Journal of Criminal Law and Criminology

Volume 39 | Issue 6 Article 10

1949

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AMERICAN JOURNAL
of POLICE SCIENCE

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Fires are of interest to the medicolegal expert because of the frequency with which bodies are recovered from burned buildings. It is true that most deaths in fires are accidental, but it is not uncommon for criminals to utilize arson in the hope of destroying the evidence of a homicide, or of disposing of the body of a victim. Furthermore, persons who are about to commit suicide occasionally set their houses afire before plunging the knife, pulling the trigger, or drinking the poison. This may be done in the hope that the death will be regarded as accidental so that the family will not be disgraced, or that insurance may be collected for accidental death. In the rare cases where fire is used to commit murder, the victims are practically always rendered unconscious by alcohol, drugs, or injury before the fire is started.

THE MEDICOLEGAL AUTOPSY

The true cause of death can usually be determined by complete autopsy, even though the remains have been badly burned. It is not uncommon for bodies recovered from burned buildings to be charred and for the extremities and head to be partially burned away (Fig. 1). Even so, the cavities and organs of the body can usually be completely examined and blood can be collected for chemical examination. When the surfaces of the body are so badly burned that injuries such as knife wounds or bullet wounds are not visible externally, evidences of the injuries may be found by dissection.

The examiner should attempt to determine if the person had been alive or dead when the fire started. Burns of the skin made before death often cause blisters which contain fluid. Also, one may find a thin red zone around the edge of a burn made while

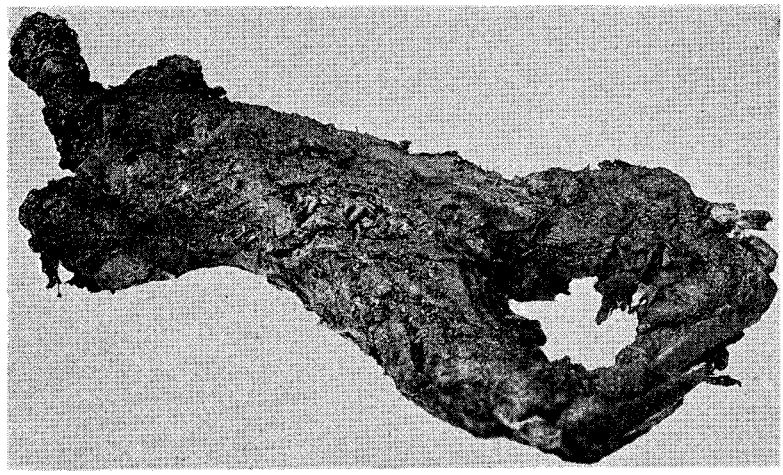

Figure 1

Badly Burned Body Removed from Residence Destroyed by Fire
Complete autopsy revealed that the man had been alive at the time the fire started and that death was due to the effects of heat and carbon monoxide poisoning.

the individual was alive. If death occurred during the fire, there often will be deposits of soot in the windpipe (Fig. 2). Sometimes only a few granules of soot are found, but occasionally the entire lining of the windpipe is covered with soot. Naturally the amount of soot that was present in the smoke is an important factor in determining how much soot will be found in the windpipe.

The best evidence that an individual was alive during a fire is the presence of carbon monoxide in his blood. This toxic gas

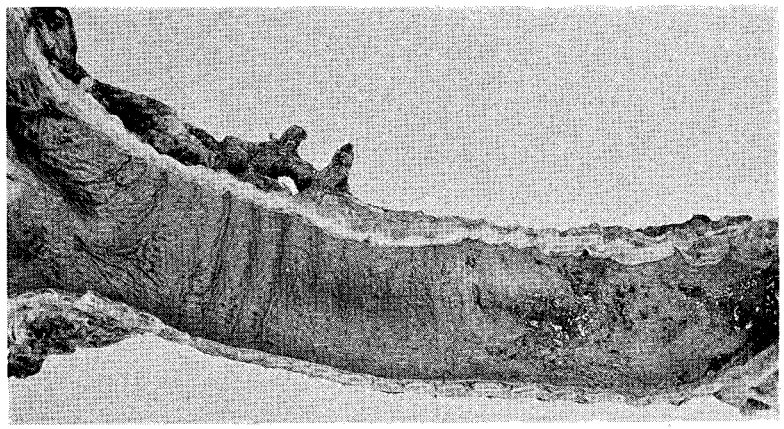

Figure 2

Particles of Soot Adherent to Lining of Windpipe
A fire which destroyed an automobile house-trailer was the cause of this accidental death.

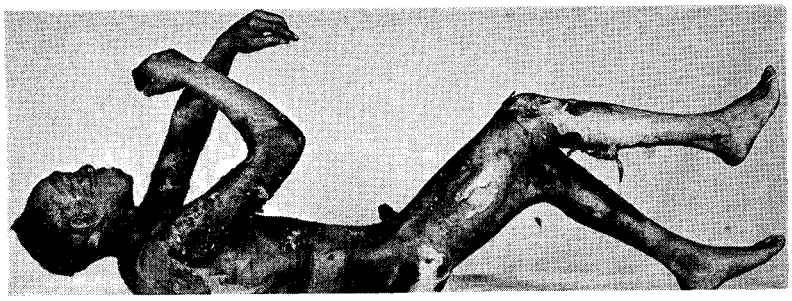

Figure 3

The "Pugilistic Attitude"

This condition results from the muscles being contracted, after death, by the heat of a fire.

is produced in nearly every fire, and chemical examination of the blood for its presence is essential in the investigation of any death where fire may have been a factor.

Heat will cause contraction of the muscles after death, so that bodies which have been exposed to heat often have slightly stooped postures with the arms and legs partially drawn up (Fig. 3). This "pugilistic attitude" has no significance in regard to whether the victim died of burns, since it may also occur in bodies exposed to heat after death, even if death was from another cause.

Partial burning of a body may cause changes after death which may be mistaken for evidences of injury before death. If the the skin is heated sufficiently, it may split in such a way that it

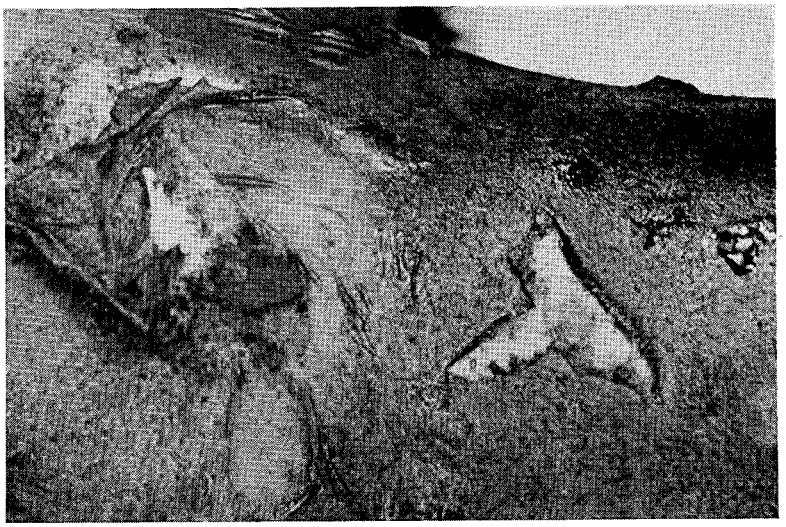

Figure 4

Split Resulting from Heating of the Skin

The absence of hemorrhage into the base reveals that it was produced after death.

Figure 5

Forehead Injury Similar to Split Resulting from Burning
In this case the hemorrhage in the wound indicates that it was produced before death. This wound was produced by crushing of the scalp against the skull with a lead pipe wrapped in leather.

mimics injuries from sharp or blunt instruments (Figs. 4 & 5).

At times the body may be heated to such an extent that steam is produced within the cavity of the skull, and the pressure may be so great that the skull is fractured.

Causes of Deaths in Fires

In most fires there are several potentially injurious factors, and any one or any combination of these may be the cause of death. These factors include heat, toxic gases, fumes, and vapors, and falling walls or floors.

When death has resulted from heat, there are usually extensive burns of the body, and the clothing is partly or completely consumed.

The lungs of persons who have been in burning buildings are frequently damaged. The cause of this damage has not been well understood, but it has been believed due either to the inhalation of heated air or to the inhalation of flame. However, it has recently been demonstrated that when dry air at temperatures usually found in fires is breathed it will be cooled, in its passage through the windpipe, to temperatures below those required to produce injury to the lungs (1).

It is now recognized that toxic gases liberated as a result of the heat are actually responsible for the damage to the lungs. This damage may result in immediate death, or death may be delayed for a considerable time after exposure to the gases. Toxic gases are produced in greatest quantity and with greatest rapidity in fires where the temperatures are high, and where the supply of fresh air is limited. These conditions are common during the burning of buildings. Experiments (2) have been conducted to demonstrate these points. Artificial leatherette, which had been recovered from unburned furniture and walls of the Boston Cocoanut Grove Club after the fire there, was used. When this leatherette was burned in a current of fresh air, the smoke and gases produced slight irritation of the lungs of rabbits; but when, in the absence of a supply of fresh air, the leatherette was decomposed within a closed flask by applying heat to the flask, extremely toxic gases were produced which caused rabbits to die within a few minutes after breathing the gases.

The most important of the toxic gases produced in fires is carbon monoxide. It is impossible to estimate the number of deaths in fires which are largely or completely due to carbon monoxide, but there can be little doubt that a large proportion of deaths in fires result directly from this gas. It is rare for blood from the body of a person who died in a fire to be free of carbon monoxide, regardless of whether the body is slightly burned or almost completely consumed.

It is unlikely that depletion of atmospheric oxygen causes death in fires. Olsen and others (3) have analyzed gases from burning newspaper, wood, silk, wool, rubber, and gasoline, and they found that before the oxygen level was depleted to the extent that harm to man would result, the fire had burned out in most tests. In every fire where the oxygen level was so low that death from oxygen deficiency might have occurred, there developed a high carbon monoxide level which would have produced death first.

Likewise, before dangerous levels of carbon dioxide could accumulate as a result of a fire, the limited ventilation making

such accumulation possible would even more quickly result in the formation of lethal amounts of carbon monoxide.

Other highly toxic gases also result from some fires. The possibilities depend in part upon the nature of the materials being burned. Fires in which nitrocellulose film or artificial leatherette are burned result in the production of the toxic oxides of nitrogen. The burning of wool or silk liberates ammonia and hydrogen cyanide. The latter is extremely toxic. Acrolein is liberated in toxic quantities by heat decomposition of certain glycerine-containing materials. It has been found (2) that the decomposition, by heat, of a sizer oil extracted from artificial leatherette removed from the Cocoanut Grove Club results in the formation of acrolein, and it is believed that this irritating substance may have contributed to the injury of some of the victims of the Cocoanut Grove disaster.

Identification of Burned Bodies

Even though a body has been badly burned, it is usually possible to establish its identity. The pathologist should attempt, during the examination of any charred body, to confirm or deny a presumptive identification. If there has been no presumptive identification objective evidence relating to identification should be recorded.

Clothing or jewelry on the body may be of considerable aid, but it should not be forgotten that any one wishing to obscure identification might substitute these articles before the fire was started. Important information relating to identity may be obtained from the teeth, by comparison of the dental records of a dead person with records obtained from dentists of persons known to be missing. The organs and skeleton should be carefully examined for evidence pertaining to the race, sex, and age of the body. Individual peculiarities, such as evidences of disease, deformities or previous operations should be noted. The use of X-rays of the entire skeleton may be of considerable value. The technics of examination of the skeleton and the information which may be derived therefrom have been discussed in a previous paper (4).

Protection of the Public Welfare

The medical investigator has the opportunity of serving the public interest when there has been a conflagration with loss of life. Even though criminal negligence is not suspected, enough autopsies should be performed to establish the exact causes of the deaths of a significant number of victims. In this way it will

be determined if toxic gases or other unsuspected factors played a significant part in the deaths, and the information obtained may be of value in treating injured survivors. Likewise, this information may serve as an important point of direction in subsequent investigations by fire and police officials.

Conclusions

1. Most deaths in fires are accidental. In some instances, where death seems to have been accidental, a fire has actually been utilized to erase evidences of a suicide or homicide. Occasionally, homicide or suicide is perpetrated by burning.
2. Postmortem examination of charred remains can usually provide information as to the actual cause of death.
3. Fires sometimes produce alterations of the tissues after death which are difficult to differentiate from injuries produced before death.
4. Deaths which actually occur in fires are caused by heat, toxic gases, injuries from falling walls or ceilings, or combinations of these.
5. Identification of a charred body can usually be made by utilizing information gathered at autopsy.
6. Information of value in the treatment of injured survivors, as well as of value to officials investigating a fire, may be obtained by postmortem examination of the bodies of some or all of the victims who died.

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