police Officers whilst others are non-uniformed.

Police Photographer.

Police Surgeon. Medical practitioners who are on call to serve and advise the Police on medical aspects. A misnomer really, in that they are rarely surgeons. They will usually attend scenes to pronounce life extinct. (Note: There is no law in England as to who should certify life extinct and many of the old established practices are being revisited. Some Lancashire Coroners allow Paramedics to do this and it has been mooted that some would accept a Fire Officer's decision that a badly incinerated body was in fact dead. This does seem commonsensical, however there are some obvious dangers for the Fire Officer.)

Forensic Scientists. These scientists are usually employed by the Forensic Science Service (FSS) in Lancashire and are based at Washington Hall, Chorley. Experts are available to cover very wide subject areas ranging from sampling and analysis to DNA profiling.

Forensic Pathologist. Usually instructed by the Coroner and will frequently present evidence found at post-mortem to Coroners inquests and criminal courts. (Forensic Pathologists specialise in suspicious deaths in a variety of circumstances and will usually have considerably more experience in fire fatality autopsies than most hospital pathologists.)

Forensic Toxicologist.

Other specialists who may be involved in certain cases:

Forensic Odontologist.(dentistry)

Forensic Anthropologist, to assist in identification and sexing. They may also be able to establish the race of skeletalised remains.

Experts who specialise in facial identification, superimposition and reconstruction.

Kenyon Emergency Services. (KES) A British specialist company who are retained by most British (and many overseas) transport carriers, including airlines, rail and shipping companies as well as insurers and governments. They are usually involved in incidents involving major fatalities such as mass disasters. KES retain many of the above specialists to provide a rapid worldwide response.

Private Forensic Scientist. They are sometimes retained by interested parties to give contrasting views.

The above list is by no means exhaustive but it does illustrate how difficult and complex the process can be. It also demonstrates that the Fire Investigation Officer needs to develop many skills, diplomatic as well as professional.

In contrast, many American fire investigators do not have some of the UK's complications in their work. Their relevant responsibilities are widely known and recognised by all agencies involved in the process.

The Chicago Fire Department, for example, has a legal obligation to investigate the cause and origin of every fire. The following paragraph is taken directly from the City of Chicago law:

"The specified Fire Officer has the powers of a trial judge for the purposes of summoning witnesses and compelling them to attend before that officer to provide evidence and information."

Powers are also given to Chicago Fire Officers to enter premises to investigate the cause of fire at any time. This is an interesting point and one that is very hazy and unclear over on this side of the Atlantic.

Such powers do not exist in the UK. If it is clear that no crime has occurred then it is doubtful that any investigation could take place without the owner or occupier's permission. Whilst it must be said that this author has never experienced problems in this arena in 34 years of involvement, this may well change in the future. People are much better informed today and we live in an ever increasingly litigious society.



Figure 5:Lancashire Fire and Rescue Service's fire investigation Dog Team at the scene of a fire. This dog ("Burney" detects the accelerants that are often used to assist the development of deliberate fires.

In the UK, the Human Rights Act came into force on the 2 October 2000. It gives "further effect to rights and freedoms guaranteed under the European Convention on Human Rights". The application of the "Bluff Act" is over.

British Fire Service legislation does not yet incorporate responsibility for the Fire and Rescue Service to investigate the cause and origin of fires. In post war Britain when this legislation was formulated the scientific expertise did not exist in the Fire Service and the legal system looked towards qualified scientists.

The Police soon took on this role and were way ahead of the Fire Service in recruiting academically qualified Police officers as well as facilitating the academic training of existing staff.

The situation has now completely changed with the Police employing non-uniformed scientists for practical, professional and economical reasons.

The legal system leans towards the use of the Forensic Science Service (FSS) in England and Wales. The FSS are now a national agency and should be considered as a virtually private company. Their services can be expensive. Lancashire Fire and Rescue Service officers do not request their attendance without the authority of a principal officer.

It is usually the Police who request the attendance of the Forensic Science Service and they provide the funding from their budget.

Lancashire Fire and Rescue Service operates a Fire Investigation Dog Team. The dog detects the accelerants that are often used to assist the development of deliberate fires. The Team has proved most successful and the service is now extended to the surrounding Fire Brigades of Greater Manchester, Merseyside, Cheshire and West Yorkshire. The funding received for this assists Lancashire to sustain such a service.

Training

Lancashire Fire and Rescue Service has a number of experienced and qualified Fire Investigation Officers who provide detailed and scientific investigations.

Lancashire Fire and Rescue Service sponsors two students each year to attend the University of Central Lancashire on a four year Fire Engineering degree course, with the options for:

1) BSc (Hons) - Fire Engineering Management.

2) BEng (Hons) - Fire Engineering.

A prerequisite is that applicants must be qualified to "Member" level of the Institution of Fire Engineers.

Lancashire Fire and Rescue Service is committed to improving the levels of Fire Investigation training within our Service and a good starting point is for Fire Investigation Officers to be at the forefront of the subject and to become recognised locally as experts in their field.

The achievement of this level of expertise will eventually attract recognition, and responsibilities appropriate to relevant skills may well be incorporated into the Fire Services Act. To facilitate this aim two levels of Fire Investigation courses are taught at Lancashire's International Training Centre:

a) *Fire Investigation 1*. A one-week course for crew Commanders, private companies and Police Scene of Crimes Officers. Students excelling at assessment can be nominated for the Fire Investigation 2 course, subject to meeting the qualification requirements.

b) *Fire Investigation 2*. A two-week course for specialist officers, private companies and other specialists. This course contains practical as well as scientific input. Students can elect to sit an accredited examination resulting in the Institution of Fire Engineers "Member" paper in Fire Investigation.

References and Notes

1. The UK Home Office Fire and Emergency Planning Directorate's objectives include: To reduce deaths from fire in the home to 304 per annum by March 2003 by setting key milestones in improved public attitudes, behaviour and brigade activity through national media campaigns and linking with local

initiatives; and establishing a statutory duty on fire brigades through the Community Fire Safety Bill.

2. Simpson's Forensic Medicine. Tenth Edition. (Page 121) Bernard Knight. Publisher Edward Arnold.
3. The table illustrating the physiological effects is representative of a number of tables containing differing information. They all indicate the complexity of the subject matter and present some contrasting views. The sources are: Kirk's Fire Investigation. Fourth Edition. John DeHaan. Publisher Brady Prentice Hall. Page 378. Simpson's Forensic Medicine. Tenth Edition. (Page 305) Bernard Knight. Publisher Edward Arnold. Lecture Notes on Forensic Medicine. Fifth Edition. (Page 201) David J.Gee & Alan A. Watson. Publisher Blackwell Scientific Publications.
4. Kirk's Fire Investigation. Fourth Edition. John Dehaan. (page 386).
5. "Hawley's Condensed Chemical Dictionary" revised by N.Irving Sax & Richard J. Lewis Sr., defines threshold limit value (TLV) as: "A set of standards established by the American Conference of Governmental Industrial Hygienists for concentrations of airborne substances in workroom air. They are time-weighted averages based on conditions, which it is believed that workers may be repeatedly exposed to day after day without adverse effects. The TLV values are revised annually and provide the basis for the safety regulations of the Occupational Safety and Health Administration. They are intended to serve as guides in control of health hazards, rather than definitive marks between safe and dangerous concentration."

N.B. All pictures appearing in this paper were submitted to this journal in very high resolution. However because of space constraints, the pictures have been reduced in resolution. Readers wanting to see the pictures in high resolution, may want to contact the author himself.