CHAPTER 14
FORENSIC ASPECTS OF FIRE INVESTIGATION

INTRODUCTION

- ***Arson*** investigations often present complex and difficult circumstances to study due to the fact that the perpetrator has thoroughly planned the act, is not present during the act, and the destruction is so extensive.

INTRODUCTION

- The criminalist's function is limited to detecting and identifying ***relevant chemical materials*** collected at the scene and reconstructing and identifying igniter mechanisms.

THE CHEMISTRY OF FIRE

- Chemically, ***fire*** is a type of oxidation, which is the combination of oxygen with other substances to produce new substances.
- To start a fire, the minimum temperature needed to ignite fuel spontaneously, known as the ***ignition temperature***, must be reached.
- The heat involved when a substance burns is known as the ***heat of combustion***.

THE CHEMISTRY OF FIRE

- An additional factor needed to explain fire, besides the liberation of energy, is the ***rate or speed*** at which the oxidation reaction takes place.
- A ***fuel*** will achieve a reaction rate with oxygen sufficient to produce a flame only when it is in the gaseous state.

THE CHEMISTRY OF FIRE

- A liquid burns when the temperature is high enough to vaporize it (*flash point*).
- A solid must be hot enough to decompose into gaseous products (*pyrolysis*).
- *Glowing combustion*, or smoldering, is burning at the fuel-air interface, such as that of a cigarette.

THE CHEMISTRY OF FIRE

- *Spontaneous combustion*, which is rare, is the result of a natural heat-producing process in poorly ventilated containers or areas.

THE CHEMISTRY OF FIRE

- When a fire occurs, oxygen combines with a fuel to produce noticeable quantities of heat and light (flames).
- To initiate and sustain combustion, the following is required:
  1. A *fuel* must be present.
  2. *Oxygen* must be available in sufficient quantity to combine with the fuel.
  3. *Heat* must be applied to initiate the combustion, and sufficient heat must be generated to sustain the reaction.

THE BASICS

- A fuel will achieve a reaction rate with oxygen sufficient to sustain a fire only when it is in the gaseous state.

HEAT TRANSFER

- The three mechanisms of heat transfer are conduction, radiation, and convection.
  - ***Conduction*** is the movement of heat through a solid object.
  - ***Radiation*** is the transfer of heat energy by electromagnetic radiation.
  - ***Convection*** is the transfer of heat energy by the movement of molecules within a liquid or gas.

THE FIRE SCENE

- The arson investigator needs to begin examining a fire scene for signs of arson as soon as the fire has been extinguished.
  - Experience shows that most arsons are started with petroleum-based accelerants.
  - The necessity to begin an immediate investigation takes precedence even over the requirement to obtain a search warrant.

THE FIRE SCENE

- The search of the fire scene must focus on finding the fire's *origin*, which may be most productive in any search for an accelerant or ignition device.

THE FIRE SCENE

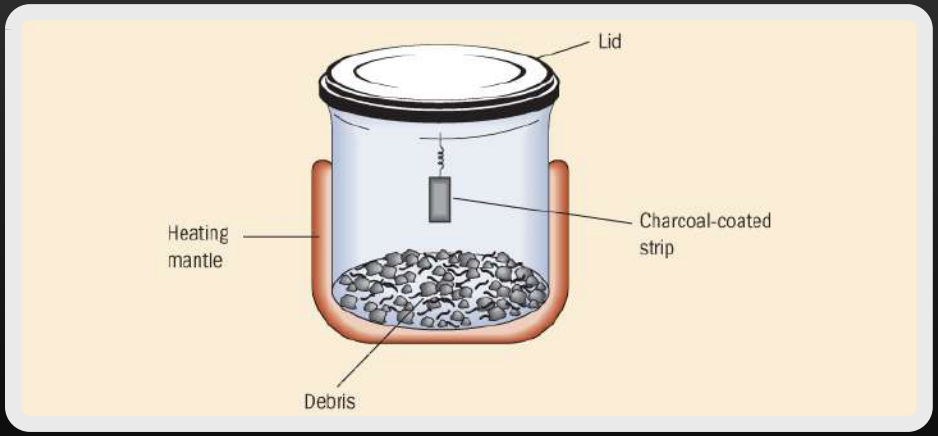
- Some telltale ***signs of arson*** include evidence of separate and unconnected fires, the use of "streamers" to spread the fire from one area to another, and evidence of severe burning found on the floor, as opposed to the ceiling of a structure, due to a flammable liquid.

THE FIRE SCENE

- Normally, a fire has a tendency to move in an upward direction, and thus the probable origin will most likely be the lowest point showing the most intense characteristics of burning.
- Fortunately, combustible liquids are rarely entirely consumed during a fire.

COLLECTION

- At the suspected point of the origin of a fire, ash and soot, along with porous materials that may contain excess accelerant, should be collected and stored in airtight containers, leaving an airspace to remove samples.



COLLECTION

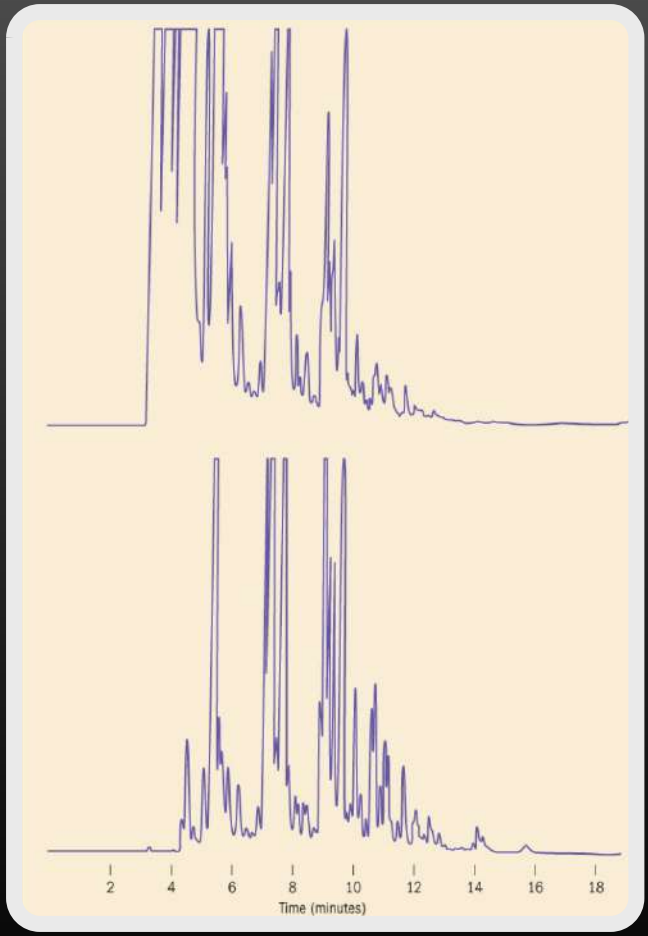
- Traces of flammable liquid residues may be located with a ***vapor detector*** (sniffer).
- It is important that a sampling of similar but uncontaminated ***control specimens*** be collected.
- A search for ***igniters***, such as matches, an electrical sparking device, or parts of a "Molotov cocktail" must also be conducted.

GAS CHROMATOGRAPHY

- In the laboratory, the ***gas chromatograph*** is the most sensitive and reliable instrument for detecting and characterizing flammable residues.
- The vast majority of arsons are initiated by petroleum distillates such as gasoline and kerosene.

GAS CHROMATOGRAPHY

- The gas chromatograph separates the ***hydrocarbon components*** and produces a chromatographic pattern characteristic of a particular petroleum product.



GAS CHROMATOGRAPHY

- By *comparing* select gas chromatographic peaks recovered from fire-scene debris to known flammable liquids, a forensic analyst may be able to identify the accelerant used to initiate the fire.