FIRE PROTECTION EDUCATION

by

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CHAPTER I

INTRODUCTION

If the United States is to maintain its position as the leader in public education the curriculum of every school in the land should be altered to give the coming generation the fundamentals of fire protection. The strongest basic concept of life is self-preservation but yet adults have neglected to inform youth of the great dangers that can befall them by being ignorant of the ever increasing danger that fire presents. The over thirty million young people in the schools today have a major interest in the successful reversal of the ever increasing fire-loss trend. They stand to lose even more than the adult population. They can rightfully expect the senior citizens of this country to give them at maturity the assets of the richest nation in the world. They do not expect them to be laid by fire before they can use them. Statistics prove that one of the major groups that succumb to fire deaths are the youth of the nation. Prevention of the loss of life or personal injury by fire is the ultimate objective of all fire protection, with the saving of property secondary.

Origin and Need for the Study. One needs only to read the daily newspaper or listen to the radio or television to become aware of the ever increasing need to prevent the needless loss that the population suffers daily due to fire. The author's experience in the field of fire protection goes even deeper. While serving in the United States Navy he

was assigned the duty of fire marshal of a large Naval Air Station and several auxiliary stations. From the experience gained in this job and attending several fire schools the author saw at first hand the great need to educate the population in the field of fire protection. Through ignorance many people feel that fire prevention and protection are something that they do not need and would rather take the chance of disaster rather than make improvements. There can never be an over emphasis on fire protection. For this reason the author feels there is a crying need to improve fire protection education at all levels, particularly at the grade school level. After entering the teaching profession the author has observed at first hand the needs of the grade schools in this program. This study would have more than served its purpose if even one fire death could have been prevented. It is hoped that study will prove useful to the alert educators who provide even the bare essentials of fire prevention to their students. If all educators could observe at first hand the loss of life and painful after effects of fire injuries they would not hesitate to incorporate in their curriculum a required course in fire prevention at all levels.

Survey of Previous Studies. In preparing for this study the author made an extensive search of the library of Oklahoma A. and M. College to obtain literature on fire protection. The college library contains one of the most complete and up-to-date sections on fire protection of any library in the nation, thanks to the efforts of Professor R. J. Douglas of The School of Fire Protection. Only one report made by a former student of the college was found, "Fire Prevention in School Shops" by James Brown, 1952. This report and other materials from the college library contributed to make this study possible. In addition, the author

obtained informative materials from government and private agencies interested in fire protection.

Methods of Research. The author has interviewed noted experts in the field of fire protection in order to collect information on various phases of the subject. A nation-wide survey was conducted of the forty-eight states to ascertain the offering by public education in fire protection. Tests were conducted by the author at the Stillwater Junior High School to determine the amount of information that the average student would assimilate without training in fire prevention. Further information has been obtained from selective readings from works of authorities in the fire protection field through the media of the Oklahoma Agricultural and Mechanical College library, and materials obtained by the author from government and private agencies.

Extent of Study. It is the purpose of this study to carry the problem about which it is concerned through its historical background to a logical conclusion using those principles deemed best in the development of fire protection education.

Definition of Terms. Many of the terms used in the fire protection profession are synonymous to this field and are not familiar to the person outside of the profession. It is, therefore, important that the terms used in this study be defined. The terms and definitions that follow are defined as they are used wherever they appear in this study:

Fire Protection Education:

> Fire protection education is a process concerned fundamentally with the building of knowledge and skills that may be utilized in the removal of circumstances under which uncontrolled and unobserved fire might occur. These circumstances include hazards

existent in the physical environment, hazardous and negligent practices, and unsafe conditions allowed to continue because of a lack of knowledge of proper fire-safe standards. Fire prevention education is also concerned with the development of knowledge and skills that are essential in safeguarding life and property in the event of fire through preventing its serious spread and providing for its prompt detection and extinguishment. Fires both small and large will occur regardless of the preventive and protective measures that may be taken and, therefore, the individual must develop adequate knowledge and sufficient skill to keep at a minimum possible injury and loss to himself and the community. (3, page 7)

Approved:

Tested, inspected, and declared safe by Underwriters' Laboratories. (Buy only electrical equipment and fire extinguishers with Underwriters' seal of approval.) (28, page 33)

Arson:

The wilful and malicious burning of the dwelling of another. (4, page 47)

Carbon Dioxide:

Heavy, odorless gas, CO_2, used to extinguish flame; not poisonous, but leads to suffocation. (28, page 33)

Carbon Monoxide:

Poisonous, colorless, odorless gas, CO, formed by incomplete combustion of fuels, such as hard coal or coke. (28, page 33)

Combustion:

With few exceptions (such as the burning of phosphorous in bromine vapor) combustion may be defined as the continuous oxidation of a substance, the oxidation being accompanied by the emission of heat but not necessarily of light. (11, page 19)

Conduction:

By conduction, heat from one body is transferred to another by direct contact or through an intervening heat-conducting medium, as through a teaspoon from hot coffee to the hand. (4, page 59)

Convection:

Transmission of heat by moving currents in fluids, such as water. (28, page 33)

Cooling:

Reducing temperature in, and removing heat from burning material to below its kindling temperature in order to extinguish fire. Water is used ordinarily as a cooling medium. (28, page 33)

Explosion:

If the rate of oxidation of a combustible is practically instantaneous then the process of combustion may assume all violence of an explosion. (11, page 36)

Extinguish:

To quench or put out flames. (28, page 33)

Fire:

Rapid combination of a substance with oxygen (nearly always), producing light, heat, and usually smoke, and various chemical compounds. (28, page 33)

Fire Hazards:

Conditions conducive to fire likely to increase the extent or severity of the fire. (4, page xxiii)

Fire Prevention:

Measures directed towards avoiding the inception of fire. (4, page xxii)

Fire Prevention Week:

Week designed to call attention of public to importance of the safety; observed during the week of October 9 to commemorate the Chicago Fire of October 9, 1871. (28, page 33)

Fire Protection:

Everything relating to the prevention, detection, and extinguishment of fire, reduction of losses, of human lives, and the preservation of property. (4, page xxii)

Fire Resistance:

Fire resistance is a relative term, used to indicate the extent to which a material or structure resists the effect of fire. (4, page xxii)

Fire-resistive:

Fire-resistive refers to properties or design to resist the effects of any fire to which a material or structure may be expected to be subjected. Fire-resistive materials or assemblies of materials are noncombustible, but noncombustible materials are not necessarily fire-resistive; fire-resistive implies a higher degree of fire resistance than noncombustibles. (4, page xxii)

Fire Retardant:

Fire retardant, in general, denotes a substantially lower degree of fire resistance from fire-resistive and is often used to refer to materials or structures which are combustible in whole or in part, but have been subjected to treatments or have surface coverings to prevent or retard ignition or the spread of fire under the conditions for which they are designed. (4, page xxii)

Fire Triangle:

Illustration that three things are necessary to make fire: (a) air, (b) a material that will burn, and (c) sufficient heat. (28, page 33)

First Aid Fire Appliance:

Portable appliance designed to extinguish fire in its early stages. (28, page 33)

Flammable:

Flammable refers to any material which is very easily ignited and burns with unusual rapidity. The form or condition of material, as well as its inherent properties, affects flammability, e.g., fine dry wood shavings would be considered flammable, whereas a large solid piece of wood would not. Flammable is used in a general sense without reference to specific limits of ignition temperature, flash point or other properties, and there is no sharp line of demarcation between a material which is flammable and one which is not. (4, page xxiii)

Flammable Liquid:

Liquid capable of giving off vapor which will burn, such as gasoline. (28, page 33)

Flash Point:

The flash point of a substance (which may be a solid or a liquid) corresponds to the lowest temperature to which that substance must be heated before it will evolve flammable vapor in sufficient quantities to be capable of ignition on application of a light or flame. (11, page 41)

Foam:

Thick fluid consisting of bubbles filled with carbon dioxide gas, produced by reaction between two solutions inside a foam extinguisher which mix when extinguisher is inverted. Used to extinguish fires in flammable liquids and ordinary combustibles. (28, page 33)

Friction:

Rubbing of one thing against another, producing heat, and sometimes an electric spark; may produce fire. (28, page 33)

Fuse:

Easily melted metal piece (or link) inserted in electric circuits as safety precaution. When current increases beyond a certain strength, because circuit has been overloaded or for some other reason, metal melts and breaks (or opens) the circuit, thus cutting off flow of current. (28, page 33)

Ignition Temperature:

The temperature at which a flammable liquid takes fire. (11, page 51)

Lightning Rod:

Metallic electrical conductor with one or more points located above the highest point of a building, connected with a low resistance ground to earth or water, in order to diminish chances of destructive effects of lightning. (52, page 31)

Radiation:

Transmission of heat thru space and some materials, such as glass or rock salt, by means of energy waves, as heat from sun to earth. (28, page 33)

Smothering:

Cutting off air supply. Common smothering agents for fires include foam, carbon dioxide, vaporizing liquid, and sand. (28, page 33)

Spontaneous Heating and Ignition:

Heating and ignition involving a combustible material or combination of materials is described as "spontaneous" if the inherent characteristics of the materials cause an exothermic (heat-producing) chemical action to proceed without exposure to external sources of fire spark or abnormal heat. The process is known as "spontaneous heating" and as "spontaneous ignition" or "spontaneous combustion" if ignition occurs. (4, page 472)

Sprinkler System:

System of water piping with heat-actuated sprinkler heads by which fires are automatically extinguished. (28, page 33)

Available Literature. The available literature in the field of fire protection is quite extensive. The Oklahoma Agricultural and Mechanical College library, as previously mentioned, is an excellent source. The various government agencies publish material in this field. The

General Superintendent of Documents in Washington, D. C. will furnish a listing on request. Other governing agencies also publish material which can be obtained by writing directly to the agency. Several non-profit organizations offer excellent material at a reasonable cost. These are the National Fire Protection Association of Boston, Massachusetts; The National Educational Association, Washington, D. C.; The National Safety Council, Chicago, Illinois; The American Red Cross, Washington, D. C.; The National Board of Fire Underwriters, New York City, New York; The Underwriters' Laboratories, Inc., Chicago, Illinois; and others too numerous to mention. In most cases the material from these sources can be obtained on any level desired from the technical to the simplified elementary grade level. This country is indeed fortunate to have so many agencies and organizations that devote so much time and money toward national fire protection.

Predicted Views of the Result of This Investigation. This study has clearly shown the great weakness of the fire protection educational movement in the public educational system of the United States. The nation-wide survey plus the sampling of the knowledge of the Stillwater Junior High School students on the subjects further emphasize the need for the citizens of the nation to demand that youth receive adequate training in fire protection. It is sincerely hoped that the educators that come in contact with this report will realize the need for further fire protection education in public schools and as the result of reading this report be inspired to seek further knowledge on this subject.

Plan of Presentation. The findings of this investigation will be presented to the reader in a logical sequence beginning first with the

history of fire protection education from ancient times up to the present day. The development of the fire protection curriculum for the three major levels of public education is presented, elementary, junior high school, and senior high school. Following the curriculum development the common causes of fire are taken up in more detail. To understand fire protection one must have a complete knowledge of the causes of fire and the proper methods to prevent them. The presentation of this material has been necessarily simplified in order to eliminate highly technical terms not generally understood by persons outside of the fire protection profession.

The material included in this report does not cover the complete developments in the fire protection field but only information that would be pertinent to the development of the fire protection curriculum of study. To cover the subject of fire protection completely would require countless volumes. An effort has been made to consult the best available sources and select facts that seem to be significant in the development of this study.

To understand the development of the fire protection movement one must be familiar with the technical terms used. The literature on the subject is extensive and readily available to interested persons. To gain a better basic understanding of how fire protection education developed to the advanced stage as of today, one must be familiar with its history. The historical development stems from a colorful past.

CHAPTER II

HISTORICAL DEVELOPMENT OF FIRE PREVENTION

Fire has existed on earth many centuries before the arrival of primitive man. Of all the life on the planet only man is able to understand and convert fire to his own use. Without this historical discovery advanced civilization as it is known today would never have come into being. The value of fire to civilization can hardly be exaggerated. It cooks the world's foods, warms people in winter, and furnishes the energy that drives all the great machines and makes vast industry possible. In fact, fire is so nearly indispensable to life itself that no race of people has been known who has not possessed the art of making a fire; and according to the modern theory, it was the discovery of fire and its uses that marked the emergence of man from the lowest conditions of savagery.

Part A

Early Discovery and Developments of Fire

It is believed that it was man's curiosity that led him to the discovery of fire. Early man may have touched a dead branch to a bed of hot molten lava and the stick suddenly ignited into flame.

Early Religious Aspects of Fire. Some of the early primitive peoples have had various myths as to the origin of fire but most agree that once fire is obtained it is sacrilegious to allow it to burn out because they believed that it had been created by a "supernatural" force. It became the duty of some member of the tribe to keep the eternal light

burning.

Man's Discovery of Fire's Potential Dangers. When early man found that fire could harm him and destroy his possessions, instinct served to warn him against too close an approach to fire. This discovery prompted him to keep his valuable possessions well away from the fire. This early instinct is believed to be the first awareness of man to the destructive power of fire. This action was the first primary fundamental of fire prevention and even today is one of the essentials of preventing destructive fires. Early man, as well as man of today, found it necessary to segregate combustible materials from sources of ignition.

The danger of fire was greater in buildings in the temperate zone where it was customary to have the fire inside with an opening in the roof to allow the smoke to escape. To control this danger the couvre-feu or curfew was designed as a lid to put over hot ashes so that the fire might be maintained over night and prevent the emitting of sparks or radiant heat which could set the dwelling on fire.

Man's Early Methods of Creating Fire. When man gained the ability to create fire by himself the need to keep it burning continually became unimportant and its mystic powers declined. There are even today primitive tribes that still believe in fire worship. To kindle fire, man developed the crude method of friction by the use of a fire drill. This consisted of twirling a pointed stick between the palms of the hand until a hole was formed in a second stick. The rapid motion produced sawdust and the sawdust was ignited by the heat of friction then nursed into a larger fire.

By 1500 B.C. the Egyptians had perfected a device for producing fire known as the bow drill. The bow was pulled back and forth causing a drill

to rotate and the friction caused tinders to ignite. This crude method of starting fires has been used for centuries and the boy scouts of today use it for demonstrational purposes.

Other Early Methods of Producing Fire. Firemaking by reflecting the sun's rays was never used extensively but was used primarily for ceremonial worship. The Incas of Peru used this method in the Golden Temple of the Sun in ancient times. The Copper Eskimo of northern Canada has for centuries made fire by striking two lumps of stone, iron pyrite, and impure quartz together over a leather tinder bag containing dried arctic heather, and after a spark was started the tinder blaze was blown to a red, glowing fire.

The Malays of northern Luzon in the Philippines made fire with a small hollowed-out barrel of buffalo horn and a small, slender hardwood piston that fitted tightly. The piston was driven sharply into the barrel and quickly withdrawn. This action caused rapid compression of the air in the barrel which generated sufficient heat to ignite the tinder in the tip of the piston.

Fire as a Weapon of Early Warfare. In ancient times fire was used as a weapon of war. The first use of fire as a weapon was probably the tying of burning objects to a spear that was thrown at the enemy.

The fire ship was another ancient improvement in the use of fire in warfare. They were generally old vessels filled with combustibles and fitted with grappling irons in order to hook the enemy's ships and set them on fire. This method of warfare was employed successfully by the Tyrians against Alexander. From 673 A.D. to the seige of Quebec in 1759 fire ships were used extensively.

Fire as a Destructive Weapon in Modern Warfare. Fire has been a highly destructive force in war. During World War II the enemy was partly destroyed by the use of fire bombing to burn out his cities and his war production capacities.

In World War II great destruction was caused in the cities of the world by fire and high explosive bombs. For the first time in the history of warfare the development of modern aircraft capable of lifting heavy bomb loads and carrying them for long distances has made large-scale fire destruction of industries and homes not only possible but predictable within reasonable limits.

Historically, the evolution of the destruction by air power from the hit or miss methods used in the early days of air warfare to the present level of performance has been to attack then evaluate the effectiveness of attack and prepare for the next attacks by applying lessons gained from previous attacks to the new estimate of the situation.

> British experience with the results of early German Air Force attacks indicated that fire as a destructive agent was much more effective, weight for weight, than high explosives. Thus the maximum use of fire as an offensive weapon in modern warfare has again proved itself as in the past. (13, page 61)

The incendiary bomb was the most effective weapon in starting fires. Incendiary bombs serve two major purposes. First, objectives are made visible to raiding aircraft, thus minimizing the effectiveness of blackouts. Second, sweeping conflagrations more devastating than tons of explosives may result from the fires that are kindled by such bombs. A small incendiary bomb could result in an entire city being destroyed by fire.

Part B

The Development of the Fire Prevention Movement

The development of the fire protection movement dates back to the earliest discovery of fire. Man has had to learn his lesson by the needless loss of his loved ones and possessions. Even today in modern civilization man must undergo tremendous losses of life and property before he will initiate improvements to help reduce these losses.

Egyptians' Early Fire Fighting Equipment. In ancient times man was seldom able to protect his possessions against fire so he could only remove what little he could before it was consumed by fire. From the writings of Heron, an ancient writer who lived in Egypt three hundred years before the birth of Christ, it is recorded that the Egyptians used small fire engines nearly twenty-three centuries ago.

The Great Fire of Rome. A few centuries after the great fire of Rome, it's fire fighting department was much improved. By then the city had recovered from the fire and the emperor selected several thousand "watchmen." These men served as both policemen and firemen. When a fire broke out they dashed down the streets carrying a few hooks, ladders, axes, and simple hand pumps with them. Most of the actual fire fighting was done with buckets.

Nero, emperor of Rome, had elaborate Building Acts drawn up, requiring fireproof material to be used for external walls of houses. There are some who believe that he wilfully caused the great fire which destroyed a large part of Rome in order that he might put his new fire prevention act into operation.

In Roman times Marcus Crassus maintained a private fire brigade.

When a fire was discovered he would offer to buy the building at a low price. If the owner agreed he would have the fire extinguished. If he didn't agree the firemen would stand back and enjoy watching the building destroyed.

During the Middle Ages people lost the knowledge of fire fighting. In about 1500 they were using axes and long iron hooks to pull down burning walls. During this period a "handsquirt" was used to throw water on the fire. It was relatively ineffective.

The Great Fire of London, 1666. In the year 1666 a history-making fire broke out in London, England destroying two-thirds of the city and leaving two hundred thousand people homeless. This fire was finally extinguished after burning for four days by a drenching rain. This disastrous fire pointed out the need for improving fire fighting and fire protection needs.

The Great Fire of London was a turning point in English history. It cleared away the old, out-moded and unsanitary buildings and made possible reconstruction of new, improved fire-resistant buildings and a safer street planning.

The first Lord Mayor of London, in the reign of Richard I, 1189, issued a regulation prescribing the proper construction of stone walls. The walls should be three feet thick and sixteen feet high. The roofs shall not be of reed or rush but of tile, shingle, or board. All houses that were previously built with reed or rush must be plastered.

On the 11th of April 1665 only one year before the disastrous fire of London, King Charles II wrote the Lord Mayor of London warning him of the fire from the poor house construction and narrow streets. He gave permission to imprison persons that continued to build and not conform

to the Building Acts.

Alfred the Great of England established fire watches that worked on a monthly rotation and were furnished with tin hats, hatchets, buckets, and ladders and hooks on the end of chains for pulling off burning thatch. In the same century Edinburgh was levying a tax to raise funds for equipping firemen.

After the fire Nicholas Barbon had the idea of forming an insurance company to protect property owners against fire losses. Fire insurance soon became popular and many companies were formed and each had its own fire brigade. Each company protected only the houses it insured. To know which houses to protect, each company hung a metal plate over the doorway of every house it insured. These plates were called "fire marks" and many may be seen in museums today.

In the early days of London's fire brigades, town criers were hired to walk up and down a regular beat watching for fires.

Many times the fireman would arrive at the scene of the fire only to find that the burning house was not insured by their company so they would stand back and wait for the proper brigade to arrive even if the house burned to the ground, and many did.

As the cities grew the need also grew for consolidation of the various fire brigades. The large number of brigades were expensive and were relatively ineffective so the large cities took over their operation.

Early Colonial Fire Prevention Legislation. In the year 1569 the Dutch colony of Nieu Amsterdam, under Governor Peter Stuyvesant, purchased and distributed 250 leather buckets and some hooks and ladders. In 1648 the Dutch passed the first fire protection measure requiring the colonists to keep their chimneys clean and to tend their fire so that no

excessive sparks would fly out. A tax of one guilder for every chimney in town was instituted to provide for the maintenance of the equipment. In 1689 Brent Master was appointed first fire chief in the new world. In the year 1737 the General Assembly of the Colony passed an act instructing the corporation to appoint forty-two men as firemen. This act established the first Volunteer Fire Department which served New York up to 1865 when a paid force was installed.

In the early colonial period buckets were the chief method of fire extinguishment and long lines of bucket brigades were formed to speed the water to the fire. The change from the use of candles to oil lamps greatly increased the danger of fire. This increase in the size of fires paved the way for the use of fire pumps and better fire prevention measures. In 1731 the first two fire engines were brought over to New York from London. The early engines were fed by buckets and later leather fire hoses were employed to increase efficiency. Even a man in good physical condition could only operate the hand pumps for about ten minutes. These early engines were pulled to the fire by hand. Later horses were used for this task.

First Steam Water Pump in America. About 1714 or 1715 an old slave of Arent Schuyler, owner of a large tract of land in North Arlington, New Jersey, discovered a rich specimen of copper ore. Full scale mining operations were undertaken and a large quantity of ore was removed. As the mine was deepened water poured in and stopped operations. In 1748 or 1749 an order was placed for a steam water pump with a manufacturer in London. These pumps had been used successfully in mine operations in England.

Joseph Hornblower accompanied the engine to America to install the machine at the mine. The engine arrived in America on June 6, 1753, and after two years of work the engine went into operation on March 12, 1755. The venture proved successful and mining operations were resumed.

This crude water pump was the fore-runner of other pumps that were incorporated in fire fighting equipment. This event was particularly significant because up to this time water was removed by hand either with a bucket or a hand-operated pump.

Paid Professional Fire Departments. The volunteer fire department served well but as cities grew larger paid departments were hired. In 1853 Cincinnati, Ohio hired the first paid department in the United States. In the same year Cincinnati put the first steam fire engine into service.

The Establishment of the Factory Mutuals. In 1835 an association of manufacturers interested in fire safety organized for the following purposes, as stated in the book, Fire Prevention Education.

> (1) Ascertaining and eliminating the causes of fire, and (2) providing ample protection so that any fire which occurred would be extinguished with the minimum loss. This association which became the "Factory Mutuals" was responsible for much of the stimulation of the development of present-day fire-safety activities as a result of its work with private owners and establishments during the early years of this country's development. (3, page 6)

This and other groups are making valuable contributions to national fire prevention.

Establishment of the National Board of Fire Underwriters. One of the outstanding fire prevention and protection organizations that has pioneered in its field is the National Board of Fire Underwriters which was established in 1866. It was established as an educational, engineering, statistical, and public service organization. It is maintained

by the majority of capital stock fire insurance companies of North America. Theoretically, its services are in the interest of its membership but practically it has become a public service institution in most of its activities.

The fire protection work of the organization was a direct outgrowth of the Baltimore, Maryland Conflagration of 1904. This fire made the insurance companies realize the need to help promote better fire prevention measures in this country.

The National Board of Fire Underwriters is composed of several committees. The committee on Fire Prevention and Engineering Standards is important in bettering municipal fire-safety conditions. This group has men in the field that make surveys of municipalities and submit reports to the cities so that corrective measures may be incorporated in planning improvements.

The National Board's Committee on Public Relations has done much to supplement the technical work of the other committees. The Committee on Building Construction has contributed a great deal in establishing building standards that will reduce fire hazards.

Establishment of the National Fire Protection Association. The National Fire Protection Association has for many years made a major contribution to the development of the fire-prevention and fire-protection movement. The organization was established in 1896 for the following purposes, as stated in the book, Fire Prevention Education.

> (1) To promote the science and improve the methods of fire protection and fire prevention, (2) to obtain and circulate information on these subjects, and (3) to secure cooperation in establishing proper safeguards against loss of life and property by fire. The association is a non-commercial, non-profit organization supported by the dues of its membership. The two main

> functions of the association are to formulate authoritative standards for the reduction of fire waste, and to educate the people in the observance of these standards, pointing out the grievous penalties exacted as the result of ignoring them. (3, page 9)

The National Fire Protection Association has its work broken down into committees on the various phases of fire protection work. The committees are composed of members throughout the United States and Canada. Professor Douglas on the faculty of Oklahoma Agricultural and Mechanical College is a member of the Committee on Airport Fire Safety.

The Association is concerned with the preparation of fire-safety standards. These standards are widely used as fire prevention legislation throughout the United States and Canada. Public education activities are carried out through the publication of fire prevention literature.

Establishment of The Underwriters' Laboratories, Inc. An organization that is well known by the general public is the Underwriters' Laboratories, Inc. of Chicago, Illinois. This is a non-profit organization that maintains a laboratory for the examination and testing of devices, systems and materials as to their relation to fire and casualty hazards. It was founded in 1894 by the National Board of Fire Underwriters. Manufacturers send things to be tested to the laboratory and if the items pass the tests given by the laboratory the manufacturers are given permission to place the UL label on their merchandise as long as they maintain the standards.

The Objectives of Fire Protection. The objectives of fire protection, as stated by the International City Managers' Association, are in order of importance:

> (1) To prevent fires from starting, (2) to prevent loss of life and property in case a fire does start, (3) to confine a fire to the place of origin, and (4) to extinguish the fire. (9, page 1)

Fire fighting, because it requires positive and dramatic action, has had a greater appeal for people than have preventive measures which involve restrictions, prohibitions, and interference with what we call "individual rights." For this reason even today the majority of the money and efforts are used for fire fighting and equipment rather than fire prevention where the need is greatest.

Basic Fundamentals of Fire Prevention. Roland P. Blake, in his book Industrial Safety, gives some good fundamental principles of fire prevention.

> 1. Prevention of the start of fire through construction, arrangement, proper storage of flammable materials, periodic inspections, control of operations and processes, maintenance, good housekeeping, and the elimination of unsafe practices.
>
> 2. Prompt discovery and extinguishment of fires in their early stages. Except for the relatively few fires caused by explosive combustions of dusts, vapors, and so on, all fires start in a small way. Included under this subject should be the selection and location of first-aid fire equipment, sprinkler systems, alarm systems, and the organization and training of fire brigades.
>
> 3. Limits of spread through sound engineering from a fire-protection standpoint. This study must include types of construction, fire doors, barriers, protection against adjacent fires, and confinement of fires that have started to small areas.
>
> 4. Provision and proper maintenance of adequate satisfactory facilities in order to hold at a minimum personal injuries that accompany serious fires. (2, page 430)

Eric L. Bird and Stanley J. Docking, in their book Fire in Buildings, give an excellent definition of fire protection.

> Fire protection is a combination of fire prevention, fire combating, and fire research. (1, page 64)

These fundamental principles are the basis for all successful fire protection programs. To achieve success the program must incorporate all phases of fire protection; nothing can be left to chance.

The Ever-Increasing Needless Loss of Life in the United States. Over 12,000 persons die from fire every year in the United States. This places fire third among causes of accidental deaths, being exceeded only by automobile accidents and falls. Personal injury by fire is particularly painful and disfiguring. Fire casualties are due primarily to burns and inhalation of carbon monoxide and other gases of combustion. The reduction of the loss of life is the essence of any fire protection program.

The fire casualties due to indirect causes may exceed the direct causes. An example of this is a fireman that is overcome by smoke and dies several months later from lung complications. The direct fire casualties are those that die at the time of the fire. The following table indicates the fire fatalities by age groups for the year 1949.

TABLE I

FIRE DEATHS - 1949

Age	Number	Per Cent
Under 5 years of age	1197	20.0
5 to 14 years of age	580	9.7
Total children	1777	29.7
65 years and over	1393	23.3
Total children and aged	3170	53.0
15-64 age (including age unknown)	2812	47.0
Total	5982	100.0

(4, page 27)

From these figures it may be readily seen that the greatest need in protecting lives is the young children and the aged. From these and other statistics fire protection specialtists can ascertain the additional precaution that must be incorporated into a fire prevention program.

From 1930 to 1952 forty-one schools were involved in fatal fires accounting for 410 deaths. Some of the major school fires in past history resulting in fatalities are as follows:

TABLE II

SCHOOL FIRES CAUSING LARGE LOSS OF LIFE

Date	School	City	Dead
March 4, 1908	Lakeview Grammar	Collinwood, Ohio	175
October 28, 1915	St. John's Parochial	Peabody, Mass.	22
May 17, 1923	Cleveland	Beulah, S. C.	77
December 24, 1924	Babb's Switch	Hobart, Oklahoma	36
March 18, 1937	Consolidated	New London, Texas	294

(4, page 33)

These school fires clearly show the pressing need to educate the youth of this country in fire prevention. All of the school fires could have been prevented if proper preventive measures had been taken.

The discovery of fire by man was the most important event in history. It changed the pattern of life from one of a higher animal to one of civilized human beings. From the first discovery of fire man has seen the need to protect himself and his valuables from the destructive forces of fire. Even today fire is the number one enemy of man.

From its early beginning the fire prevention and extinguishing movement has had a colorful and exciting development. The early fire fighters

and organizations were the center of the social life of this country, and even today the volunteer departments in the smaller communities are still the same old social leaders.

The advancement of the fire prevention movement has always been excelled by the great loss of life and property. The burning of Rome and the Fire of London in 1666, the Baltimore Conflagration in 1904, are just a few major fires that shocked people into demanding improved control of fire.

The many organizations that are devoted to fire prevention and fire safety are the direct results of public demand for improving conditions. These organizations perform a valuable service to the people of the United States.

Even with all the great strides that have been attained in the fire prevention movement the loss of life and property grows continually, showing the great need for more public education and understanding of fire and its potentials.

CHAPTER III

DEVELOPING THE FIRE PROTECTION EDUCATION CURRICULUM FOR THE PUBLIC SCHOOLS

The past history of the fire protection education movement has been a long and tedious one. The movement started when man first discovered fire and learned that it could damage his body as well as his belongings. After early man discovered these facts he conveyed them on to others. This was the beginning of the fire prevention movement.

Without exception man has learned the need for fire prevention education by the loss of loved ones through fire. The history of the large and small fires throughout the ages has shown this to be true. Early man soon discovered the use of rocks to keep fires within bounds. The Great Fire of Rome showed the need for improving fire fighting equipment and techniques as well as educating the citizens in fire protection education. It also showed the need for improved building codes.

In the present advanced civilization most citizens feel that the present system of education is adequate to meet the needs of today's youth. From the findings of the author it is clearly shown that most citizens show little or no interest in educating today's youth in the essentials of fire protection. It is felt that if the average citizen were informed of the great need for this type of education he would demand that all schools incorporate courses in fire protection in their state required curriculum.

Part A

Developments that Led to the Need for Modern Fire Protection Education

The school fires of the past and present are even more dramatic evidence of the need to educate the youth, the teachers, and the administration in sound fire prevention education. The earliest school fire on which any limited data is available on occurred March 4, 1908 at the Lakeview Grammar School, Collinwood, Ohio. In this fire 175 died. The reason for the high loss of life was the lack of fire escapes, and proper fire drills were not held. The fire occurred in the stairway, trapping the students on the second floor. This fire resulted in improved fire exits for some schools.

The first major school fire that complete records are available on occurred on the evening of May 17, 1923 at the Cleveland District School in Kershaw County, South Carolina. A play was being presented by the children as part of the commencement exercises. Fire broke out in the auditorium and in twenty minutes only smoking ruins remained and seventy-five had died in the fire. The fire was caused by an oil lamp that broke lose from the ceiling and ignited the flammable materials about the stage. A single, narrow exit would not accommodate the people so panic developed and bodies were piled up at the exit. This fire paved the way for improved egress in schools and the use of fire resistant materials in assembly halls. Seventy-seven people died needlessly because of lack of fire prevention education.

On December 25, 1924 the worst school fire in Oklahoma's history occurred at Babb Switch School, seven miles south of Hobart. This fire cost the lives of thirty-two men, women, and children; seventy-five

wounded were hospitalized. The fire was so intense that identification of the cremated bodies in many cases was impossible. The children were having a Christmas party in the frame school house when one of the candles on the Christmas tree toppled over on some highly combustible tissue paper. In attempting to extinguish the fire the tree crashed to the floor which caused panic and a stampede as all those present tried to reach the one exit. The rush was so great that people were trampled to death and bodies blocked the exit. The windows were covered with heavy wire mesh so that all escape by the windows was impossible. More than two hundred persons were in the school building and the room measured only 25 by 36 feet. The following precautions were neglected, as outlined in the National Fire Protection Association Quarterly.

1. The building itself was of the lightest kind of frame construction - the least fire-resistant type of building.
2. For illumination gasoline lamps were provided.
3. Open flame candles swung from the boughs of the tinder-dry cedar Christmas tree. Here was a hazard so well known that it is astounding that no one present recognized the danger. This was the fatal hazard.
4. The building was crowded beyond reason. Reports set the number of people in it at between 200 and 250. Even 200 in a room 25 by 36 feet is several times what any law would permit.
5. The one door opened inward. It was a veritable "check valve" making it next to impossible for a surging crowd to pass through. The state fire marshal had vigorously condemned such construction in schools but could not act because he was not backed by any building code.
6. Only one exit was provided to the building. The windows which might have been used for emergency means of egress were heavily barred.
7. Not a single provision to take care of a fire should one start had been made. There was not even a fire pail. The blaze was attacked in its incipiency by wraps and bare hands, and was probably spread rather than checked.
8. Those who escaped from the building had to stand by and see the fire burn unhindered for there was not a hose line or even a drop of water in the vicinity. (48, pages 219-223)

The tragedy of the school house could have been prevented if Oklahoma had enacted a state building code.

At 3:15 p.m. on March 18, 1937 the worst school disaster of the present century occurred. Two hundred and ninety-four school children and teachers died as the result of a gas explosion. This disaster occurred in the unincorporated community of London, about ten miles from Henderson, Texas.

The building involved in this explosion was a modern structure of a type regarded by many as "fireproof." The disaster was due not to the same defects of construction and arrangement which have been responsible for previous school fire tragedies, but to the neglect of proper precautions in the insulation of gas piping. The explosion was caused by an accumulation of explosive gas under the building due to a leak in the gas line. It is believed that it was ignited when the shop teacher plugged a portable connection into a wall socket in the basement shop. The collection of defects that made this explosion possible were presented in the National Fire Protection Association Quarterly as follows:

1. Poor ventilation in enclosed spaces.
2. Improper heating system.
3. The school allowed employees to make repairs on gas and electrical systems instead of calling in trained and skilled workmen.
4. Most all of the defects that caused this explosion could have been prevented if proper building codes had been in effect. (47, pages 299-311)

This disaster again serves to emphasize the importance of life safety as the first purpose of all fire prevention and protection, and the ever growing need to educate the population in preventing this loss of life.

These school disasters are only a few of the many needless fires that have occurred in the United States. According to the current

statistics published by the National Fire Protection Association of Boston, Massachusetts there were over five hundred school fires last year.

Part B

The School Fire Prevention Program

Many school administrators have seen the need to incorporate fire protection education in the school curriculum but because they lack the technical knowledge required to set up a program of this type, the students must be content with the monthly fire drill and a visit to the local fire station when in the elementary grades.

To establish an effective program of fire prevention education requires the active support of the school administrators, the classroom teachers, the parents, and the administrators of the community. The cooperation of these people can be easily obtained if they are properly informed of the increasing need for this type of program. The National Fire Protection Association, the National Board of Underwriters, and others, have a great deal of material available free to persons interested in this type program. Movies, booklets, and posters can be used effectively to create the needed interest.

After an interest has been aroused it may be possible to establish a committee of interested parties to help plan the program and offer advice on the administration of the program. The final authority, of course, would be the local school board.

To determine the knowledge of fire protection education that the average student in the public school possesses a sample survey was conducted in Stillwater, Oklahoma. It is realized that this survey is quite limited in its scope and only represents a small fraction of the students

enrolled in the public schools. The results are believed significant in that they show a definite trend for the need for greatly improved instruction in fire protection education.

Results of a Survey at the Stillwater Junior High School. The survey was conducted in March 1957 at the Stillwater Junior High School, Stillwater, Oklahoma. The students tested were the male students of the seventh and eighth grades enrolled in the Industrial Arts Department of the school. The seventh grade consisted of four classes with a total of eighty-four students tested. The ages of the students ranged from 12 to 14 years of age, the average age being 12.9 years. The eighth grade consisted of two classes with a total of fifty-three students. The ages ranged from 13 to 15 years, the average age being 13.5 years. The students were divided into two groups. One consisted of those who had received any formal training in fire protection education, and the other group that had received some training on the subject. Those with some training indicated they had received it from Boy Scouts, 4-H Club, Future Farmers of America, or other non-school activities. The total seventh grade students with training was 29; without 55. The total eighth grade students with training was 9; without 9.

The results of the test indicate that the average grade attained by the students indicating they had previous training in fire protection education was much higher than students with no previous training. The results of both groups showed a definite need for improved training on the subject.

The test consisted of twenty questions that could be answered "yes" or "no." The first fifteen questions were taken from the publication, Fire Safety For Junior High Schools, published by The National Educational

Association of Washington, D. C., 1950. The last five questions were composed by the author from his experience in teaching fire protection education in the armed forces. The following are the questions used for the survey test:

		Yes	No
1.	The "fire triangle" illustrates that three things are necessary for a fire: (a) air, (b) a material that will burn, and (c) sufficient heat.	____	____
2.	Lamp cords may be run safely under rugs.	____	____
3.	Blown-out fuses may be replaced safely with wire.	____	____
4.	Any number of lamps and electrical appliances may be attached to a circuit if the fuse is heavy enough.	____	____
5.	Gasoline should be used for dry cleaning only in a cool place, such as the basement.	____	____
6.	A metal rubbish burner should be placed near a garage or other outbuilding to prevent the wind from blowing the fire when waste paper is burned.	____	____
7.	Bundles of waste paper saved for a school paper sale should be stored in the attic or basement.	____	____
8.	Furnace pipes should be inspected each month during cold weather while the furnace is in use.	____	____
9.	A pint of gasoline has the explosive power of two sticks of dynamite.	____	____
10.	Oily rags and mops are capable of setting themselves on fire.	____	____
11.	Covering a campfire completely with earth is a good way to put it out.	____	____
12.	All flammable material used as decorations for parties need not be flameproofed.	____	____
13.	Class A fires are fires in ordinary flammable materials such as wood, paper, grass, and leaves.	____	____
14.	The air in the upper levels of a room is safest to breathe when a building is on fire.	____	____
15.	A good conservation practice, as well as a safe one, is to pile leaves on a compost heap rather than to burn them. (28, page 30)	____	____
16.	If you saw a fire of medium size and you had a garden hose available would you attempt to extinguish the fire yourself rather than call the fire department?	____	____

		Yes	No
17.	If an electrical motor was on fire would you use water to extinguish it?	____	____
18.	Gasoline fumes are lighter than air so they would go upward.	____	____
19.	Would you rate fire as one of the major killers in the United States?	____	____
20.	If you were in a hot fire could you be killed by breathing hot fire gases into your lungs?	____	____

Many of the students had such a limited knowledge of fire protection education that the author was required to explain many of the questions to them. Some of the terms that were most frequently not understood by the students are as follows:

1. The fire triangle.
2. Electrical circuit.
3. Flammable material.
4. Classification of fires.
5. Conservation practice.
6. Gasoline fumes.
7. Major killers in the United States.
8. Hot fire gases.

These and other terms should be easily understood by a student well versed in fire protection education. The location of the school is significant because it is located in a college town, and many of the students' fathers are on the faculty of the college so would, therefore, come from above-average homes and possess higher I.Q.'s.

To interpret the test results one must know the frequency of the questions missed by the separate groups. The following tabulation gives this information.

A. Seventh grade students with no previous instruction in fire protection education.

Question	No. Students that Missed Question	Question	No. Students that Missed Question
1.	12	11.	37
2.	11	12.	12
3.	1	13.	17
4.	11	14.	8
5.	27	15.	27
6.	4	16.	15
7.	8	17.	2
8.	14	18.	41
9.	32	19.	22
10.	21	20.	13

B. Seventh grade students with previous instruction in fire protection education.

Question	No. Students that Missed Question	Question	No. Students that Missed Question
1.	5	11.	21
2.	3	12.	11
3.	0	13.	4
4.	8	14.	3
5.	5	15.	13
6.	1	16.	3
7.	2	17.	1
8.	6	18.	18
9.	11	19.	6
10.	6	20.	5

C. Eighth grade students with no previous instruction in fire protection education.

Question	No. Students that Missed Question	Question	No. Students that Missed Question
1.	9	11.	31
2.	4	12.	15
3.	1	13.	6
4.	8	14.	3
5.	15	15.	26
6.	5	16.	9
7.	3	17.	6
8.	5	18.	32
9.	19	19.	10
10.	14	20.	0

D. Eighth grade students with previous instruction in fire protection education.

Question	No. Students that Missed Question	Question	No. Students that Missed Question
1.	3	11.	6
2.	2	12.	6
3.	0	13.	0
4.	3	14.	0
5.	2	15.	6
6.	1	16.	2
7.	0	17.	0
8.	0	18.	5
9.	6	19.	1
10.	1	20.	0

As the result of analyzing these statistics a course of study in fire protection education can be more intelligently compiled, stressing the weaknesses of the students in certain areas. For example, the question number three pertaining to the misuse of electrical fuses was missed by only a small percentage of those tested. Conversely, question number eighteen pertaining to the density of gasoline vapors was missed by a majority of the students, so the proposed curriculum would contain a section on flammable liquids.

This survey strongly indicates the average student lacks even the bare essentials of fire protection education. If the survey had been broadened out to include both sexes it is felt the results would have indicated even stronger the weakness in fire protection education knowledge because most girls have less knowledge of many of the mechanical and electrical terms presented.

To obtain a better understanding of the interest that the various states of the nation displayed towards fire protection education, the author conducted a survey. The survey was conducted in November 1956. A letter of explanation and a reply postal card were sent to the forty-

eight states' Departments of Education. The questionnaire asked the departments to complete several questions pertaining to fire protection education that could be answered with a "yes" or "no" or a short statement. The simplicity of the questionnaire made it easy for the persons concerned to reply with a minimum amount of time in completing it. Three questions were asked: (1) Are any courses offered in fire protection education in the public school system of your state?, (2) If so, at what level?, and (3) Are fire protection courses incorporated in the state required curriculum? Table III shows the results of this survey. This table again points out the great need in the United States to increase the instruction given in fire protection education and incorporate it in the required curriculum of the various states. The table shows that only six of the states that replied to the questionnaire have incorporated fire protection courses in the required state curriculum. Seventeen of the states questioned indicated they offer some type of fire protection course, many of which were incorporated in other courses. One large state's response to the question was, "We do not know what constitutes fire protection education."

TABLE III

STATES OFFERING FIRE PROTECTION EDUCATION IN THE PUBLIC SCHOOL SYSTEMS

State	Are Any Courses Offered In Fire Protection Education	If So What Level	Are Fire Protection Courses Incorporated In State Required Curriculum
Alabama	No	----	No
Arizona	Failed to reply to questionnaire		
Arkansas	Failed to reply to questionnaire		
California	Yes	Elementary and Secondary	Yes
Colorado	No	----	No
Connecticut	No	----	No
Delaware	No	----	No
Florida	No	----	No
Georgia	No	----	No
Idaho	No	----	No
Illinois	Yes; incorporated under course in Safety Education	All Levels	No
Indiana	Incidental and not offered as formal course	----	No
Iowa	Failed to reply to questionnaire		
Kansas	Failed to reply to questionnaire		
Kentucky	Failed to reply to questionnaire		
Louisiana	Failed to reply to questionnaire		
Maine	No	----	No
Maryland	Failed to reply to questionnaire		
Massachusetts	Yes	Grades 7-12	No
Michigan	Yes	Higher Education	No
Minnesota	No	----	No
Mississippi	Used as part of conservation courses	----	No

TABLE III (continued)

State	Are Any Courses Offered In Fire Protection Education	If So What Level	Are Fire Protection Courses Incorporated In State Required Curriculum
Missouri	Adult Education	University of Mo.	No
Montana	Yes	Grades 1-12	Yes
Nebraska	No	----	No
Nevada	No	----	No
New Hampshire	No	----	No
New Jersey	No	----	No
New Mexico	No	----	No
New York	Adult Education	Not specified	No
North Carolina	No	----	No
North Dakota	No	----	No
Ohio	No	----	No
Oklahoma	No	----	No
Oregon	Yes; incorporated under course in Safety Education	Not specified	No
Pennsylvania	Yes	Elementary and Secondary	Yes
Rhode Island	No	----	No
South Carolina	Failed to reply to questionnaire		
South Dakota	Yes; incorporated under course in Safety Education	Not specified	No
Tennessee	Failed to reply to questionnaire		
Texas	Yes	All levels	No
Utah	Yes	Not specified	Yes
Vermont	No	----	No
Virginia	No	----	No
Washington	Yes; offered as part of Health Safety Education	Not specified	Did not respond to question

TABLE III (continued)

State	Are Any Courses Offered In Fire Protection Education	If So What Level	Are Fire Protection Courses Incorporated In State Required Curriculum
West Virginia	Yes; integrated with Science	Elementary	No
Wisconsin	Yes	Elementary	Yes; one-half hour per month
Wyoming	Yes	Not specified	Yes

This country is becoming more and more conscious of the needs to improve and expand the educational system. The seven cardinal principles of education as quoted from Emanuel E. Ericson's book, Teaching The Industrial Arts, are accepted by most leading educators as the basis for the curriculum of the public schools. The cardinal principles are:

1. Health. With reference to the contribution of industrial arts to the attainment of this objective, the course of study of the State of Minnesota suggests that this field of activity should: "Develop and establish in the lives of pupils the method and processes of performing manual activities which are in greatest accord with the conservation of human strength, the gaining of muscular skill and control, and the assurance of safety to life and health."

   Even a most superficial survey of an industrial-arts program will reveal a large number of connections with this objective. Among these may be mentioned muscular control and knowledge of the use of mechanical appliances, study and practice in solving home-sanitation problems, knowledge of occupational hazards, and others.

2. Command of fundamental processes. This may at first seem to be confined to the activities of the regular and academic classroom. However, Schneickhard points out that industrial arts contributes in offering: "(1) innumerable situations for the application of these processes; (2) opportunities for more firmly fixing them by means of tangible relationships, particularly in arithmetical computations; (3) a necessary stimulus to many pupils not otherwise attracted to abstract fundamentals; (4) an insight into the fundamentals in actual life outside of school."
3. Worthy home membership. One of the goals listed in the earlier part of this chapter had particular reference to the developing of common skills in use of materials (handy-man activities). Another covered the intelligent selection and use of industrial products. Both of these have distinct relationship to worthy home membership. The industrial-arts program can and usually does function in offering courses covering home planning, financing, location, and furnishing of the home. All these and many others point to the important place that this special subject may assume in relation to this objective with reference to both boys and girls.
4. Vocation. This objective may be looked upon in the light of the industrial-arts program, excluding vocational training, and still suggest a wide and comprehensive

relationship. At this point a quotation from the U. S. Office of Education bulletin previously referred to will be of value: "This ideal demands that the pupil explore his own capacities and aptitudes, and make a survey of the world's work, to the end that he may select his vocation wisely." The great emphasis placed upon this very feature in all junior-high school programs indicates clearly the service of industrial-arts activity in attaining the "vocational objective."

This does not belittle the importance of a definite vocational program in fulfilling this objective. The bulletin expressly points out the duty of secondary education to "equip the individual to secure a livelihood for himself and those dependent upon him."

5. Civic education. The fact that much of the activity in shopwork in the school calls for association in cooperative effort may be pointed out as a contribution to the realization of this objective. Projects of the school shop which lead to the benefit of the school, the community, or certain groups of individuals make their contribution.
6. Worthy use of leisure. This objective has been mentioned previously in this chapter as being especially applicable in industrial arts. It is by no means confined to that level, for it fits in equally well in adult education. It is obvious that in the latter field the industrial-arts program can render a service more distinct than many of the other subjects in the curriculum. Permanent interests may be developed not only in the various manipulative possibilities, but in reading and investigating technical material, inventions, and mechanical devices, not to mention the possibilities in developing appreciation of the artistic and beautiful.
7. Ethical character. In so far as qualities of character can be established in the school, it is apparent that the school shop can make a distinct contribution. Frankness, fair dealings, honesty in claims for work produced, and similar attributes are probably more consistently demanded for success in the shop than elsewhere in school, unless in physical education. (6, pages 256-258)

The cardinal principles form is an excellent basis for educational curriculum but it fails in one important aspect. It fails to show the student how to protect himself against one of the major killers - fire. How can the citizens of this great country feel that the present system of education is adequate when twelve thousand of the nation's citizens

die as the result of fire each year? Most of these deaths could have been avoided if the persons involved had been given even the bare fundamentals of fire protection education.

Part C

Objectives of the School Fire Protection Education Program

In organizing any educational undertaking the first step is to establish certain objectives and then arrange the curriculum to cover this desired material. The objectives of fire protection education should be included in those of the general school curriculum. They are concerned with the development of knowledge, skills, and attitudes which will enable the student to act safely under fire-hazardous conditions. The objectives of fire protection education vary slightly from one author to another. The following are some good course objectives taken from Living And Growing Through Safety Protection From Fire Hazards In The Home-School-Community For Use In The Elementary Public Schools, published by the Atlanta Public Schools, Atlanta, Georgia.

Elementary Schools

I. Protection of life and of property with special emphasis on the protection of life in the home, the school, the community, and the nation.
II. An understanding of the interdependence of all types of fire prevention agencies.
III. Appreciation of services of all engaged in fire prevention.
IV. The development of a sense of responsibility in the individual child.
V. The development of a sense of alertness.
VI. Better citizenship. (41, page 1)

The book, Fire Prevention Education, published by the National Board of Underwriters, lists four additional objectives that could be incorporated into a program of fire protection education. These objectives may

be stated specifically as follows:

1. To reduce to a minimum the fire hazards both in the physical environment and in pupil activities within the school and community.
2. In case of fire, to insure the safety of all persons in the school building.
3. To reduce to a minimum the possibility of panic and the subsequent ill effects in the event of fire.
4. To take precautions to insure minimum loss to the physical plant. (3, pages 19-20)

To be effective the objectives of a course in fire protection education must take into consideration the needs of the individual student. Instruction in fire protection should be planned primarily to develop in the student behavior that is purposeful and safe in the use of fire and the elimination of fire hazards.

The school curriculum must take into account the needs of the community as well as the needs of the nation. Fire safety instruction must be adapted to meet these needs. In this study fire protection instruction is considered as a separate subject or a specific course of study requiring the full time of a trained instructor. Purposeful activities which are of recognized value to the student are essential to individual and group development.

The study of fire protection education is a relatively complicated and technical subject. To adapt it to the needs of the students of the public schools, it must be reduced to its fundamentals. Childhood is referred to as the flexible period when good habits are easily established. If good habits are formed early in life, their chances for becoming permanent in individual behavior are excellent. For this reason the study of fire protection education should start at the elementary grade level and continue through senior high school.

Part D

Recommended Course of Study Outlines

The program of fire protection education pertains to the protection of life and property against the ever-increasing danger of fire. The success of the program depends largely on the individual ability of the instructor. The instructor must understand the interests and abilities of the students. A good background of practical as well as theoretical knowledge is desirable as a prerequisite to teaching fire protection education. With this background the instructor can give meaning and practical application to abstract subject matter.

The recommended course of study outline is presented to aid the prospective teacher. Fire protection education is a complicated, technical subject requiring years of experience to master. For this reason, the material has been broken down into simplified subject matter more easily understood by the beginner.

The Course of Study for the Elementary Grades. The statistics published by the National Fire Protection Association have shown that every year the greatest loss of life due to fire is the age group one to six and over sixty-six. The education of the elementary students in the fundamentals of fire protection education is essential.

Method of Presentation. To have an effective program that will interest the elementary student, it must place the student in the learning situation. This may be accomplished by having the student participate in activities. An effective presentation is to have dramatizations, booklets, visual aids, posters, graphs, excursions, reports concerning excursions, reading lessons, surveys, construction work, creative

language (stories, rhymes, slogans) talks by the Chief of the Fire Department, and others interested in fire prevention, home inspection clubs, assembly programs, etc. In general, teach fire prevention rather than fear of fire.

Experience and an analysis of available data on injuries and fatalities due to burns indicate that the program of the elementary school should include the development of habits, knowledge, and attitudes that are essential to the prevention of fires, as indicated in the following examples taken from the book, Fire Prevention Education.

Habits:

1. Handle matches, lamps, open lights, bonfires, electrical appliances, etc., in the proper and safest way.
2. Tell an adult immediately if a fire occurs.
3. Keep work and play areas in good condition, free from rubbish.
4. Use a flashlight instead of a candle.
5. Obey (a) fire laws and (b) fire drill regulations.
6. Get off the streets at the approach of a fire engine.

Knowledge:

1. Basic principles of fire fighting and first-aid fire equipment.
2. What to do if clothing catches fire.
3. How to escape from a burning or smoke-filled room.
4. How to report a fire (telephone and fire alarm).
5. How to prevent holiday fires (Halloween, Christmas, and Fourth of July).
6. Proper care and use of electrical toys and equipment.
7. Proper use of juvenile chemistry sets.
8. Origin and celebration of Fire Prevention Week.
9. Common causes of fire.
10. Activities of the Fire Department.
11. Relation of fire prevention to various types of transportation.
12. Dangers of lightning and other rural fire hazards.
13. Damaging effects of fire on life and property.
14. How community provides protection from fires.
15. First aid for burns.

Attitudes:

1. A desire to prevent fires.
2. An appreciation of the work and responsibility of firemen.

3. An appreciation of the contributions of official and private agencies and organizations to fire safety.
4. A desire to cooperate with all groups interested in fire prevention and fire protection.
5. An appreciation of the privileges and responsibilities of citizenship. (3, pages 43-44)

Lesson Material to Aid Teachers. To help the teacher prepare lesson outlines for presentation of fire protection material, the following is offered. The material presented is only some of the fundamentals of the subject. The progressive teacher can obtain from sources listed, and others, additional material pertinent to the subject.

1. The School Fire Drill.

The Pennsylvania Department of Public Instruction Bulletin 399, Program of Fire Prevention in Schools, presents the following pertinent information on fire drills.

> It is the opinion of most fire prevention authorities that there is much to be desired in the way of improving the school fire drill. Although almost every school in America goes through the motions of having periodic fire exit drills, it is common knowledge that these drills generally do not measure up to any acceptable standard. Some are inadequate and some are actually dangerous.
>
> Not only is the fire exit drill definitely necessary but it should be brought to the attention of students and teachers that it is also an instructional device designed to insure safe egression of pupils and personnel from the school building in the event of fire. (51, page 5)

2. Matches and their Use.

Matches are one of the major causes of fire so it is important that the elementary student be familiar with their safe use. More matches are used in the United States than in all the rest of the world. More than 850,000,000 matches are used in the United States each day. All of these flames are potential destructive fires.

The National Safety Council's Safety Education Data Sheet No. 2 lists the safe use of matches.

A. Matches should never be carried loose in the pockets of clothing because they may ignite when accidentally hit. Also, because of the fact that match heads adhere closely to fiber, there is danger that they may be left in the pockets of clothing when being sent to the cleaners, causing fire when placed in a presser.

B. Before striking a match, the box or folder should be closed to keep the other matches from igniting. As a reminder, the phase "close cover before striking" now appears on most match book covers. One should also check to see that the box is right side up before opening it.

C. A tightly closed, metal container is the safest way to store or carry matches. If matches are put in a stand, they should be placed with heads down so that they will not accidentally ignite. All matches should be kept out of the reach of children.

D. Only one match should be removed from the container at a time. Several matches bunched together in the hand may flash and cause serious hand burns. One should strike the match away from oneself, but never toward anyone else, since the head may fly off and cause clothing to catch fire. When lighting a cigaret in the wind, one should be careful not to strike the match too close to the face.

E. Matches should never be carried into any storage room containing flammable or explosive materials; nor should they be carried when handling or working with flammable or explosive materials. One should use a flashlight or electric torch when rummaging around in a closet, attic, basement or garage, since combustible materials may be in such places.

F. It is recommended that burned matches be broken in two to insure that the flame is extinguished before the match is thrown away.

G. Stone jars of sand in public buildings are safe and useful receptacles for burned matches and cigaret stubs. Metal and glass ash trays are also safe places, provided wads of paper have not been put there, too. Burned matches should never be thrown into wastebasket or container of flammable materials.

H. In the open, care should be taken not to discard burned matches near dry leaves or grass. Many forest fires are caused by the failure to make certain that the match has been extinguished before throwing it away. (44, page 2)

3. Electricity.

Misuse of electricity is one of the major causes of fire in the United States so it is important that the student be familiar with its safe usage.

It was only a few generations ago that scientists began to learn some of the secret laws of electricity. The electric dynamo, a machine capable of producing a strong current, was invented in 1831. Electricity became a servant and went to work for man.

Electric current will travel readily through some substances called "good conductors." Other substances are nonconductors, since they offer an obstacle to the passage of the current. Most metals are good conductors, while ordinary rubber and glass are nonconductors.

The human body is a moderately good conductor. For this reason it is dangerous for a person to touch electric light wires, trolley wires, third rails, or anything else that carries a current. If such a current were to pass through the body, it would almost certainly cause death.

4. Flammable Liquids.

With the ever-increasing expansion of the industries many new flammable liquids have come into common use. For the elementary student the study will be limited to the most common of the flammable liquids, gasoline. Gasoline is derived from crude petroleum and has a flash point of -5° Fahrenheit. Gasoline vapor is much heavier than air so will seek the lowest level of a room. It was manufactured for only one purpose, to explode. Gasoline should never be used for dry cleaning under any conditions. It should never be poured into a sink or stored in a glass container. Safety cans should be provided for gasoline storage.

5. Clothing Afire.

The life of the student himself or one of his companions may be saved if he knows the proper methods of extinguishing this type of fire. Fire in clothing is particularly dangerous and requires quick action. The burning clothing may be stripped off or the flames may be smothered by wrapping the body in wool clothing. Running must be avoided because it fans the flames. The students can demonstrate the proper methods of extinguishment on one another.

6. Escaping from a Burning Room or Building.

Many persons are killed each year by the inhalation of hot fire gases. The students are shown the proper method of opening a door in a fire and then take turns demonstrating. The foot is placed behind the door and opened slowly. In escaping from a smoke filled room the student is instructed to keep as low as possible and cover the nose with cloth.

7. Turning in the Fire Alarm.

Toy telephones can be used by the students to call the fire department and give the proper information. In turning in the alarm from the regular fire alarm box the student, upon discovering the fire and having previous knowledge of the location of the box, goes immediately to the box and performs the necessary operation. He then waits at the box for the arrival of the firemen and directs them to the scene of the fire.

Demonstrations. The study of fire protection education offers the instructor an excellent opportunity to use visual aids. There are many simple demonstrations that can be presented with a minimum amount of equipment. The National Fire Protection Association's publication, Selected Demonstrations for Use in Fire Safety Education, and the

publication, Demonstration Lecture on Extinguishing Flame, by Herbert Lange, published by the Underwriters' Laboratories, Inc., New York, motion pictures, posters, and other training aids are easily obtained from the various organizations devoted to fire protection.

Tests. The tests can be made up by the instructor or can be obtained from several fire protection organizations.

The elementary curriculum just covered has the essential fire protection education items that should be incorporated. The list of other related material that can be used is only limited by the time that can be devoted to it.

The Course of Study for the Junior High School. Teenagers are willing if properly trained to do something about the problem of fire protection. Fire safety offers a field where knowledge can be translated into immediate action. Fire safety appeals to the idealism of the junior high school youth. It offers the student an opportunity to make a contribution towards saving human and natural resources from death and destruction. "Junior high school students are old enough to use fire 'know-how' intelligently and young enough to attack the problem with intensity and energy." (26, page 7)

It is not necessary for children or adults actually to undergo unfortunate experiences in order to learn the dangers of fire and how to identify fire hazards. Instruction in fire prevention and fire protection should serve to give children vicarious experiences and actual safe contacts with the dangers of the world in which they live.

Method of Presentation. The method of presentation for the junior high school students does not vary widely from the elementary. The material offered the junior high school student goes into more detail and requires more concentration and attention. The instructional objective of the teacher should be concerned with integrating learning experiences rather than with placing emphasis solely upon subject matter.

Lesson Material to Aid Teachers. To aid the junior high school teacher in preparing lesson outlines for presentation of fire protection, the following material is offered:

1. Matches and Smoking.

To help the students understand the subject a brief history of the discovery and use of matches would be useful. The number of fires and persons killed each year in the United States would serve to impress the students with the importance of safe use of matches.

2. Flammable Liquids.

This part of the course would be similar to the elementary except additional flammable liquids would be studied. It is important that the student understand flash point and the explosive range of flammable liquids. Several simple demonstrations can be effectively used to demonstrate these points.

3. Electrical Hazards.

The study of electrical fire hazards and their dangers is important for students of all levels. The junior high school student should be able to understand what constitutes an electrical circuit and the purpose of fusing. The purposes of city and national electric codes should be

explained. The use of proper grounding wires and extension cords should also be stressed. Simple demonstrations and diagrams can be effectively used.

4. Lightning Protection.

In certain parts of the United States the danger to life and property from lightning is severe. The students should have an understanding of what causes lightning and how to safeguard life and property from it.

5. Escaping From a Smoke-filled Room and How to Extinguish a Fire in One's Clothing.

This section is extremely important for students of all levels. The following simple methods can be demonstrated and practiced by the students. When clothing becomes ignited, do not run. Smother the flames in the direction of head-to-foot with a heavy garment, or if nothing is available roll back and forth slowly on the ground. In escaping from a smoke-filled room, get down on hands and knees and crawl. Cover the nose with a cloth.

6. Proper Methods of Summoning the Fire Department.

In turning in the alarm from the regular alarm box the student, upon discovering the fire, goes immediately to the alarm box and performs the operation that transmits the alarm. The student should wait at the alarm box until the firemen arrive so that he can direct them to the fire. The student must have a knowledge as to the location of the nearest box so that precious time is not lost searching for the box. To transmit an alarm by telephone, the student calls or dials the operator and gives the street and number of the house where the fire is located.

7. Fireworks.

The unsafe use of fireworks causes an ever-increasing loss of life and injury each year. The students should be informed of the great danger involved. Fireworks are so hazardous in the hands of children and untrained adults that communities should abolish their sale entirely.

8. Elimination of Fire Hazards by Proper Housekeeping.

Many fires could be averted if proper housekeeping methods are employed. Housekeeping in the language of the fire protection profession refers to the elimination of trash, waste paper, and other flammable items. It is important for the student to recognize these dangers and know the proper steps to remedy them.

9. Classification of Fires.

Fires are classified in three general categories, Classes A, B, and C.

A. Class A fires are the most common and occur in ordinary combustibles. To extinguish this type of fire requires quenching and cooling, usually accomplished with water.

B. Class B fires are fires in flammable liquids. To extinguish this type fire, carbon dioxide or dry compound extinguishers are used to blanket the surface of the liquid.

C. Class C fires are fires in live electrical equipment. To extinguish this type of fire, a nonconductive extinguishing agent such as carbon tetrachloride or carbon dioxide is used.

10. Common Types of Fire Extinguishers.

There are several types of common fire extinguishers that the student

may encounter in combating small fires. An understanding of their proper use is important. The National Education Association publishes a booklet, Fire Safety For Junior High Schools, which gives a good explanation of fire extinguisher operation.

A. Pump Tank Extinguisher. The pump tank extinguisher is a 2½ to 5 gallon cylindrical tank with a built-in pump to generate pressure. Plain water is used in it. It is, therefore, effective only for fires in ordinary combustible materials. A handle is provided to carry the extinguisher to the fire. The tank is placed on the floor in an upright position. One hand operates the pump, while the other directs the stream from the hose. Hand pumping will send the stream of water 30 or 40 feet. The tank can be kept filled by a second person while it is in use.

B. Soda-acid Extinguisher. The soda-acid extinguisher is a tank containing about 2½ gallons of water in which soda has been dissolved. In the neck of the tank is fastened a bottle containing sulphuric acid. When the tank is turned upside down, the acid and soda mix, forming a gas that forces the water out of the extinguisher. The gas exerts enough force to send the stream of water 30 to 40 feet. The soda-acid extinguisher is carried by the ring at the top. At the scene of the fire it is turned upside down and the stream of water is directed at the base of the fire. The soda-acid extinguisher is used for Class A fires only.

C. Gas Cartridge Extinguisher. The gas cartridge extinguisher is similar to the soda-acid extinguisher, but it also contains plain water, and the pressure inside is applied in a different way. Suspended in the neck is a metal cartridge filled with compressed gas. A plunger in the top of the extinguisher drives a pin into the cartridge, when the extinguisher is inverted and bumped against the floor. When the cartridge is pierced, the gas is released and forces the water out thru the hose attached to the top of the tank. The gas cartridge extinguisher is for Class A fires only.

D. Foam Extinguisher. Altho the foam extinguisher looks like the soda-acid extinguisher and is operated similarly, the fire extinguishing agent is very different. Inside are two separate chambers. One contains a solution of water and bicarbonate of soda and a foam-making ingredient. The other contains water and aluminum sulfate. When the extinguisher is inverted a foam-like stream is forced out the nozzle. Altho this extinguisher contains only 2½ gallons of liquids, it generates about 20 gallons of foam. The foam blankets the fire, cutting off the air supply. It is, therefore, recommended for fires in flammable liquids, or Class B fires. Since the extinguisher contains a great deal of water, it is also effective for Class A fires. When a

pressure fire extinguisher is used, especially on oil fires, its contents should be directed at the base of the fire around the edge. This prevents the flames from spreading, and eventually smothers the fire at its source.

E. Vaporizing liquid Extinguishers. The vaporizing liquid extinguisher is the kind usually found in automobiles. It is a small tank with a built-in pump, containing specially treated carbon tetrachloride. The extinguisher is operated by pumping the handle back and forth with one hand while the tank is held in the other. The stream will travel about 20 feet. When the carbon tetrachloride comes in contact with heat, it turns into a heavy vapor which cuts off the air supply and thus smothers the fire. Because carbon tetrachloride is not a conductor of electricity, this extinguisher may be used to put out fires in electrical equipment (Class C fires), as well as Class A and B fires.

F. Carbon Dioxide Extinguishers. The carbon dioxide extinguisher has a cartridge-like tank filled with carbon dioxide gas under great pressure. Attached to the tank is a nozzle shaped like a small megaphone. To operate the extinguisher, a valve on the tank is opened and the gas applied to the base of the fire at the edge by means of the nozzle. The gas smothers the fire and cuts off the air supply. Although this extinguisher has a maximum range of about 8 feet, it is very effective in oil, gasoline, grease, and electrical fires. It may be used for all types of fires.

G. Dry Compound Extinguishers. The dry compound extinguisher is shaped like the gas cartridge and soda-acid extinguishers, except that the hose is fastened to the bottom of the tank instead of at the top. By turning a hand wheel at the top, a pin is driven into a cartridge of carbon dioxide fastened in the neck of the tank. The released carbon dioxide forces specially treated bicarbonate of soda out thru the hose. The dust-like stream blankets a fire, cutting off the air supply. Since the compound is a non-conductor of electricity, this extinguisher is useful for fires in electrical equipment. It may also be used effectively in gasoline, oil, and grease fires, as well as in fires in ordinary burnable materials. (28, pages 28-29)

The fire protection educational program will be more effective if the teacher employs demonstrations, movies, charts, film strips, and other visual aids.

The Course of Study for the Senior High School. The general educational aims controlling secondary education are the same as those governing education in the elementary school. The high school student

of today will become the adult citizen of the community in a few short years. Even today those citizens can have an immediate effect on the fire loss.

The course of study for the senior high school students presents the material on a narrower subject - matter basis. The material presented is on a more advanced level and additional subjects are incorporated in the study.

Method of Presentation. The senior high school student is able to take a more active part in the program and participate in many of the demonstrations and outside activities. The teacher is thus able to integrate the student in the program. The presentation would cover lecture, demonstration, and use of visual aids. To insure proper coverage of material, testing can be used effectively.

Lesson Material to Aid Teachers. To aid the senior high school teacher in preparing lesson outlines for presentation of fire protection, the following material is offered:

1. Fire Loss.

The purpose of this first section of the course is to impress upon the students the importance of reducing the annual fire losses in the United States. A study of the following statistics should prove helpful: Loss of life by age groups, by occupation, property loss both direct and indirect, review of fires resulting in large loss of life.

2. The Burning Process.

To have a better understanding of fire and the conditions that are conducive to its ignition, the student should be familiar with the burn-

ing process. The study of the history of fire and some of the old theories such as the Phlogiston Theory should give a good background. Parts of the burning process include combustion and spontaneous ignition.

3. Fire Hazards.

The student must be familiar with the conditions that constitute a fire hazard. A fire hazard is a condition that will encourage a fire to start or will cause it to be more severe. The student should know the principle groups of materials referred to as fuel hazards and sources of ignition.

4. Fire Causes.

A fire cause occurs when heat and fuel are permitted to come together in the presence of air or oxygen. The National Board of Fire Underwriters publishes statistics on the principle fire causes in the United States. From these figures the student may see the significance of the fire causes.

5. Smoking and Matches.

Over twenty-five percent of all fires that occur in the United States are attributed to smoking and matches. Because it is the major cause of fire the student should know its potential danger to life and property.

6. Heating Appliances, Chimneys, and Flues.

Heating appliances, chimneys and flues constitute the second major cause of fires in the United States. Because this hazard is more difficult to detect, the student should be familiar with proper usage.

7. Electricity.

Most large high schools provide a course in electricity; therefore, this section would cover only the misuse of electricity, and the proper type of wiring and appliances to use in hazardous locations.

8. Flammable Liquids.

The misuse of flammable liquids accounts for over sixteen percent of the fires in the United States. With the ever-increasing number of flammable liquids coming into use, the student should be familiar with the hazardous characteristics of flammable liquids and the proper safeguards and precautions for handling.

9. Flammable and Toxic Gases.

Industry is using more and more flammable and toxic gases in manufacturing processes. Because of its increasing use, students should know the hazardous characteristics of the gases as well as the proper safeguards and precautions.

10. Explosive Dusts.

Most students are totally unfamiliar with dust explosions and their causes. The list of materials that are subject to dust explosion are extensive. Dust explosions are not limited to industry but can happen almost any place if the proper conditions occur. The students should be familiar with the theory of dust explosions and the proper safeguards to be observed.

11. Static Electricity.

Static electricity for many years was a great mystery to man. Even today many aspects of static electricity are still unknown. It accounts

for many fires every year so the students should have some knowledge of the common methods of stutic electricity control.

12. Lightning.

The average annual loss of life due to lightning is over four hundred persons, and the property loss exceeds twenty-five million dollars. The student should understand the origin of lightning and its characteristics as well as methods to safeguard life and property.

The major subjects for the senior high school course of study have been presented as a guide to the instructor. Many other subjects of minor importance may be included in the course as time permits. The material presented is not inclusive, but covers facts and information that may be utilized in reducing the more common causes and effects of destructive fires. The use of visual aids and demonstrations will expedite the learning process.

Fire prevention, as an educational study, should appeal to all teachers and students as a vital part of the preservation of life.

Students should learn the causes and dangers of fire and its prevention. If the coming generation grows up with a good understanding of fire prevention knowledge, the loss of life and property due to fire will decrease. The continued teaching of the truths about fire dangers to the student from the elementary grades through high school will instill in the student's mind the habit of carefulness.

The following chapter discusses the individual fire hazards and causes as well as methods of elimination. This section of the study may be used by the prospective fire protection education teacher as a source of additional information.

CHAPTER IV

FIRE CAUSES AND METHODS OF PREVENTION

The ever-increasing national fire loss is vivid proof of the need for improved understanding of the various fire causes and methods of prevention. With the rapid advancement of industrial technology, the understanding of fire causes and prevention requires more technical understanding. For this reason, the fire protection engineer must be a highly trained technician. Many of the publications of the fire protection field are written on this highly technical level. The prospective teacher of fire protection education may find it extremely difficult to sift out pertinent information that may be incorporated in the fire protection education course of study from the large number of publications published on the subject. This chapter will incorporate more detailed information than was possible to present in the previous chapters. The prospective teacher of fire protection education will find this material useful in preparing teaching outlines.

Part A

Fire Causes

Before methods of preventing fire can be employed, its cause must be ascertained. A fire cause occurs when a heat hazard and a fuel hazard come together in the presence of air. The method of prevention may be the removal of any of the legs of the fire triangle. Removal of the heat or source of ignition, removal of air or oxygen, or removal of

the source of fuel will result in conditions that are impossible for ignition to occur.

The following sections deal with fire causes. The fire causes will be presented in relative order of importance, starting with the number one cause of fires in the United States - smoking and matches. All conditions that cause fires are important but because the students lack the technical background only the more common causes are presented.

Section 1

Matches and Smoking

Smoking and matches are grouped because the causes and methods of prevention are synonymous. The careless use of matches is the greatest of these hazards, and among smoking materials the cigarette is the most hazardous due to the large number consumed.

The combustible material used in matches is a compound of phosphorous. White phosphorous is no longer used in the manufacture of matches because of the adverse effects on the match factory employees and persons chewing on matches. Red phosphorous has replaced white phosphorous because it is not as poisonous, has a higher kindling temperature, and is thus safer to ship and store. Any type of match when carelessly used can cause a fire but certain types of matches have greater fire-causing potentialities than others. There are two general types of matches in common use. One is the type that has all the chemicals necessary for ignition mixed together in the head so that it may be ignited on any rough surface. The other type is known as the "safety match" which will ignite only on its container. The latter type match is by far the safer type. Good quality safety matches have strong heads that are not easily broken off, and sticks treated to prevent afterglow.

It was believed for many years that rats and mice were responsible for starting fires by chewing on the heads of matches. Extensive tests have proven that even starving rats would not eat matches. Fires have been started by matches which were carried by rats and mice in to walls or crevices. The material was used for nesting material and became ignited when placed near steam pipes or chimneys.

The carelessly discarded cigarette must have ideal conditions to produce an additional fire. Only a small number of carelessly discarded cigarettes start fires but when the number of cigarettes consumed in the United States is considered, the number of fires that start from this source rounds into the thousands each year.

Many fires occur each year in the home due to careless smoking. The National Fire Protection Association's booklet, Preventing Home Fires, presents some common-sense smoking rules.

1. Smoke in safe places.

   "No Smoking" areas in the home include beds, closets, attics, and the work bench when shavings are around or flammable liquids are being used.

2. Use ash trays with built-in fire safety.

   Desirable built-in safety features are low center of gravity, adequate size (at least 4 inches diameter), and cigarette rests above the interior of the tray, or sloped toward the interior.

3. Place ash trays convenient for use.

   Plenty of ash trays, distributed for easy use, contribute to the pleasure and safety of smoking.

4. Dispose of ash tray contents so fires won't start.

   The silent butler or other covered metal container is a safe place to empty ash trays. It's far better to leave ash trays unemptied a few hours than to empty them in unsafe places.

5. Be careful with matches.

When "lighting up" out doors and in other areas where ash trays are not available it is particularly important that the match is out before being tossed away. It is a good idea not to discard the match until the head is cool enough to touch.

6. Keep awake while smoking.

Too many lives are lost and homes destroyed by sleepy smokers whose cigarettes fall on their clothes, upholstered furniture or bedding. (50, page 5)

Section 2

Flammable Liquids

Flammable liquids are used in ever-increasing number as advancement in industrial technology continues. Improper use and handling of flammable liquids causes many fires which result in the loss of life and property. The vapors produced by flammable liquids are more dangerous than the liquid itself. Flammable liquids should be stored in closed containers to reduce the formation of dangerous vapors. Vapors from flammable liquids are combustible only when mixed with the air in certain proportions. For gasoline the proportions range from over one percent to six percent. The strength of the explosion depends on the concentration of vapor. Gasoline is the most widely used and misused flammable liquid. Only liquids with a flash point lower than 200° Fahrenheit are considered flammable by the National Fire Protection Association. The flash point is only one danger of a flammable liquid. Other things to consider are the ignition temperature, explosive range, rate of evaporation, density and rate of diffusion of the vapor.

In many cases the use of a noncombustible liquid may be substituted for the flammable one. Carbon tetrachloride or trichloroethylene have many of the same characteristics as gasoline but are noncombustible.

Sources of ignition in the vicinity of flammable liquid storage should be eliminated. This includes smoking, open flames, and all electrical equipment that is not of the nonsparking type. Precautions should be taken to guard against static electricity.

There are about 5,000 home fatalities each year due to burns, fires, and explosions according to the National Safety Council. Many of these fires and explosions are the results of using gasoline for home dry cleaning. Gasoline should never be used for this purpose. The proper storage of gasoline in the home would be in metal containers with tight fitting tops, or safety cans. Only small quantities should be kept around the home premises.

The National Safety Council's publication, Safety Education Data Sheet - 12, Flammable Liquids in The Home, gives some useful information on extinguishing flammable liquid fires.

> Fires are usually put out in one of three ways: (1) By removal of the fuel supply, (2) by cooling the burning materials below their burning temperatures, and (3) by smothering the fire.
>
> Water applied by means of ordinary hose streams or thrown from buckets or similar containers is not effective in fighting flammable-liquid fires. However, a fine spray of water under pressure, such as the stream produced by a tree sprayer, is often effective in controlling flammable-liquid fires. Water is also used to keep tanks and other containers cool, in case of fire where explosions are feared. When not possible to extinguish a gasoline fire, a spray of water is sometimes used to absorb the heat and to keep the surroundings cool while the gasoline is burning itself out.
>
> There are several commercial types of extinguishers recommended for fires: foam extinguishers, carbon dioxide extinguishers, vaporizing-liquid extinguishers (carbon tetrachloride base), loaded-stream extinguishers, and extinguishers delivering a dry chemical propelled by compressed gas. It is important that only extinguishers be used that bear the label of a recognized testing laboratory. The appliances should be properly operated and maintained. (35, page 4)

Section 3

Electricity

Sixty years ago electricity was just coming into common usage. Today over ninety percent of the homes in the United States use electricity. Even today it is still not known completely what electricity really is.

If electricity is not properly used it may result in both fire and personal injury. When properly used it provides one of the safest and most convenient means of illumination, power, and heating. Electricity may become a fire hazard through arcing, sparking, or overheating. It can cause burns or shocks or personal falls as a result of shocks when contact is made with live parts. Shock is well defined in the National Education Association's booklet, Safe Use of Electrical Equipment.

> Shock is the physiological effect of electrical current upon the human body, and may range from a slight tingling sensation felt chiefly at the point of contact to severe muscular contractions. In extreme cases shock causes paralysis of the heart, breathing center, and nerve control center, sometimes resulting in death.
>
> If contact with an electrical appliance produces even a slight shock, it is almost certain that the appliance is defective. Corrective action should be taken immediately to prevent a more serious shock. If a severe shock occurs, the contact of the individual with the source of electricity should be broken immediately. If possible, the electricity should be turned off by opening the switch controlling the circuit. The victim should not be touched directly until the circuit is broken. Then artificial respiration should be given at once if the victim has stopped breathing, and a physician called. The source of trouble in the wiring or appliance should be located and remedied as soon as possible. (54, page 9)

Many homes constructed over fifteen years ago have inadequate wiring to meet the needs of modern appliances. This results in overloading circuits which causes over-heating and electrical fires. The old wiring lacks the current carrying capacity because it is too small for the load. When electrical installations have loose or improperly

made connections in wires, switches, or sockets, dangerous heating or sparking may occur at these points even when currents are not excessive.

Electrical equipment is safe only when installed and maintained properly. Hazards are created when it is improperly used or when suitable safety measures are not employed. All electrical installations should be made in accordance with the specifications of the National Electrical Code and the National Electrical Safety Code. The equipment should be used and maintained in accordance with these codes, and when deteriorated by use, abuse, or age, should be replaced. The National Fire Protection Association's Handbook of Fire Protection presents a good explanation of the National Electric Code and the National Electric Safety Code.

> The National Electrical Code provides for the practical safeguarding of persons and of buildings and their contents, from electrical hazards arising from the use of electricity for light, heat, power, radio, signaling, and for other purposes.
>
> The National Electrical Code was first issued in 1897. It is revised every few years by the Electrical Committee of the National Fire Protection Association. Each issue is submitted to the American Standards Association for approval as an American Standard.
>
> This Code combines the joint experience and judgment of all parties interested in the use of electricity. It is truly a national standard and is probably the most extensively used and vigorously enforced code in existence.
>
> The National Electrical Safety Code provides rules for the installation and maintenance of electric supply stations, for the installation and maintenance of overhead and underground lines, for the installation and maintenance of electric utility equipment, for the operation of electric equipment and lines, for radio installations, and for electric fences. It has been approved as an American Standard and is issued by the Department of Commerce. (4, page 163)

Knowledge of wire sizes and ampere ratings helps to understand how an electrical circuit may become overloaded. The size of a wire is known by a number that refers to the diameter of the wire. The system works

inversely with the size of the wire; large wire has a small number, small wire has a large number. Each wire has a specific safe current-carrying capacity set below the current value, sufficient to melt the wire. When a wire is overloaded it is carrying current above its safe capacity. An overloaded wire will overheat and damage the insulation, and may ignite. An excessive number of appliances is one of the most common overloads.

Electric circuits should be protected from damage by fuses or circuit breakers. They protect the electrical circuits from excessively high currents which can cause fires or other hazardous conditions. A fuse contains a section of low melting-point metal that is calibrated to carry the rated current. If an excessive current passes through the fuse, due to a short circuit or an overloaded circuit, the fuse link melts and opens the circuit and thereby prevents damage.

The newer method of protecting a circuit is the circuit breaker. It performs the same function as the fuse but has the advantage that it does not need to be replaced when a short circuit or overload occurs. The National Education Association's booklet, Safe Use of Electrical Equipment, has a good simplified explanation of the circuit breaker.

> The circuit breaker contains a mechanism which functions as an electromagnet when an excessive current passes thru it. The magnet in turns snaps open or trips, thus opening the circuit by trigger action. When the circuit breaker opens as a result of electrical trouble, it is necessary first to find and then to eliminate the cause before any attempt is made to reset the circuit breaker. It can then be reset by operating a lever similar to a wall switch. (54, page 19)

The best method of extinguishing an electrical fire is to shut off the current. If this fails to extinguish the fire other extinguishing methods must be employed. For small fires, vaporizing liquid such as carbon tetrachloride, or carbon dioxide or dry chemical extinguishment

may be successfully used. These may be used on electrical equipment before the current is cut off because the extinguishing materials are nonconductors. For large fires, water may be applied with a fog nozzle.

Section 4

Heating Appliances and Chimneys

Heating appliances and chimneys are among the major causes of fires, particularly in the colder winter months when the equipment is operated at full capacity. These hazards are usually more difficult for the average person to detect. Every year there are thousands of heating plant fires.

A source of heat is a potential fire hazard unless protective action is taken to prevent dangerous temperatures in adjacent combustible materials. Long continued exposure to a moderate heat may cause a combustible material to ignite at temperatures below the normal ignition temperature. To prevent this condition from occurring, insulation may be effectively employed.

The National Fire Protection Association's Handbook of Fire Protection recommends several good, fire-safe methods of installing and operating heating equipment such as:

(a) Required clearances between the unit and combustible walls and combustible materials.
(b) Mountings to permit safe operation for long periods on the floors on which they are installed.
(c) Safe storage and handling of fuel and disposal of ashes.
(d) Connections to chimneys and vents where required.
(e) Proper chimneys or vents.
(f) Adequate air supply for the heater room for complete combustion. (4, page 85)

Defective chimneys are one of the leading causes of fires in buildings. A chimney should be made safe even if it requires substantial

repairs. One method of determining the condition of a chimney is to place the hand against it when it is in operation. If it is too hot for comfort the chimney is unsafe.

Chimneys should be built from the ground up, completely supported on approved masonry or self-supporting fire-resistive construction.

Section 5

Lightning

According to the Bureau of the Census about four hundred persons are killed and one thousand injured annually in the United States as a result of lightning strokes. Lightning is a frequent cause of fire and at times has led the list for value of losses in individual states. In the United States, lightning is most frequent in the southern states. The lightning strokes which do damage are those between a cloud and the earth.

To understand methods of controlling lightning, it is important to know the nature of lightning. A charge of one type of electricity will repel another of the same kind but will attract one of the opposite kind. The charges in the thunderstorms will accumulate in large quantities and develop potential differences of high voltage between the base of the cloud and the earth. The booklet, Protection of Buildings and Farm Property From Lightning, published by the United States Department of Agriculture, gives a good discussion of how lightning occurs.

> When the potential gradient along the lines of force between the accumulations of negative and positive charges becomes so intense that the insulating characteristic of the air breaks down, the air is punctured, and negative charges rush toward the positive ones in vast numbers, while a counterflow of positive charges tends to occur in the opposite direction. The rush of electricity between the charges heats the air to incandescence. This results in a giant spark called lightning. (52, page 3)

A flash of lightning is so intense it heats the air and causes it to expand rapidly. This expansion occurs along the path of lightning and causes the long roll of thunder.

To protect a building from lightning damage a metallic path must be provided from the highest part to the ground. This system is referred to as lightning rod protection. It conducts lightning discharges harmlessly to the ground thus preventing damage. The most important item in obtaining protection is a proper connection to the ground. A water pipe provides the best ground. If one is not available, pipes or rods must be buried deep in the soil.

If a person is struck by lightning the result is usually fatal. In some cases resuscitation may be used to revive the injured.

The National Fire Protection Association's Handbook of Fire Protection gives some good rules for personal protection against lightning.

> Persons inside a building properly equipped with lightning rods are safe. If the building is not so equipped, and does not have a steel frame, it is well to keep away from fireplaces, stoves, open doors, piping, and large metal objects.
>
> If compelled to remain out of doors, one should avoid isolated trees, wire fences, hilltops, large open spaces, and small sheds in an exposed location, and seek shelter in a cave, dense woods, a grove of trees, a deep ravine, or at the foot of a cliff. (4, page 22)

Section 6

Static Electricity

Sparks caused by static electricity may cause fires to start if they are near easily ignitible materials such as flammable vapors or gases, or combustible dusts. Sparks from static electricity are usually of short duration so do not produce enough heat to ignite most solid materials. It is, therefore, only necessary to take precautions against

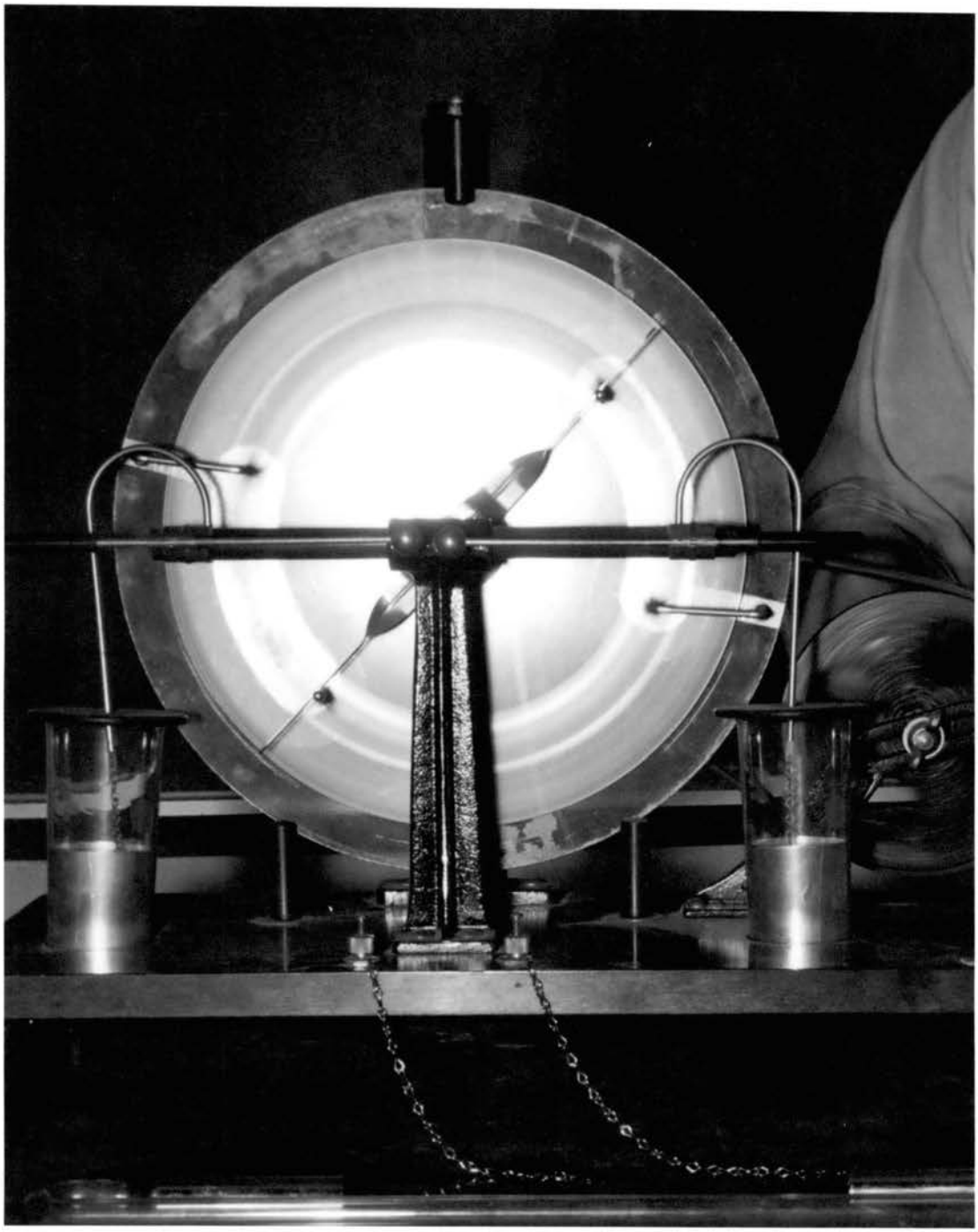

Figure 1

MACHINE FOR PRODUCING STATIC ELECTRICITY

static electricity where flammable gases, vapors, dusts, or other flammable materials are present.

The United States Department of Labor, Bureau of Labor Standards, in the booklet, Safety Subjects, gives an excellent discussion on static electricity.

> Static electricity is generated by friction or by the motions relative to one another of adjacent dissimilar materials. Sparking is prevented if the static is not allowed to accumulate. Accumulation can be prevented by grounding, humidification, and neutralizing. Grounding consists of connecting to earth or bonding together through low resistance connections, the surfaces on which the static would collect. (56, page 211)

Section 7

Explosive Dusts

The dust explosions were first detected in coal mines and flour and milling operations. The conditions necessary to cause an explosion are a fine, flammable dust suspended in the air, and a source of ignition. A dust explosion may occur in any situation where combustible dust is created. Over 28,000 industrial plants in the United States have hazardous dust explosions annually. This results in thousands of dollars worth of property damage and many lives lost.

The principle factor affecting explodibility of dust is the size of the dust particle. The finer the dust the easier it is to suspend in the air. Thus, more surface is exposed to the air. Moisture content does not affect explosive dust. If it is dry enough to form dust it will explode. The cause of the destructive force is due to the heat generated by the burning of the dust particles and the gases evolved by the decomposition of the dust. The gases after combustion develop extremely high pressure. These pressures range from one to seventy pounds

per square inch. Under these conditions one hundred pounds of flour could generate one-quarter million foot tons of energy.

Even the home is not exempt from dust explosions. These explosions are not common but they may occur from many sources, such as emptying a vacuum cleaner bag, spilling flour, and others.

Dust explosions may be prevented in industry if the building is constructed to prevent dust accumulating on ledges and overhead beams. A dust collection system will prevent scattering of the dust. All static sparks must be eliminated.

To give an idea of the large range of materials that are subject to explosion when suspended as dust, the following table from the National Fire Protection Association's Handbook of Fire Protection is included.

TABLE IV

DUST EXPLOSION PRESSURES

Type of Dust	Explosion Pressures (Pounds Per Square Inch)
Grain Dusts	37 to 46
Starches	38 to 78
Sugars	22 to 45
Woods	36 to 44
Sulphur and Lime Sulphur	31 to 41
Hard Rubber	36 to 57
Cork and other Dark Dusts	38 to 40
Metals	3 to 72
Fertilizers	34 to 51
Milk Powders	31 to 42
Cocoa	About 23
Flours	26 to 42
Meals	21 to 41
Spices	28 to 43
Drugs	28 to 43
Waxes and Soap Powders	31 to 60
Carbon, Coal, etc.	24 to 48
Plastics and Resins	44 to 69

(4, page 412)

Figure 2

DUST EXPLOSION DEMONSTRATION, FIRST STAGE

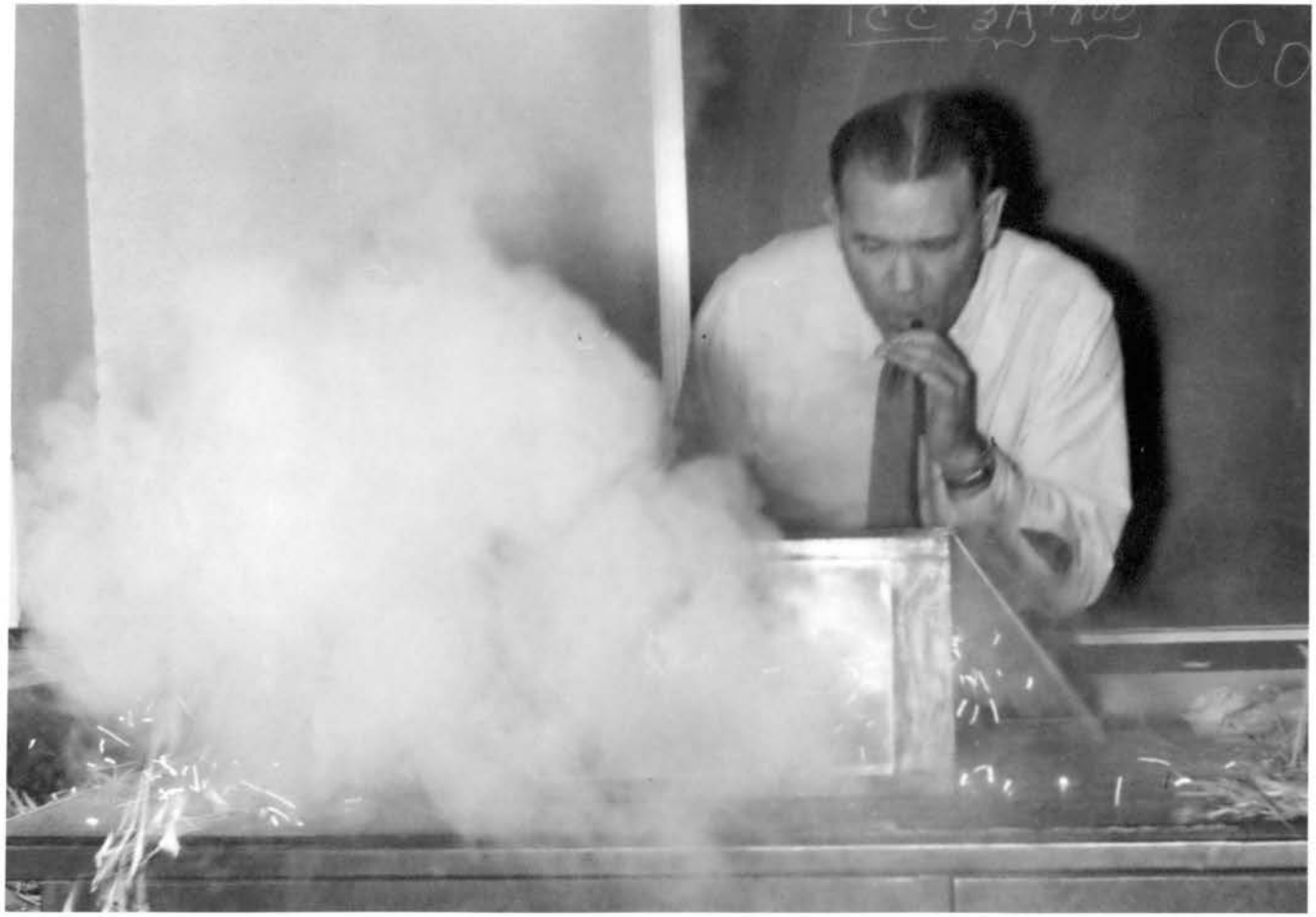

Figure 3

DUST EXPLOSION DEMONSTRATION, SECOND STAGE

Section 8

Spontaneous Heating and Ignition

Spontaneous ignition is one of the sources of ignition with which the average person is not familiar. It accounts for a fire loss of several thousands of dollars annually. To be able to control this type of fire hazard a complete understanding of causes and methods of prevention is important.

Certain materials have such an affinity for oxygen that they will under certain conditions combine with it slowly at ordinary temperatures. Oxidation results in gradual heating and if the heat is not drawn off the temperature rises. Oxidation will be accelerated and ignition results. The stronger the chemical attraction of the substance for oxygen the faster the reaction will be.

Moisture plays an important part in spontaneous heating. It is important in bacteria ferments which cause heating in vegetable matter.

The basic causes of spontaneous heating or ignition are relatively small, but the conditions under which the fundamental factors may operate to create an unsafe condition are many and varied. Spontaneous heating and ignition can involve complicated reactions, and the technical answers are many times unknown. It is not safe to assume that a substance is not subject to spontaneous ignition because it has failed to do so under a given set of circumstances. If these conditions change, even slightly, spontaneous ignition may occur.

In most cases the spontaneous heating is a slow chemical process involving a period of days or weeks during which the temperature slowly increases. Conditions conducive to spontaneous heating or ignition are usually found in large masses of material that are not too tightly pack-

ed together. Ventilation is an important factor in controlling spontaneous ignition. If the oxygen or air is excluded, there can be no oxidating. If there is an excess of air the heat will be dissipated too rapidly to cause combustion. The presence of moisture and temperature are important influences that control spontaneous heating.

The fire protection profession has classified materials that are subject to spontaneous heating and ignition into four general classifications. The first group consists of substances which are not under normal conditions subject to ignition. Calcium oxide, or unslaked lime as it is commonly called, is an example of this group. One pound of lime combined with water will produce 493 B.T.U.

The second group is composed of substances having an ignition point below the ordinary room temperature. An example of these materials are phosphorous and silicons. Most of the substances in this group are materials that are not likely to be encountered under normal conditions.

The third group is composed of combustible substances which may undergo sufficient oxidation at ordinary temperatures to reach the ignition point. This is the largest of the groups and includes vegetable oils, fats, certain metals in the finely divided state, and others too numerous to list.

The last group comprises organic combustible substances subject to microbial thermogenesis. This includes agricultural products such as hay, grain, and others. Spontaneous ignition of this type of material takes place in two or more stages. The first stage of the spontaneous heating is caused by fermentation. Further heating is caused by chemical oxidation.

Section 9

Flammable and Toxic Gases

The problems of controlling flammable gases are similar to those encountered in controlling flammable liquids. Any gas at a low temperature and high pressure becomes a liquid, and any liquid at sufficiently high temperature and low pressure becomes a gas.

Gases are usually stored in steel containers under pressure or, under some conditions, may be piped to the location where needed. The major problem or hazard is the possibility of the gases escaping in to the surrounding air and creating an explosive atmosphere.

The extinguishment of flammable gases is extremely difficult. The most effective method is to cut off the gas supply thus separating the fuel from the flame. The new dry powder extinguishers may combat a small-to-medium sized flammable gas fire. In some cases the extinguishment of the fire will not stop the flow of the flammable gas. The accumulation of the gas creates an explosive mixture, potentially more dangerous than the gas fire itself.

The Interstate Commerce Commission has a strict code to control the safe shipment of flammable and toxic gases. They require that the gases must be shipped in steel containers. The steel containers must be pressure tested periodically to ascertain their condition. All steel containers must have a pressure relief valve to prevent explosion in case of fire.

Toxic gases and vapors can be classified under three general classifications. Irritant gases are those causing injury to air passages or lungs and induce inflammation of the surfaces of the respiratory tract. Ammonia chlorine and nitrous fumes are examples of this type of gas.

The next group is asphyxiant gases. These gases act mechanically by excluding oxygen. Examples are carbon dioxide and ethane. The last group is called anesthetic gases and vapors. These produce anesthesia but do not cause serious after effects in long exposure to concentrations too low to cause unconsciousness. Examples are propane, gasoline, and kerosene.

The list of toxic and flammable gases in use today is increasing rapidly. Each gas has its own characteristic that must be understood in order to use it safely. Many persons are killed and thousands of dollars in property value are lost each year because the characteristics and dangers of flammable and toxic gases are unknown to them.

Section 10

Housekeeping

Good housekeeping is important in preventing the start and spread of fire. Rubbish and waste material of various types contribute to a large number of fires, and are frequently called a fire cause. This material does not cause fires but furnishes the fuel or tinder that may be easily ignited. Bad housekeeping may encourage spontaneous combustion when substances subject to rapid oxidation are not properly stored.

It is important to remove all combustible waste at regular intervals in order to prevent excessive accumulation. Metal receptacles with metal covers should be provided for this waste material. All combustible oils, cleaning compounds, and other combustible materials should be stored in metal containers. It is as important to the prevention of fires to maintain good housekeeping inside as well as out-of-doors.

The National Fire Protection Association's booklet, Preventing Home

Fires, presents some good ideas on housekeeping in the home.

1. Collect and remove rubbish. Regular disposal of waste-paper and other combustible waste materials is of utmost importance. Waste materials should be placed in covered metal containers and removed from the house for public collection at frequent intervals.
2. Clean up the basement, attic and closets. Old furniture, clothing and other useless articles that accumulate in these areas are fuel for fires and should be discarded.
3. Clean or discard dirty polishing and paint cloths. Many paints and household cleaning and polishing liquids contain oxidizing oils. Rags contaminated with these oils will heat spontaneously and ignite under certain conditions.
4. Police the yard. Cleanliness is as essential out-of-doors as within the home. Rubbish, dry weeds, grass and leaves are readily ignited and are a definite fire hazard. Removal of dry grass by burning is dangerous. Permission should be obtained from the fire department, and burning should only be done under favorable weather conditions and with ample personnel and extinguishing equipment available.
5. Keep the garage neat. Fires rarely start in clean garages. The family car is too costly and important an item to be stored in a garage cluttered with overflow storage from the house, bundles of papers, dried leaves, oily cleaning and polishing cloths. The floor should be kept free of oil and grease drippings. (50, page 21)

Section 11

Fireworks

Fireworks are responsible for many fires, loss of life, and injuries, particularly among the youth of the nation. The National Fire Protection booklet, Fireworks Are Dangerous, points out the ever-increasing dangers that fireworks create.

> America's greatest holiday, Independence Day, should be an occasion of rejoicing and cheer; instead it is a day of sorrow and tragedy for thousands each year. Overshadowing the celebration of national freedom are death, injury and destruction caused by fireworks. More than a century and a half has passed since the war for American independence. Of the heroes who fought in that war, 4,044 did not return from the battlefields; 6,004 returned permanently disabled. Since 1900, more Americans have lost their lives, celebrating with fireworks the victories of the Revolution, than were sacrificed in the war itself. Those maimed, crippled and blinded

> by these observances total more than 100,000. Traditionally, the Fourth of July is a day on which we annually sacrifice human health and happiness to our ancestors in orgies of fire and noise. No thoughts of American liberty or public welfare are reflected in them. They represent only childish indulgences and stupid adolescent irresponsibility. To safeguard our children from fire and explosion the year around and then turn them loose for a day or two of reckless and unrestrained indulgence with fireworks is worse than folly; it is a crime. (32, pages 2-3)

The only effective method of controlling the use of fireworks is to prohibit its general sale and use. Fireworks should be limited to authorized displays, and supervised by fire departments or other competent authorities.

Section 12

Fire Exits

Fire exits are the most important factor in reducing the loss of life in building fires. The National Fire Protection Association has prepared a Building Exit Code that is considered the final authority on the proper construction, arrangement, and use of exit facilities. This code has been approved as an American Standard by the American Standards Association.

Exit facilities must be constructed to take care of various conditions such as panic and over-crowded conditions. In addition, all public buildings where numbers congregate must have at least two exits. It is essential that there be more than one means of escape from every area so arranged that smoke or fire that could block one exit would not cut off other ways of escape.

According to the National Fire Protection Association a unit of exit is twenty-two inches. This is the space required for the free travel of one file of persons from a building. Exits are referred to

in terms of these units. For example, a three-unit exit would be sixty-six inches wide. The National Fire Protection Association Handbook of Fire Protection makes this statement:

> The rates of travel through exits vary widely with conditions. The NFPA Committee on Safety to Life has adopted the conservative figure of 45 persons per minute per unit of exit width on stairs, and 60 per minute through horizontal exits. (4, pages 583 and 585)

Exits should be clearly marked and easily accessible. Doors used for fire exits should never be kept locked while the building is occupied.

Panic hardware should be provided on all exit doors of schools and places of public assembly. The panic hardware is placed on the doors to provide a quick release for the doors in case there is a panic. The doors will open outward when pressure is applied. However, many persons not familiar with the proper use of this life-saving device will install chains on the doors in order to prevent their being opened. The National Fire Protection Association Handbook of Fire Protection gives a good discussion on the details of panic hardware.

> Panic hardware should be provided on the exit doors of schools, motion picture theatres and places of public assembly. Latches should release when pressure not to exceed 15 lbs is applied to the device in the direction of exit travel. Releasing devices may be bars or panels extending not less than two-thirds the width of the door and placed at heights suitable for the service required, - usually not less than 30 nor more than 44 inches above the floor. (4, page 591)

To insure the efficient and safe use of fire exits, fire drills should be held. To have an effective fire drill some suitable fire alarm system should be used. Public schools must have at least eight fire drills per year. The drills should be held at different hours of the day so they will not become routine.

In the booklet, Fire Exit Drills and Alarm Systems, published by

the National Fire Protection Association, the duties of the principal and teachers in the school fire drill are discussed.

> Every fire exit drill shall be an exercise in school management for principal and teachers. The chief purpose of every drill is complete control of the class so that the teacher will form its ranks quickly and silently, may halt it, turn it or direct it as desired. Great stress shall be laid upon the execution of each drill in a brisk, quiet and orderly manner. Running should be prohibited. In case there are pupils incapable of holding their places in a line moving at a reasonable speed, provisions should be made to have them taken care of by the more sturdy pupils, moving independently of the regular line of march. (24, page 19)

If the people of this nation would realize the importance of proper exits and drills, many lives would be saved each year. The history of most of the major fires indicates that blocked or inadequate exits have contributed to the large loss of life.

Section 13

Fire Extinguishers

A discussion of fire causes and methods of prevention would be incomplete without a section on fire extinguishers. Fire extinguishers are appliances having a limited supply of fire extinguishing material. Extinguishers are portable and may be carried or pulled to the scene of the fire. The term "first-aid" is applied to fire extinguishers by the fire protection profession because this type of fire fighting equipment is intended to be used only on fires in the early stage. To be effective they must be used on fires before they reach major proportions. Extinguishers will never substitute for larger fire fighting equipment. Under most conditions the fire department would be called when a portable extinguisher is used so that if the fire gets beyond the capacity of the extinguisher, additional equipment would be

immediately available. There are many cases where portable extinguishers were used to attempt to extinguish a large fire, and the fire department was called only when the fire was out of control. Many lives and millions of dollars in property value have been lost by ignoring the simple rule of calling the fire department when a portable fire extinguisher was used to combat a small fire.

Fire extinguishers, in some cases, are constructed to combat more than one type of fire but under no condition will any one type of extinguisher be effective on all types of fires. The proper type of extinguisher to install in a location depends on the type of hazard involved. The extinguishers should be installed so they are readily accessible and can be put into use with a minimum delay.

The National Fire Protection Association's Handbook of Fire Protection gives some good rules for first-aid fire extinguishers.

1. Persons that may have occasion to use any fire extinguisher should have knowledge of the proper way to use the device effectively.
2. The instructions of the manufacturer of the extinguisher as to charging, maintenance and operation should be followed exactly.
3. All extinguishers should be examined at least once a year to determine positively that they are in operating condition.
4. Frequent inspections should be made to determine that extinguishers are in their designated places, are readily accessible, have not been injured or tampered with, and that nozzles are not clogged. (4, pages 718-719)

To have a better understanding of the various types of fires that portable first-aid fire extinguishers are called upon to extinguish, fires are classified under three general classifications. The National Board of Fire Underwriters in their booklet, First Aid Fire Appliances, gives a good definition of the classification of fires.

(a) Class "A" Fires, defined as fires in ordinary combustible materials such as wood, cloth and paper where the "quenching-cooling" effect of quantities of water or solutions containing large percentages of water is most effective in reducing the temperature of the burning material below the ignition temperature and is, therefore, of first importance.
(b) Class "B" Fires, defined as fires in flammable petroleum products or other flammable liquids, greases, etc., where the "blanketing-smothering" effect of oxygen-excluding media is most effective.
(c) Class "C" Fires, defined as fires involving electrical equipment where the electrical nonconductivity of the extinguishing media is of first importance.
(33, page 4)

The location of fire extinguishers is important in giving the needed protection from fire. In certain locations where the hazard is light, extinguishers may be located so that a person will not have to travel more than one hundred feet from any point in order to reach the extinguisher. In ordinary occupancies where small fires of average severity may be encountered, the extinguishers must be not more than fifty feet from any point. In extra hazardous occupancies such as spray painting, dipping, and others, extinguishers for Class A, B, and C fires would be required.

Fire extinguishers that would be used on Class A fires use water as their principle extinguishing agent. Water has a high heat absorbing ability and it can absorb heat without adding to the fuel of the fire. When water is applied to a fire part of the heat which is being released by combustion is absorbed and the temperature of the whole area, including the temperature of the fuel, is reduced. If sufficient water reaches the burning material, the temperature is reduced to a point below the ignition temperature of the fuel and the fire goes out because of lack of heat.

Pump Tank Extinguishers. (Figure 4)

The simplest type of water extinguisher is the pump tank type. This extinguisher is manufactured in the two and one-half, and the five-gallon capacity. This type of extinguisher does not have a pressurized tank and has a maximum range of about thirty to forty feet. It has a hand-operated pump and has the advantage of being easy to operate and maintain, and it may be refilled at the scene of the fire. It is subject to freezing in cold weather, and the evaporation rate is high due to the loose fitting top. This extinguisher is effective primarily on Class A fires.

Soda-acid Extinguishers. (Figure 5)

The most common type of water extinguisher is the soda-acid extinguisher. The two and one-half gallon size is the most common. The chemicals used are sodium bicarbonate (baking soda) and sulphuric acid. The sodium bicarbonate is dissolved in water and the acid is held in a glass bottle in the top of the extinguisher. To operate, the extinguisher is inverted causing the acid and the sodium bicarbonate to mix and react chemically to produce carbon dioxide gas which builds up pressure and forces the water solution out of the extinguisher. This extinguisher has the advantage of low maintenance cost and requires only a small amount of equipment to recharge. It has a good range and is easy to operate. This type of extinguisher does have the disadvantage of not being able to be refilled at the scene of the fire so the duration of operation is short. It must be protected from freezing because the use of anti-freeze would disturb the chemical reaction between the soda and the acid. The extinguisher must be recharged annually because the chemicals will deteriorate. The extinguishing agent is more harmful to

Figure 4

PUMP TANK EXTINGUISHERS

Figure 5

SODA-ACID EXTINGUISHERS

other materials than plain water.

Water-filled Gas Pressure Extinguishers. (Figure 6)

The newer type water-filled gas pressure extinguisher is gradually replacing the older type soda and acid extinguisher. The gas pressure extinguisher comes in the two and one-half gallon size. The extinguisher is filled with plain water, and the pressure for expelling it from the extinguisher is supplied by a cartridge of carbon dioxide gas. When the extinguisher is inverted and bumped on the floor the gas retaining seal on the carbon dioxide cartridge is punctured letting the high pressure carbon dioxide gas into the extinguisher and expelling the water. This extinguisher has several advantages over the soda-acid type. It does not require annual recharging but when recharging is required a new carbon dioxide cartridge is installed and the extinguisher is refilled with water, and it is then ready to operate. This type extinguisher is easy to operate but has several disadvantages. The carbon dioxide cartridges are difficult to obtain in many parts of the country. There is also a possibility the cartridge may leak, making the extinguisher inoperative. This type extinguisher is effective primarily on Class A fires.

Foam Extinguishers. (Figure 7)

Foam extinguishers are particularly effective on Class B fires. They expel a foam of carbon dioxide bubbles which float on the surface of flammable liquids and excludes the oxygen thereby extinguishing the fire. The most common size is two and one-half gallons. Sodium bicarbonate and a foam stabilizing agent are dissolved in water and placed in the larger, outer container of the extinguisher. An alumi-

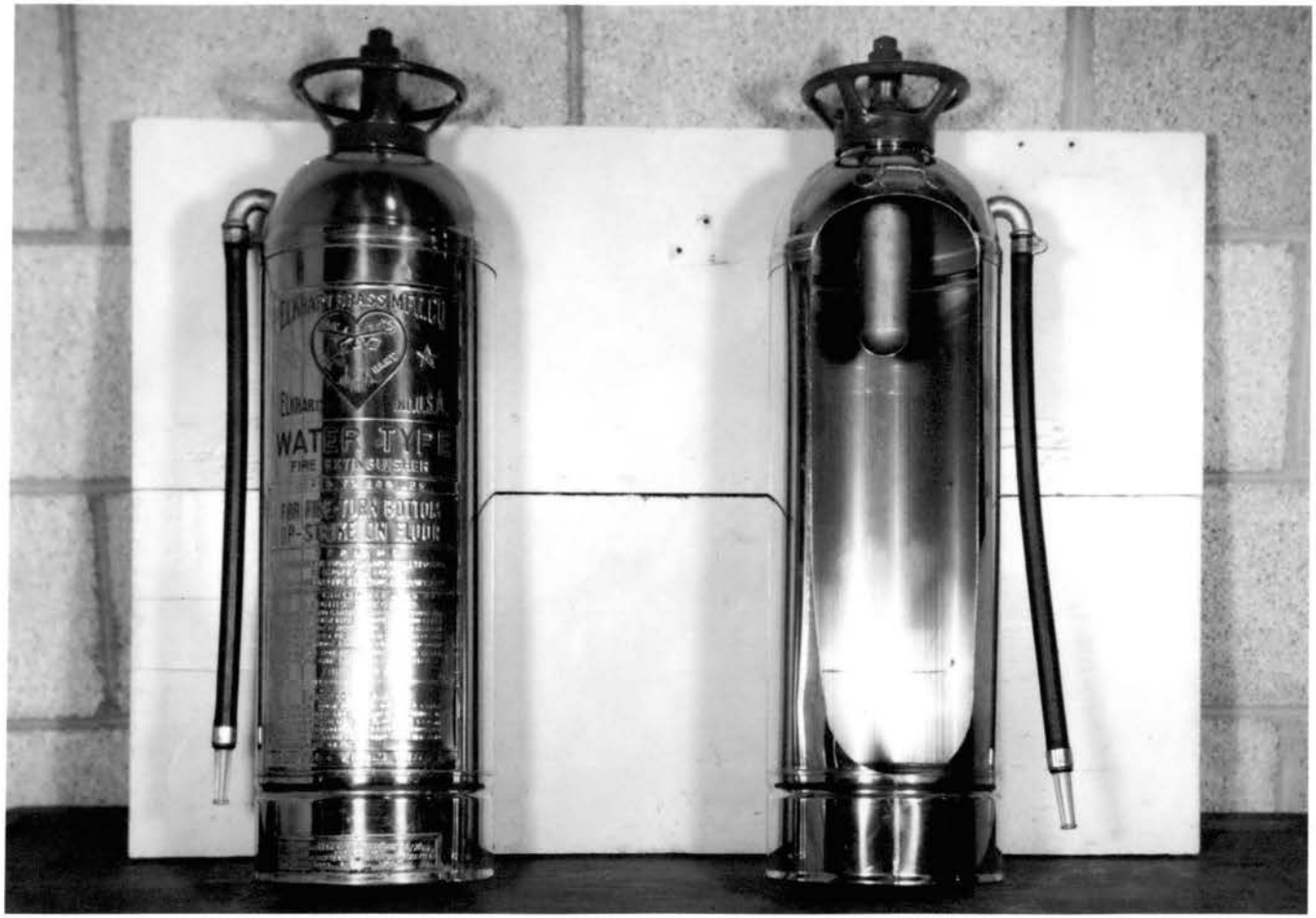

Figure 6

WATER-FILLED GAS PRESSURE EXTINGUISHERS

Figure 7

FOAM EXTINGUISHERS

num sulphate solution is placed in the smaller, inner container. When the extinguisher is inverted the chemicals mix, foam is produced, and pressure is created thus expelling the foam from the extinguisher. The effective discharge range is thirty to forty feet. The extinguisher must be recharged annually. The foam will damage or stain many materials that it comes in contact with. It is easy to operate and recharge.

Vaporizing Liquid Extinguishers. (Figures 8 and 9)

The vaporizing liquid extinguisher comes in three basic types. They are the small hand pump, the pressure type using carbon dioxide as the expelling agent, and the stored pressure type using compressed air as the expelling agent. The extinguishing agent used is an electrically nonconducting liquid composed largely of carbon tetrachloride and other components to lower the freezing point. When the liquid is played upon the fire, the liquid rapidly evaporates and forms a smothering blanket of vapor which excludes the air from the fire causing it to be extinguished. This type of extinguisher is effective on Class B and C fires.

Carbon Dioxide Extinguishers. (Figure 10)

The carbon dioxide extinguisher is most effective on Class B and C fires. It has the increased advantage over other extinguishers in that the carbon dioxide evaporates completely leaving nothing behind to be cleaned up. The extinguisher contains liquid carbon dioxide under a pressure of eight hundred to nine hundred pounds per square inch. It is basically a pressure container, a valve for releasing the gas, and a tube and horn to direct the flow. Carbon dioxide is a nonconductor and extinguishes the fire by excluding the oxygen. The extinguisher only requires weighing annually to ascertain if any carbon dioxide has been

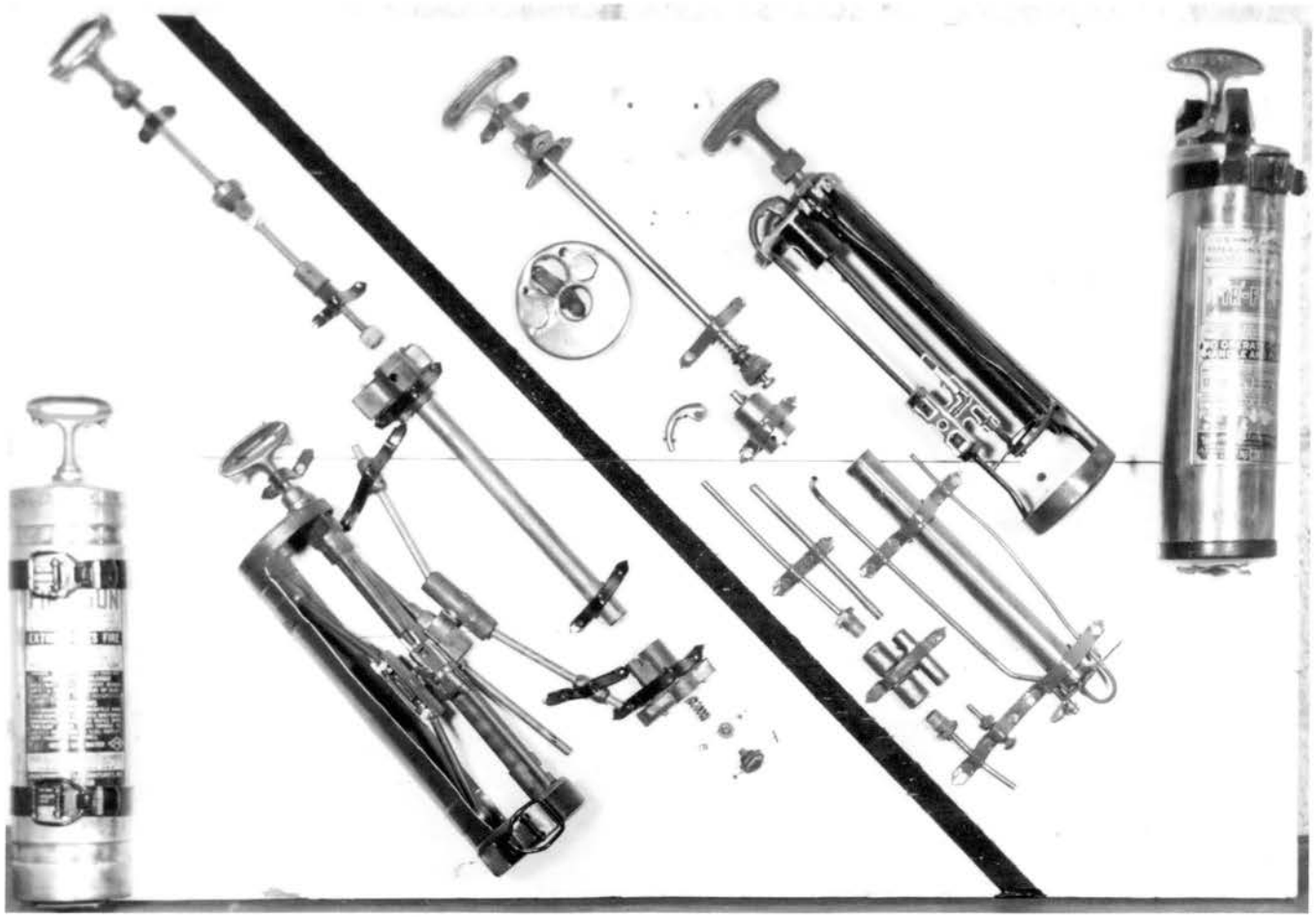

Figure 8

VAPORIZING LIQUID EXTINGUISHERS (PORTABLE HAND MODEL)

Figure 9

VAPORIZING LIQUID EXTINGUISHER (CART MODEL)

Figure 10

CARBON DIOXIDE EXTINGUISHERS

lost.

Dry, Chemical Gas-pressure Type Extinguishers. (Figure 11)

The dry, chemical gas-pressure type extinguisher comes in sizes ranging from four pounds to thirty pounds. The extinguishing agent is a dry chemical mixture of sodium bicarbonate and other materials to make it water repellent so that it will not cake in the extinguisher. The dry powder is expelled from the extinguisher by pressure from a carbon dioxide cartridge. This type of extinguisher is effective on Class B and C fires. The powder smothers and blankets the fire excluding the oxygen. Table V taken from the National Fire Protection Association's pamphlet, Put That Fire Out, gives some useful information on fire extinguishers.

The complete study of fire causes and methods of prevention would require many volumes. The author has selected the more important subject that would help the prospective teacher of fire protection education in preparing the course of study. The material selected was based upon the needs of the student to meet the objectives of fire protection education. The selection of the material was also guided by the author's personal experience in the field of fire protection.

The following chapter contains a summary of the study and the author's recommendations and suggestions for furthering the fire protection education movement.

Figure 11

DRY, CHEMICAL GAS-PRESSURE TYPE EXTINGUISHERS

TABLE V

FACTS ABOUT FIRE EXTINGUISHERS

Type of Extinguisher	Extinguishing Effect	USE ON FIRES OF			How to operate	Recharge	Protection from freezing
		Class A	Class B	Class C			
PLAIN WATER:							
Pump tank	Cooling	Yes	No	No	Pump by hand	After use	Approved anti-freeze chemicals may be added to the water
Gas cartridge	Cooling	Yes	No	No	Turn over, bump on ground	After use	
WATER AND CHEMICALS:							
Soda-acid	Cooling	Yes	No	No	Turn over	Annually	Keep in heated cabinet if building is unheated. NEVER add anti-freeze chemicals.
Foam	Cooling smothering	Yes	Yes	No	Turn over	Annually	
Loaded stream	Cooling and "oxidation inhibiting"	Yes	Yes	No	Turn over, bump on ground	After use	None required to -40° F.

TABLE V (continued)

Type of Extinguisher	Extinguishing Effect	USE ON FIRES OF			How to operate	Recharge	Protection from freezing
		Class A	Class B	Class C			
CHEMICAL:							
Vaporizing liquid	Smothering	Only small surface fires	Yes	Yes	Pump by hand	After use	None required to -50° F.
Carbon dioxide	Smothering	Only small surface fires	Yes	Yes	Open valve at top	After use	None required.
Dry Chemical	Smothering	Only small surface fires	Yes	Yes	Read directions on extinguisher	After use	None required.

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CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

The only possible way of reducing the needless loss of life and property, due to fire, is to start with the elementary students and educate them in the fundamentals of fire protection education. This educational process should continue through senior high school. With this training behind them, the high school graduate will be in a position to take a place in society as a well-informed citizen.

Early man found it essential to train the youth in some of the fundamentals of fire protection. He was directly dependent on fire for survival. For this reason, he treated fire with respect knowing that misuse of it could prove disastrous. Modern man is still dependent on fire but in this advanced civilization he has little direct contact with it. His essential needs are met by the use of electricity, gas, and other forms of energy, with little or no contact with the open flame. For this reason, modern man has lost the realization that fire can be one of the major destructive forces.

Summary of the Survey. The history of all the major fires throughout the ages has shown the need for improving training in fire protection. The survey indicates that the majority of the states of the union offer little or no courses in fire protection education. It is felt that this reflects the indifference of the average citizen toward fire protection. If the people of the various states were sincerely

interested, they would demand that this subject be offered.

The sample survey conducted at the Stillwater Junior High School points out clearly that the youth of this nation are in desperate need of training in fire protection. Without this training no student graduating from the public educational system can be considered as having a complete education.

The proposed course of study presented in this survey is intended to guide the prospective teacher of fire protection education. The material presented is not inclusive but merely covers the essential information. The objectives of fire protection education should be flexible enough to meet local conditions.

The important items of fire protection are presented in a non-technical manner that could be easily understood by a person with a minimum of training in fire protection education. The items are presented as a reference guide to help the teacher prepare the lessons to present to the students.

Conclusions. The conclusions of this survey indicate that most of the states that do offer limited instruction in fire protection education do not have separate courses on the subject. The subject is frequently incorporated in some other course such as conservation, safety, or other courses in this area. The survey clearly points to the inadequate instruction offered the students of the nation in fire protection education.

Recommendations. It is recommended that the citizens of the country demand that the school authorities offer courses in fire protection education. To insure that all school districts offer courses

on this subject, it should be incorporated in the state required curriculum. The community should obtain the most highly qualified teacher and actively support the program. A program of this type can only succeed if it is skillfully carried out and the proper results obtained.

Recommendations for Further Study. Recommendations for further study would be to conduct surveys to determine the type of material offered by the various states that teach fire protection education. In addition, a national survey of the level of fire protection knowledge that average students possess for the various grade levels would prove helpful in preparing a course of study to better meet the needs of the students. A study of new developments in the fire protection profession in the United States and foreign countries that could be incorporated in the school program would be desirable.

The study of fire protection education should prove challenging to the teacher as well as the students, and they should continually strive to improve the effectiveness of the program. The program would prove worthwhile if it could result in the saving of a single life from fire. The danger of fire can never be eliminated but through proper training many lives can be saved.

A SELECTED BIBLIOGRAPHY

A. Books

1. Bird, Eric L., and Docking, Stanley J., Fire in Buildings, Van Nostrand Company, Inc., New York, 1935, 295 pages.

2. Blake, Roland P., Industrial Safety, Second Edition, Prentice Hall, New York, 1953, 374 pages.

3. Center for Safety Education, New York University and a Committee for Fire Prevention Education, Fire Prevention Education, compiled by a committee with Herbert J. Stack, Chairman. Self published, 1942, 355 pages.

4. Crosby, E. U., Fiske, H. A., and Forster, H. W., N.F.P.A. Handbook of Fire Protection, National Fire Protection Association, Boston, Massachusetts, 1952, 1544 pages.

5. Dunshee, Kenneth H., Engine! Engine! A Story of Fire Protection, Published by Harold V. Smith for The Home Insurance Company, New York, 1939, 63 pages.

6. Ericson, Emanuel E., Teaching the Industrial Arts, The Manual Arts Press, Peoria, Illinois, 1946, 384 pages.

7. Encyclopedia, The American, "Fire Protection", Vol. 11 (30 Vols.), American Corporation, New York and Chicago, Illinois, page

8. Encyclopedia, Britannica, "Fire Protection", Vol. 9, Encyclopedia Britannica Inc., Chicago, London, Toronto, page 268.

9. International City Managers' Association, Municipal Fire Administration, Fourth Edition, Chicago, Illinois, 1946, 667 pages.

10. Kearney, Paul W., I Smell Smoke, Simon and Schuster Publishing Company, New York, 1955, 214 pages.

11. Minton, A. S., Dictionary of Fire Technology, Chantry Publications, Ltd., London, 1952, 97 pages.

12. Mitchell, Helen, Fire Fighters, The Story of Fire Protection, Past, and Present, Row, Peterson and Company, New York, 1941, 36 pages.

13. National Fire Protection Association, Fire and The Air War, edited by Horatio Bond, Chief Engineer, National Fire Protection Association, International, Boston, Massachusetts, 1951, 262 pages.

14. White, Jack, Fire! Fire!, Frederick Muller, Ltd., London, 1944, 168 pages.

B. Periodicals

15. Kearney, Paul, "Is Your House a Firetrap?" The Saturday Evening Post, Vol. 229 (August 25, 1956), pages 19, 20, 21, 78.

16. "Public Service Guide to Fire Prevention," Reader's Digest, 1952, 41 pages.

C. Bulletins and Pamphlets

17. Brown, James D., Fire Prevention in School Shops, Thesis, Summer 1952, 74 pages.

18. Build a Fire-safe Home, National Fire Protection Association, 1945, 4 pages.

19. Construction of School Buildings and Improvement of Existing Structures, National Board of Fire Underwriters, Chicago, Illinois, 1937, 22 pages.

20. Correlated Program on Fire Prevention for Use in All Departments of Junior High Schools, Atlanta Public Schools, Atlanta, Georgia, Revised March 1937, 42 pages.

21. Douglas, R. J., and Thompson, C. E., Some Studies in Chemical Fire Hazards, Oklahoma Agricultural and Mechanical College, Stillwater, Oklahoma, November 1949, 17 pages.

22. Electrical Equipment, Safety Education Data Sheet No. 9, National Safety Council, 1946, 4 pages.

23. Fire Defense, National Fire Protection Association, Boston, Massachusetts, 1941, 221 pages.

24. Fire Exit Drills and Alarm Systems, National Fire Protection Association, Boston, Massachusetts, 1951, 22 pages.

25. Fire Prevention and Protection as Applied to the Public and Parochial Schools, National Board of Fire Underwriters, Chicago, Illinois, 1935, 18 pages.

26. Fire Prevention and Safety Reference Manual for Classroom Teachers, Greensboro Fire Prevention Bureau, Greensboro, North Carolina, no date, 46 pages.

27. Fire-Safe School Buildings, National Board of Fire Underwriters, Chicago, Illinois, 1954, 21 pages.

28. Fire Safety For Junior High Schools, National Education Association, Washington, D. C., 1950, 33 pages.

29. Fire Safety For Senior High Schools, National Education Association, Washington, D. C., 1951, 24 pages.

30. Fire Safety For Teachers of Intermediate Grades, National Education Association, Washington, D. C., 1950, 33 pages.

31. Fire Safety For Teachers of Primary Grades, National Education Association, Washington, D. C., 1950, 25 pages.

32. Fireworks are Dangerous, National Fire Protection Association, Boston, Massachusetts, 1956, 4 pages.

33. First Aid Fire Appliances, National Board of Fire Underwriters, Chicago, Illinois, No. 10, July 1956, 54 pages.

34. Flammable Liquids, National Board of Fire Underwriters, Chicago, Illinois, 1956, 42 pages.

35. Flammable Liquids in the Home, Safety Education Data Sheet No. 12, National Safety Council, 1946, 4 pages.

36. How Many Fire Alarms a Year?, National Fire Protection Association, Boston, Massachusetts, no date, 4 pages.

37. How to Prevent Fire in the Home, North America Companies, Insurance Company of America, Indemnity Insurance Company of North America, Philadelphia Fire and Marine Insurance Company, no date, 22 pages.

38. Incinerators, National Board of Fire Underwriters, Chicago, Illinois, No. 82, 1953, 15 pages.

39. Installation of Extinguishers, National Board of Fire Underwriters, Chicago, Illinois, No. 10, 1948, 10 pages.

40. It's Dangerous, National Fire Protection Association, Boston, Massachusetts, no date, 4 pages.

41. Living and Growing Through Safety Protection From Fire Hazards in the Home-School- Community, For Use in the Elementary Public Schools, published by the Atlanta Public Schools, Atlanta, Georgia, 1937, 19 pages.

42. Loree, L. F., First Steam (Fire) Engine in America, Council of Newcomen Society, New York, 1929, 12 pages.

43. Manual of Fire-Loss Prevention of the Federal Fire Council, Third Edition, U. S. Government Printing Office, Washington, D. C., 1955, 187 pages.

44. Matches, Safety Education Data Sheet No. 2, National Safety Council, Washington, D. C., 1945, 2 pages.

45. Moulton, Robert S., National Fire Code, National Fire Protection Association, Boston, Massachusetts, 1948, 607 pages.

46. National Fire Protection Association Quarterly, Vol. 17, No. 1, The South Carolina School Fire, published by A. M. Schoen, Boston, Massachusetts, July 1923, 96 pages.

47. National Fire Protection Association Quarterly, Vol. 30, No. 4, pages 299-311, Boston, Massachusetts, April 1937.

48. National Fire Protection Association Quarterly, Vol. 18, No. 3, pages 219-223, Boston, Massachusetts, January 1925.

49. President's Conference on Fire Prevention, Report of the Committee on Fire Prevention Education, U. S. Government Printing Office, Washington, D. C., May 6, 7, and 8, 1947, 29 pages.

50. Preventing Home Fires, National Fire Protection Association, Boston, Massachusetts, 1950, 23 pages.

51. Program of Fire Prevention in Schools, Manual for Teachers, Commonwealth of Pennsylvania, Department of Public Instruction, Bull. 399, Harrisburg, Pennsylvania, 1951, 179 pages.

52. Protection of Buildings and Farm Property From Lightning, U. S. Department of Agriculture, Washington, D. C., No. 1512, 1950, 32 pages.

53. Put That Fire Out!, National Fire Protection Association, Boston Massachusetts, 1950, 4 pages.

54. Safe Use of Electrical Equipment, National Education Association, Washington, D. C., 1951, 35 pages.

55. School Fires, Safety Education Data Sheet No. 47, National Safety Council, Chicago, Illinois, 1950, 6 pages.

56. Safety Subjects, U. S. Department of Labor, Bureau of Labor Standards, Washington, D. C., Bul. 67 (Revised), 1953, 270 pages.

57. Selected Demonstrations for Use in Fire Safety Education, National Fire Protection Association, Boston, Massachusetts, 1938, 28 pages.

58. Standards of the National Board of Fire Underwriters for the Installation of Sprinkler Systems, National Board of Fire Underwriters, Chicago, Illinois, No. 13, August 1955, 140 pages.

59. Stop Fires, Save Jobs, National Board of Fire Underwriters, Chicago, Illinois, no date, 15 pages.

60. Suggested Fire Prevention Ordinance, National Board of Fire Underwriters, Chicago, Illinois, 1930, 81 pages.

61. Suggested Guide for Safety Instruction in Primary Grades, American Red Cross, (5-55), 4 pages.

62. Suggested Guide for Safety Instruction in Upper Elementary Grades, American Red Cross, 1447, (5-55), 4 pages.

63. Tested Activities for Fire Prevention Committees, Federal of Mutual Fire Insurance Companies, Chicago, Illinois, 1956, 84 pages.

64. The Teacher Fireman Team, National Education Association and National Fire Protection Association, Washington, D. C., 1953, 21 pages.

65. There's No Place Like Home for Fires, National Fire Protection Association, Boston, Massachusetts, 1950, 4 pages.

66. Trapped by Fire, National Fire Protection Association, Boston, Massachusetts, 1945, 4 pages.

67. Unit of Work on Fire Prevention For Use in the Senior High Schools, Atlanta Public Schools, Atlanta, Georgia, 1937, 54 pages.

68. Viles, M. E., School Fire Safety, U. S. Government Printing Office, Washington, D. C., 1951, 12 pages.

69. Watch Out For Fire Too at Christmas Time, National Fire Protection Association, Boston, Massachusetts, 1956, 4 pages.

70. Winter Fire Hazards, National Fire Protection Association, Boston, Massachusetts, 1945, 4 pages.

71. Your Fire-safe Home, National Board of Fire Underwriters, Chicago, Illinois, no date, 5 pages.

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