AMERICA BURNING

The Report of The National Commission on Fire Prevention and Control

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The Commission on Fire Prevention and Control has made a good beginning, but it cannot do our work for us. Only people can prevent fires. We must become constantly alert to the threat of fires to ourselves, our children, and our homes. Fire is almost always the result of human carelessness. Each one of us must become aware—not for a single time, but for all the year—of what he or she can do to prevent fires.

—President Richard M. Nixon
September 7, 1972

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AMERICA BURNING

The Report of
The National Commission on
Fire Prevention and Control

NATIONAL COMMISSION ON FIRE PREVENTION AND CONTROL

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May 4, 1973.

The PRESIDENT,
The White House,
Washington, D.C.

DEAR MR. PRESIDENT:

Transmitted with this letter is the final report of the National Commission on Fire Prevention and Control.

The report is based on almost 2 years of work by the Commission. We believe it presents the most significant fire safety problems, and the greatest opportunities for fire loss reduction, in the United States today. The vast majority of the Commission agreed with all fundamental issues.

Over $11 billion of our resources are wasted by destructive fires each year. Additionally, 12,000 people are killed and tens of thousands of persons are scarred physically and emotionally by fire. Recommendations are presented in this report which, if implemented, will significantly reduce this great toll.

The recommendations emphasize prevention of fire through implementation of local programs. This is in keeping with the very nature of the fire problem which is felt hardest at the community level. Additionally, the recommendations emphasize built-in fire safety-measures which can detect and extinguish fire before it grows large enough to cause a major disaster.

We know our great Nation has the resources and technology presently available to lessen the destructive impact of fire. We believe a continuing Federal focus on the fire problem is a necessity. It is the earnest hope of the members of this Commission that this report will provide helpful guidelines for local, State, and national efforts to reduce the life and property loss by destructive fire in the United States.

Sincerely,

Richard E. Bland

RICHARD E. BLAND,
Chairman.

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INFORMATION UPDATE

Since AMERICA BURNING was originally published in 1973 some of the statistical information presented has become outdated either through actual change, better data, or new methods of estimation.

The changes are:

Approximately 6,200 people die in fires in this country each year, including fire fighters, not 12,000, as stated in the cover letter, and on pages x, 1 and 53. (Source: U. S. Fire Administration (USFA) Estimate, Based on the National Fire Incident Reporting System (NFIRS) Data).

About 100,000 people are injured in fires annually, including fire fighters, not 300,000 as given on pages x, 1. (Source: USFA Estimate, based on NFIRS Data).

Direct property loss is currently estimated at $10,400,000,000 not 2,700,000 as given on page 2. (Source: USFA Estimate, based on NFIRS Data).

The cost of treating a severly burned individual can cost well over $100,000 rather than $60,000 as given on page 11. (Source: Office of Health Care Finance, U. S. Department of Health & Human Services).

Clothing fire deaths range between 150 and 200 annually, not 3,000 as shown on page 67. (Source: National Center for Health Statistics, U. S. Department of Health & Human Services).

Fire deaths resulting from motor vehicle accidents are estimated at 650 to 750 annually, not 4,260 as shown on page 85. (Source: USFA Estimate, based on NFIRS Data).

U. S. Fire Administration
September, 1989

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WHAT THIS REPORT IS ABOUT

The striking aspect of the Nation's fire problem is the indifference with which Americans confront the subject. Destructive fire takes a huge toll in lives, injuries, and property losses, yet there is no need to accept those losses with resignation. There are many measures--often very simple precautions-that can be taken to reduce those losses significantly.

The Commission worked in a field where statistics are meager, but its estimates of fire's annual toll are reliable: 12,000 American lives, and more than $11 billion in wasted resources. Annual costs of fire rank between crime and product safety in magnitude. These statistics are impressive in their size, though perhaps not scary enough to jar the average American from his confidence that "It will never happen to me." In a Washington hearing the Commission heard testimony from the parents of a J-year-old boy who caught fire after playing with matches. They described the horror of the accident, the anxiety while awaiting doctors' reports, the long weeks of separation during the critical phases of treatment, the child's agony during painful treatment, the remaining scars, and the many operations that lie ahead. Multiply that experience by the 300,000 Americans who are injured by fire every year, and consider, as we did, that it could easily happen in your own family; then the Nation's fire problem becomes very immediate and very fearsome.

During its deliberations the. Commission uncovered many aspects of the Nation's fire problem that have not received enough attention-often through indifference, often through 'lack of resources. It became clear that a deeper Federal involvement was needed to help repair the omissions and help overcome the indifference of Americans to fire safety.

We felt strongly that fire prevention and control should remain primarily local responsibilities. Local governments-through codes and fire safety laws, and through heavy investments in fire department personnel and equipment-have shouldered the major burden of protecting citizens from fire and should continue to do so. Those governments appreciate special local conditions and needs more fully than an arm of the Federal Government would be able to do. Roles for the Federal Government, in the Commission's view, are appropriately limited to lending technical and educational assistance to State and local governments, collecting and analyzing fire information, regulating the flammability of materials, conducting research and development in certain areas, and providing financial assistance when adequate fire protection lies beyond a community's means.

To the extent these functions are being performed at all, they are scattered among the Federal agencies. The Commission feels there should be an entity in the Federal Government where the Nation's fire problem is viewed in its entirety, and which encourages attention to aspects of the problem that have been neglected. This same entity would serve as the conduit for the inter-governmental cooperation that is needed to combat the Nation's fire problem. Accordingly, the Commission recommends the establishment of a United States Fire Administration in the Department of Housing and Urban Development where the primary Federal responsibility exists with local government. The US. Fire Administration would not swallow all the ongoing programs of research and action, but would supplement them for the sake of a more coherent effort to reduce the Nation's fire losses. In this way, the special abilities of each Federal agency would be utilized.

The following summarizes briefly some of the aspects of the Nation's fire problem which the Commission studied and which the U.S. Fire Administration, through encouragement or direct sponsorship, could help to solve :

- *There needs to be more emphasis on fire prevention.* Fire departments, many of which confine their roles to putting out fires and rescuing its victims, need to expend more effort to educate children on fire safety, to educate adults through residential inspections, to enforce fire prevention codes, and to see that fire safety is designed into buildings. Such efforts need to be continuously evaluated, so that the Nation can learn what kinds of measures arc most effective in reducing the incidence and destructiveness of fire.
- *The fire services need better training and education.* Training for firefighters and officers ranges from excellent, as in some large cities, to almost non-existent, as in many rural areas. Better training would improve the effectiveness of fire departments and reduce firefighter injuries. Better education provides the key to developing leadership for fire prevention.
- *Americans must be educated about fire safety.* Most destructive fires are caused by the careless actions of people, largely through lack of concern and ignorance of hazards, Many fires caused by faulty equipment rather than carelessness could

be prevented if people were trained to spot the faults before it's too late. And many injuries and deaths could be prevented if people knew how to react to a fire, whatever its cause.

- *In both design and materials, the environment in which Americans live and work presents unnecessary hazards.* The hazards of flames have been studied and regulated to some extent, but recognition of the hazards of smoke and toxic gases has come belatedly. Ironically, efforts to make materials fire-retardant may have increased the life hazard, since the incomplete combustion of these materials often results in heavy smoke and toxic gases. While materials and products that present unreasonable hazards should be banned, the Commission believes the major emphasis should be on a labeling system (to be developed by the Consumer Product Safety Commission) for materials and products, so that consumers, at the time of purchase, know what risks are involved. The impact of new materials, systems, and buildings on users and the community should be assessed during design stages, well before use. Careful analysis and filing of a fire safety effectiveness statement should permit recognition of faults before tragedy strikes.
- *The fire protection features of buildings need to be improved.* There is a need for automatic fire extinguishing systems in every high-rise building and every low-rise building in which many people congregate. Economic incentives for built-in protection are not available today and should be provided. Many communities are without adequate building and fire prevention codes, and many nursing homes and other facilities for handicapped citizens are without adequate fire protection. Perhaps most important, Americans need to be encouraged to install early-warning fire detectors in their homes where most fire deaths occur.
- *Important areas of research are being neglected.* The state-of-the-art in firefighting, in treatment of burn and smoke victims, in protecting the built environment from combustion hazards, points to the need for a major expansion of research and development in these areas. Progress in most of these areas is hindered by a lack of fundamental understanding of the behavior of fire and its combustion products.

To encourage solutions to these problems, the Commission has made recommendations in this report to a number of bodies: the American public, the President, Congress, State and local governments, industries, professional organizations, and agencies of the Federal Government. It has also outlined important tasks for the proposed US. Fire Administration:

- to develop a comprehensive national fire data system, which will help establish priorities for research and action ;
- to monitor fire research in both the governmental and private sectors, to assist the interchange of information, and to encourage research in areas that have been neglected;
- to provide bloc grants to States so that local governments may develop comprehensive fire-protection plans, improve firefighting equipment, and upgrade education of fire service personnel:
- to establish a National Fire Academy for the advanced education of fire service officers and for assistance to State and local training programs;
- to undertake a major effort to educate Americans in fire safety.

The Commission has also recommended the reinforcement of programs in other agencies, including: detection and alarm systems for federally assisted and insured housing, and built-in protection loan insurance (Department of Housing and Urban Development) ; extension of burn treatment facilities (Department of Health, Education, and Welfare) ; burn and smoke research (National Institutes of Health) ; rural fire protection (Department of Agriculture) ; and further research in the engineering-based technology programs of the National Bureau of Standards.

If these efforts are carried out we predict a 5 percent reduction in fire losses annually until the Nation's losses have been halved in about 14 years. A 5 percent reduction in resource losses alone would amount to $350 million in the very first full year, which is considerably more than the annual costs of the projected Federal involvement of $153 million annually, as discussed in Chapter 19.

The public members of the Fire Commission represent the Nation's firefighters, insurers, fire equipment manufacturers, testing laboratories, and other groups in the private sector concerned with reducing the Nation's fire losses. We reached the conclusion that there must be a significant Federal effort only after careful consideration of the shortcomings of present efforts to reduce fire losses in the United States.

Many of the Commissioners have devoted their careers to improving the Nation's fire record. We have become accustomed to public indifference to the fire problem. But we hold the hope that this attitude can be changed. It is our wish that this report will provide a turning point, by reaching-if only indirectly-the conscience of millions of Americans.

ASTER

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THE NATION'S FIRE PROBLEM

Fire! Hundreds of thousands of times a year, that shout reverberates down hallways or the inner recesses of the mind as Americans come face to face with one of the most dreaded causes of death and disfigurement. Ironically, for every American who will confront flames or choking smoke this year, there are hundreds who give the threat of fire not a moment's thought, who will continue to take only the slightest precautions to guard against fire.

Fire is a major national problem. During the next hour there is a statistical likelihood that more than 300 destructive fires will rage somewhere in this Nation. When they are extinguished, more than $300,000 worth of property will have been ruined. At least one person will have died. Thirty-four will be injured, some of them crippled or disfigured for life.

Annually, fire claims nearly 12,000 lives in the United States. Among causes of accidental death, only motor vehicle accidents and falls rank higher, Most of fire's victims die by inhaling smoke or toxic gases well before the flames have reached them.

The scars and terrifying memories live on with the 300,000 Americans who are injured by fire every year. Of these, nearly 50,000 lie in hospitals for a period ranging from 6 weeks to 2 years. Many of them must return, over and over again, for plastic and reconstructive surgery. Many never resume normal lives.

The price of destructive fire in the United States amounts, by conservative estimate, to at least $11.4 billion a year (see Table 1-1) . Beyond calculation are the losses from businesses that must close and from jobs that are interrupted or destroyed.

In an America that has only lately grown conscious of its ecological responsibilities, there is a need also to develop an awareness of fire's role as one of the greatest wasters of our natural resources.

Appallingly, the richest and most technologically advanced nation in the world leads all the major industrialized countries in per capita deaths and property loss from fire. While differing reporting procedures make international comparisons unreliable, the fact that the United States reports a deaths-per-million-population rate nearly twice that of second-ranking Canada (57.1 versus 29.7) leaves little doubt that this nation leads the other industrialized nations in fire deaths per

capita. Similarly, in the category of economic loss per capita, the United States exceeds Canada by one-third.

Table 1-1. Estimated Annual U.S. Fire Costs

Property loss	$2,700,000,000
Fire department operations	2,500,000,000
Burn injury treatment	1,000,000,000
Operating cost of insurance industry	1,900,000,000
Productivity loss	3,300,000,000
Total	$11,400,000,000

Among those paying most heavily for this poor record are the Nation's firefighters. Theirs is the most hazardous profession of all. Their death rate is 15 percent greater than the next most dangerous occupations, mining and quarrying. In 1971, the injury rate for firefighters was 39.6 per 100 men-far higher than that of any other profession. That same year, 175 firefighters died in the line of duty; an additional 89 died of heart attacks and 26 are known to have died of lung disease contributed to by the routine smoke hazard of their occupation.

While many firefighters, particularly in smaller departments, do not have adequate opportunities for training, the fact is that the best training available does not obliterate the risks that firefighters must take in the line of duty. Every fire is a gamble with the unknown, a venture into a unique complex of combustible materials and fire dynamics.

Risk substitutes for certainty, intuition for firm knowledge. As the Committee on Fire Research of the National Research Council pointed out in 1959, "growth in our knowledge of how to cope with fire has not kept pace" with the growth of the fire problem. This basic force of nature has attracted little interest in the scientific community, and its elementary characteristics remain mysteries. To cite an unanswered practical question, posed in the Committee's 1969 report: "When should the top of a building be opened by firefighters to minimize spread; when does opening it increase the spread?" Every fire chief, of course, has to answer that question many times at many fire scenes, based on his training and experience. But little fundamental research has been performed to make one chief's answer better informed than another's.

America's poor fire record, and its failure to marshal enough scientific and monetary resources to improve the record, concerns those who work in the field of fire protection. Firefighters, individually and through such organizations as the International Association of Fire Fighters and the International Association of Fire Chiefs, have been outspoken on the need to improve fire protection. The insurance industry, fire equipment manufacturers, fire research scientists, code officials, government administrators : Each of these groups has sought to improve the Nation's performance in combating the fire problem. For three-quarters of a century, the National Fire Protection Association, representing a variety of interests, has compiled an excellent record in public education and in the setting of standards for fire safety.

Causes of America's Fire Problem

The efforts of individuals and organizations in the, fire protection field have run against the twin tides of ignorance and indifference-tides which contribute substantially to the extraordinary magnitude of the fire problem in the United States.

While genuine economic problems often stand in the way of deeper investment in fire protection, lack of understanding of fire's threat helps to account for the low priority given fire protection. And while those who have survived a fire never forget its destructive potential, for most Americans fire appears a remote danger that justifies indifference.

But indifference exists where it is least excusable. For example, there are those in the fire services who are unaware of the technological state-of-the-art in their field. There are fire department administrators who pay lip service to fire prevention and then do little to promote it. The public shares their unconcern, for in the public's image-an image which firefighters share-the fire department is a heroic-proportioned battalion of people rescuers and fire suppressers, not a professional corps of fire preventers.

Designers of buildings generally give minimal attention to fire safety in the buildings they design. They are content, as are their clients, to meet the minimal safety standards of the local building code. Often both assume that the codes provide completely adequate measures rather than mini-

The death rate from fire among children under five is three times that of the rest of the population.

ma1 ones. In other instances, building owners and occupants see fire as something which will never happen to them, as a risk they will tolerate because fire prevention measures can be costly, or as a risk adequately balanced by the provisions of a fire insurance policy. Product designers, too, give little thought to possible toxic or fire-aggravating effects should their products become involved in a fire.

The Federal Government also has been largely indifferent to the fire problem. The Federal programs that exist (some of which are excellent) touch only small portions of the total fire problem.

Lastly, the American public is indifferent to and ignorant of the heavy toll of destructive fire. The problem has not reached the American consciousness with the same force as, for example, the far less lethal problem of air pollution. In contrast, poliomyelitis, which in the peak year of 1952 killed about a third as many people as died by fire in that year, has been virtually eradicated because of the public attention it received. Moved by the sight of crippled children, Americans dug into their pockets to support research and control programs to attack the polio problem. Little concern has come forth regarding the grave losses to the Nation by fire.

Indifferent to fire as a national problem, Americans are similarly careless about fire as a personal threat. There is an old saying in the fire protection field, to the effect that fires have three causes: men, women, and children. It takes the careless or unwise action of a human being, in most cases, to begin a destructive fire. In their home environments, Americans live their daily lives amid flammable materials close to potential sources of ignition, Though Americans are aroused to issues of safety in consumer products, fire safety is not one of their prime concerns. Few private homes have fire extinguishers, much less fire detection systems. Too few multiple-family dwellings and institutions have automatic equipment for extinguishing fires. And often when fire strikes, ignorance of what to do leads to panic behavior and aggravation of the hazards, rather than to successful escape.

Fire accidents due to carelessness occupy a vast middle portion of the spectrum of man-caused fires. At one end of the spectrum are the fires that are caused by the relatively helpless in our society-the very young, the old, and the handicapped. At the other end of the spectrum' are the fires set deliberately.

The death rate from fire among children under 5 and the elderly over 65 is three times that of the rest of the population. Though together these young and old make up only 20 percent of the American population, they account for 45 percent of the fire deaths.

In contrast to the fire accidents difficult to prevent are the fires set on purpose. In 1971, among fires reported to the National Fire Protection Association, about 7 percent were classified as incendiary; an additional 17 percent were "of unknown origin." Arsonists pick expensive targets : Among the 1971 fires in which losses exceeded $250,000,27 percent were classified as incendiary, another 47 percent as of unknown origin. In many large cities, fire chiefs believe that almost half of all fires in their experience have been deliberately set.

Fire has always held an attraction for demented thrillseekers. That fire is a way of attacking authority is indicated by the fact that in 1971 26 percent of the large-loss school fires and 44 percent of the large-loss church fires were incendiary.

First cousin to the maliciously set fire is the false alarm. In large cities, it is not uncommon for false alarms to constitute 20 to 30 percent of all calls for service (excluding ambulance requests), In Boston false alarms in 1972 occurred on the average of one every 45 minutes.

Not all deliberately set fires stem from malice or thrillseeking; an increasing number are set for profit. A number of building owners have been setting their properties afire to reap insurance benefits and tax write-offs in excess of market value, delinquent taxes, or demolition costs. In the troubled city of Newark, N.J., where the number of vacated buildings increased by 300 percent between 1965 and 1971, the number of fires in these structures increased by over 500 percent. There is evidence that the Fair Access to Insurance Requirements (FAIR) plan, designed to provide insurance on properties not qualified under normal company standards, is being used by some owners of deteriorating buildings to burn for profit.

Social Changes Affecting the Fire Problem

That there is not an all-out war against arson and false alarm again reflects national indifference toward destructive fire. Partly because of this national indifference, and partly because rapid changes in American society have created other problems, our approaches to 'the fire problem are not adequate to meet the needs of today. They suffer what anthropologists call "cultural lag"; our methods of handling the fire problem are attuned to the America of yesteryear-not to contemporary needs, much less to future needs. They have changed slowly, while America has been changing rapidly.

It doer; not follow that the increasing lag has led to increasingly inadequate fire protection. For, as the National Fire Protection Association has documented, our Nation's dollar losses from fire (adjusted for inflation) have not worsened materially over the years. The percentage of national wealth destroyed by fire has actually been decreasing by a very small extent. What follows is that, if the Nation's fire record is to improve significantly, our methods of protection against fire losses must respond, more effectively than they have thus far, to important changes that have been taking place in America.

One such trend is the increasing urbanization of the United States. Half a century ago, about half our population lived in urban areas. Today, about three out of four Americans do. While distances from firehouse to fire site are generally shorter in urban areas than in rural areas, clogged city streets often add costly minutes to response time when a fire breaks out. Intensive use of land in urban areas means bigger buildings, which create complex problems of fire safety. More people are concentrated and exposed to the threat of fire or its toxic smoke. High-rise buildings, though hallmarks of urban progress, are special nightmares to firefighters. Upper floors are hard to reach, and it is difficult to vent heat and smoke in modern air-conditioned buildings.

Urbanization has created social problems-the migration of the poor into cities, the expansion of ghettos, the rising expectations of minorities which are being met only laggardly---that have affected the magnitude of fire losses. The most rundown neighborhoods, where dilapidated buildings are tinder boxes, are where the poor are forced to live.

The crowded apartment houses and tenement buildings often reflect total indifference to fire safety, because landlords see no benefit in decent, long-term upkeep of their properties. Tenants must often warm their rooms with dangerous portable or make-shift heaters because central heating is inoperable or nonexistent, Discontent in the ghettos can breed problems for fire departments: in the form of riots, set fires, false alarms, and harassment of firefighters.

The movement of America's minorities for recognition of their rights has forced upon us the realization that fire departments are, in general, manned disproportionately by white Americans. Racial minorities are under-represented in the fire departments in nearly every community in which they live.

Another social change pertinent to the Nation's fire protection is the increased militancy of municipal employees. Firefighters have seen what unionization has done for the salaries and benefits of other city employees. They have seen conditions improve for other municipal departments while they have been bypassed. Quite understandably they have petitioned for higher wages and better working conditions. In the past half-dozen years, in some of the larger cities, they have also undertaken job actions-slowdowns, massive sick leaves, and even a few strikes-which jeopardized fire protection for the community.

The increasing militancy of firefighters meets, head on, another important change: the increasing financial plight of local governments. Especially in the large cities, but not exclusively there, governments are facing static or declining tax revenues, increasing costs, and hence the need to question all city expenditures and to place greater emphasis on the efficient operation of municipal services. Local governments are demanding better long-range planning and better utilization of manpower and equipment. They are pressing fire. departments to produce sophisticated cost-benefit justifications for their expenditures. They are demanding that fire departments operate more efficiently without jeopardizing the public's safety from fire.

This makes pertinent a further trend in our society: the increasing application of management science to solve these local problems. Local governments are calling in research experts to re-

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Working amid flame, smoke, and collapsing buildings, firefighters pursue the most hazardous profession of all.

view municipal services with the same systems approaches that have worked so well in industry.

Still another important change bearing on the Nation's fire protection is the so-called technological revolution. Our man-made environment is being filled with new materials and new products about which little is known concerning their hazard potential when they burn. New chemicals and other hazardous materials are being produced, shipped, and used around the country. Often fire departments are unaware of these dangers in their midst, nor have they experience in dealing with them. Some of these new products produce toxic gases while burning that are far more deadly than the kinds of smoke firefighters are accustomed to.

About the technological revolution it can also be said that it has hardly touched the fire services. In comparison with such fields as aviation, large-scale construction, and electronics, the technology of firefighting has been relatively stagnant. Ironically, while flammability standards have been imposed on children's sleepwear, no such standards exist for firefighters' "turnout" coats.

Prevention Needs Priority

Response to important social changes is a key to improving the Nation's record in fire protection. A consideration of equal importance is the need to change priorities in the field of fire protection. Currently, about 95 cents of every dollar spent on the fire services is used to extinguish fires; only about 5 cents is spent on efforts-mostly fire prevention inspections and public education programs-to prevent fires from starting. Much more energy and funds need to be devoted to fire prevention, which could yield huge payoffs in lives and property saved. (While fire prevention efforts would lower the incidence of fire and, hence, might lower the costs of fire suppression, it would be essential to support fire suppression services at current levels until a marked reduction in fires had been documented.)

The Role of This Commission

The National Commission on Fire Prevention and Control was funded by Congress in 1971 to study the fire problem and make recommendations "whereby the Nation can reduce the destruction of life and property caused by fire in cities, suburbs, communities, and elsewhere."

The enabling legislation (see Appendix I), without limiting the Commission's scope, defined a number of areas for our study. We rephrase them here as questions: What technological advances, construction techniques, and improved inspection procedures would prevent fires most effectively? Is the Federal Government doing all it should to lessen the danger of destructive fires in federally assisted housing and in the redevelopment of the Nation's cities and communities? Are existing methods for suppressing fires adequate? Are the procedures for recruiting personnel adequate? Are firefighters receiving sufficient training? Are current fire communication techniques adequate? Does firefighting equipment need improvement? Standardization? Are there administrative problems affecting the efficiency or capabilities of fire departments? Finally, how should responsibilities for reducing fire losses be distributed among Federal, State, and local governments?

In pursuit of answers, the Commission has held hearings in five widely scattered cities, heard the testimony of more than 100 witnesses filling thousands of pages of transcript, and spent countless hours learning and deliberating in both formal and informal sessions. In addition, special studies have been prepared by Commission staff and by a dozen experts from government and private groups exploring particular problems and their alternative solutions. Over 130 position papers were filed with the Commission advocating different approaches to the fire problem.

How Fire Safe Could We Be?

Congress established this Commission out of a conviction that- present rates of losses in life and property by fire in the United States need to be reduced. The question naturally arises: What level of losses is acceptable? For us to set as a goal a total end of destruction of life and property by fire would be unrealistic.

An acceptable goal, however, can be based on the allocation of an appropriate part of our national resources. The goal of saving lives, of course, is inherently worthy of pursuit. But one way of defining a minimal appropriate level of Government investment is to find that level which will maximize the payoff, in tax revenues, from

In some large cities, nearly a third of the engine responses are to false alarms-not always set by children

both lives and property saved. Another is to compare the severity of the fire problem relative to other important problems competing for resources, such as crime and death on the highway.

This Commission believes that a reduction of 50 percent in deaths, injuries, and property losses is quite possible within the next generation. This can be attained by a declining balance reduction of 5 percent per year. To that end, we have recommended a number of actions that can be taken by government and industry at little or no cost. But we also see the necessity, if that goal is to be achieved, of Federal assistance averaging $150 million annually over the next 5 years.

This 5 percent drop per year in fire losses over the next 5 years could accomplish :

- A total saving of 8,000 lives;
- A total reduction of injuries by 210,000;
- Property losses saved totaling $1.9 billion;
- Hospital and medical costs lowered by $85 million. (Under the present system of subsidized medical care, this might save the Federal Government $30 million.)

Federal Action is Needed

While the Commission's stated goals for fire reduction might be argued, it is indisputable that the Federal Government must at *some* cost help the Nation attack the fire problem if any significant reduction in fire losses is to be achieved. It must help devise educational programs so that Americans can prevent fires and cope with them

when they occur. It must help provide better training and equipment for firefighters. It must assist an accelerated and coordinated effort in research on the fire problem.

Accordingly, **the Commission recommends that Congress establish a United States Fire Administration to provide a national focus for the Nation's fire problem and to promote a comprehensive program with adequate funding to reduce life and property loss from fire.**

Details of the responsibilities we envision for the U.S. Fire Administration, and of its relations to existing Federal agencies, will emerge in subsequent recommendations. It is sufficient to say here that we would not want the proposed U.S. Fire Administration to swallow or supplant ongoing programs of research and action. The function of the Administration would be to help guide efforts, by keeping local, State, and Federal agencies informed of related efforts in both the private and public sector, encouraging cooperation, and promoting interest in areas of research or action that have been neglected.

Many of our recommendations call for augmented programs and new efforts by State and local governments. We recognize that many of these governments are unable to undertake new expenditures in fire protection without Federal help. Thus we envision the new Fire Administration as also being a grant-making agency in the field of fire protection, similar in concept to the Law Enforcement Assistance Administration.

The Need for Fire Data

One other function of the proposed U.S. Fire Administration deserves special emphasis : to help place solutions to the fire problem on a firmer foundation of scientific data.

Time and again-in listening to testimony, in studying the fire problem, in searching for solutions-this Commission found an appalling gap in data and information that effectively separated us from sure knowledge of various aspects of the fire problem. The lack was not total; the National Fire Protection Association, for example, collects valuable data on a voluntary basis from the fire services. Other valuable studies have been conducted by the National Bureau of Standards, the Committee on Fire Research of the National Research Council, and a number of insurance companies. But in many areas of the fire problem, proposed solutions rest on limited experience, shaky assumptions, and guesswork,

Cost-effective solutions to the fire problem will require a lot more data-broader in scope and deeper in detail than now exist. This is not a one-time need. Continuing data collection will be needed to measure the effectiveness and impact of new programs in fire protection and to identify emerging problems in the field.

Accordingly, **the Commission recommends that a national fire data system be established to provide a continuing review and analysis of the entire fire problem.** In addition to filling in current gaps in understanding of the fire problem, the system could ensure against duplication of effort by data-gatherers in both the public and private sectors. (In this connection we note that the National Fire Protection Association has developed the most broad-based and thorough data system; it would be appropriate for the Government to utilize the NFPA surveys as part of its larger effort in data-gathering.) Since the proposed U.S. Fire Administration could not perform its functions effectively without adequate data, it is altogether logical to house responsibility for administering a national fire data system within that Administration.

2

LIVING VICTIMS OF THE TRAGEDY

Fire kills. But fire has its *living* victims too: those who grieve the loss of loved ones killed by fire, those who manage to get out alive (while others close to them may not have), those who are left homeless or jobless or impoverished because of fire. The victims most poignant to consider are those maimed and disfigured by burn injuries. About half of these victims are children. Their scars, psychological as well as physical, often last a lifetime.

Among the illnesses and injuries that require long hospitalization, few are as traumatic as severe burns. The frightening circumstances of the injury, the long isolation from family, the feeling of helplessness, the continuous pain during recovery, the cosmetic operations that fall far short of expectations, the stigma of disfigurement--all contribute to a deep despondency that impairs recovery.

Often the patient is not the only one to endure psychological wounds. If the victim is a child, parents are likely to feel guilty for what has happened. Some parents find it impossible to accept and love a disfigured child. Nurses, who must inflict considerable pain on the patient over long periods of treatment, are subject to stress. In many burn care facilities there is a 100 percent turnover in nursing staff every 6 months.

The Long Road to Rehabilitation

The average hospital stay for a burn victim is over three times that of medical and surgical patients. An individual's hospital stay and later treatment can add up to $60,000 or more. (Reducing fire accidents, therefore, should be among the top priorities in the national effort to control health care costs.)

If the severely burned patient is fortunate, he or she will be treated in one of a dozen "burn centers" in the United States. In these special facilities, patients receive expert medical and surgical care from the outset, and physical and emotional rehabilitation through the long weeks of recovery. The process can be described through an actual case history:

It is the fall of 1970. Eight-year-old Susan and her older brother are playing in their garage. An unsealed can of gasoline tips over and, an instant

later, the pilot light of the nearby water heater ignites the vapor. In the flash fire and explosion, Susan's face and arms are badly burned, her dress set afire. She is rushed to a local emergency room, where she is treated for shock. Because the burns are extensive and predominantly third degree (the most severe kind), the doctors arrange for her admission to a burn center, 100 miles away.

There, intensive care begins. The wounds are cleaned and treated with antibacterial agents; intravenous lines are inserted; and a catheter is placed into the bladder to collect urine, which serves as a guide to the fluid needs of the body. Nurses in the intensive care unit keep a close watch, lest she go into shock or turn blue from smoke inhalation injury. Later she is anesthetized and wheeled into surgery, where a doctor begins debridement, the cutting away of burned tissue. The wounds are covered with antibiotic dressing, and Susan is given penicillin to ward off infection.

More debridement operations follow. Doctors and nurses continue to monitor closely Susan's fluid management and the functioning of her vital organs. On the third day, having survived the acute phase in which fluid imbalances can be fatal, Susan is taking food by mouth, and the intravenous lines are removed. For the first time, she complains of pain from her wounds.

On the seventh day there is a marked change in Susan. She refuses food, she is unruly. But the staff members have seen this kind of behavior often, for it signals the onset of guilt or fear of parental reaction about the accident. After conferring with staff, Susan's parents discuss the accident, assuring her they were concerned but not angry. Her mood soon brightens. But there will be other periods of irritability. Having less than the normal amount of skin is a depressing condition, and it is common for patients to be difficult, irascible, or complaining until the wounds heal or are successfully skin-grafted.

During the second and third weeks, operations are performed to remove further dead skin. As *so* often happens, the wounds become infected and for a time her life is in jeopardy. In the fourth week grafting operations begin-four in all, staged at 1O-day intervals. Between operations, Susan undergoes intensive physical therapy, since grafted skin tends to contract and hamper the body's movements. Despite all precautions, contractures of her neck, right wrist, and right hand begin to develop, drawing her chin toward her chest, her wrist backward, and her fingers out of joint. Though Susan is discharged after 80 hospital days, the deformities already developing grow worse, despite frequent physical therapy and splinting. She is readmitted twice during the ensuing 4 months for reconstructive surgery.

More plastic surgery awaits her. It will never totally erase the scars. And despite the efforts of the psychiatrist on the burn center staff, Susan still carries psychological scars. She is introspective, self-conscious, and overly dependent on her father.

ONE CHILD'S ORDEAL

"Todd was burned on both sides. He kept rejecting grafts for 5 weeks. They would leave him in one position as long as the graft seemed to take, then they would turn him over and try grafting another area."

He would stay in that position?'

"Yes, for 2 or 3 weeks.

"During the time that he was in the unit, he exhibited the typical signs of withdrawal. He wouldn't speak to us. He would turn his face to the wail. . . .

"We were able to touch him through plastic gloves only. We were not able to touch him at all until 10 weeks, until he was out on the floor, and even then we had to wear a mask. . . .

"After he was out he had to learn how to walk all over again. Being bedridden for that amount of time, he was extremely weak. He was very bent over at this particular time because the folds were burned right around his hips and in the groin area, As time went on the scar tissue was contracting, pulling down. . . .

"This [indicating brace] Todd wears for his nap and also at nighttime. When he first came home, we tried everything to keep this on his legs. We had restraints made ourselves. We would spend an average of an hour a night getting him into this splint, because it was very important that his knees remain straight so that his hip would be flat. . . .

"[Before applying ointment] you have to take the scab off that forms, so that the wound will not heal on the outside and stay open underneath. So you have to pick this off your child's skin while he screams and cries, 'Please, Mommy, don't hurt me."

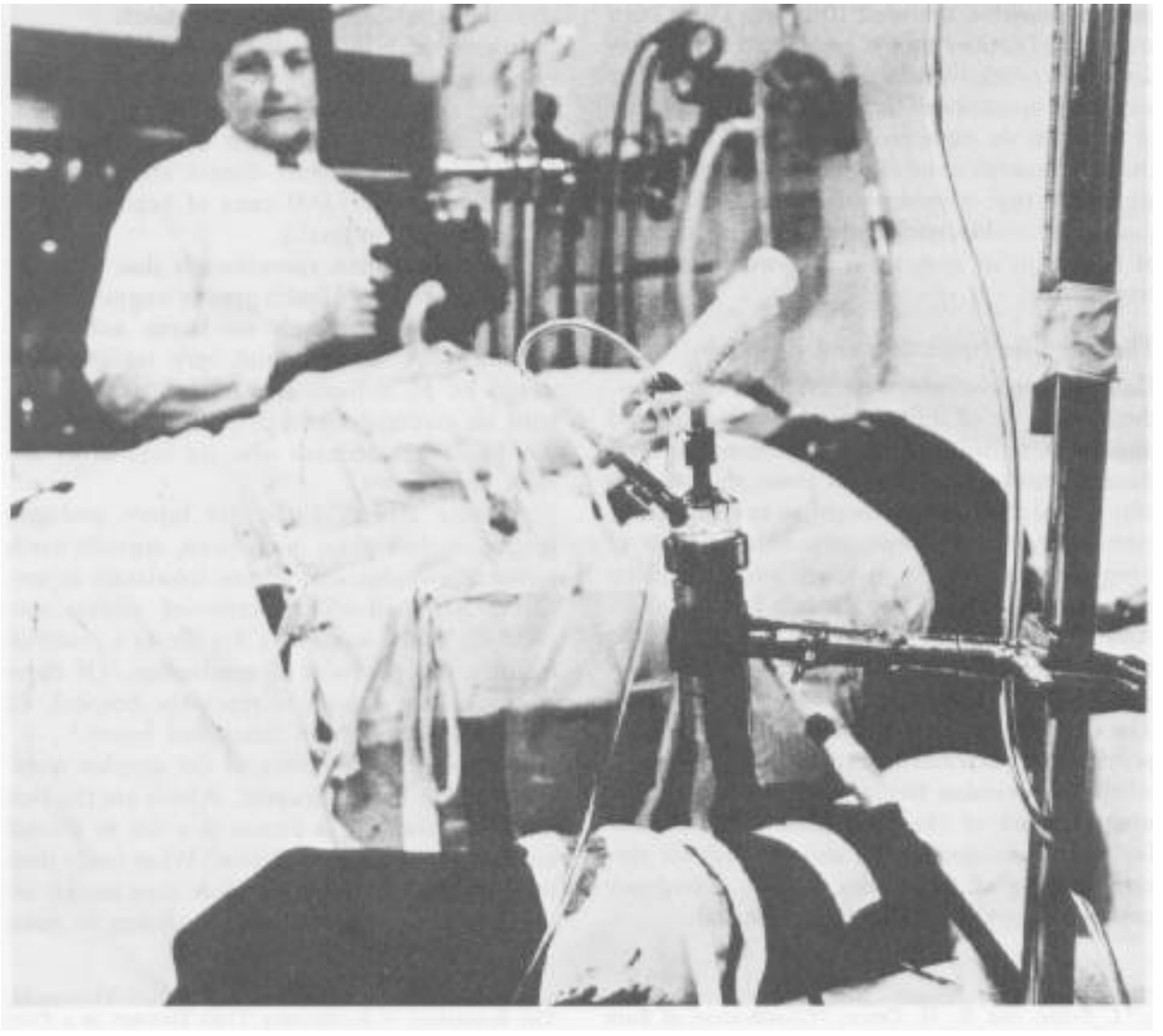
From testimony to the Commission (February 15,1972) of parents of a 3-year-old bum victim.

Most Treatment is Inadequate

At present, fewer than 100 of the 6,000 general hospitals in the United States provide specialized burn care. Together these few hospitals treat only 8 percent of the Nation's patients with serious burn injuries.

Of the burn centers like the one that treated Susan, there are only 12 in the United States. These are separate hospital facilities with research and teaching programs as well as patient care. Typically, a burn center employs a large staff of general, orthopedic, and plastic surgeons, specially trained nurses and physical therapists, psychologists, psychiatrists, social workers, and others who mount a coordinated effort to treat all aspects of the patient's problem.

The difference between the treatment in burn centers and the treatment in most hospitals can be a matter of life or death. For example, of all the 2-year-olds treated in hospitals for second- and third-degree burns over 45 percent of the body, only one in ten survives. Of the small proportion of these children who are lucky enough to be treated in burn centers, more than six out of ten survive. Among 8-year-olds suffering second- and third-degree burns over 60 percent of the body, the national survival rate is only two out of ten. Among patients in this category treated in burn centers, half survive.



Only 8 percent of the Nation's seriously burned patients receive treatment in specialized hospital facilities.

Not only do burn centers save more lives than most hospitals, they also expend more effort on rehabilitation-psychological and vocational as well as physical.

There is obviously a great need for additional burn centers in the United States. There is also a need for less elaborate facilities to handle less serious cases. Presently there are 20 hospitals in the Nation with "burn units"--that is, specialized facilities of at least four beds used only for burn victims. An additional 46 hospitals are known to have "burn programs"-a staff of burn injury specialists but not separate facilities.[1]

The Commission recommends that Congress enact legislation to make possible the attainment of 25 burn units and centers and 90 burn programs within the next 10 years. These burn treatment facilities should be located where they are most needed-that is, close to populations with high incidence of burn injuries. The number of facilities we have recommended is far fewer than the number some experts say are needed, but we believe that other measures we recommend in this report could significantly reduce the number of burn injuries and, hence, the need for costly treatment.

The Need for Specialists and Research

If these added facilities were available tomorrow, they would be of little value without dedicated physicians, nurses, and other professionals to staff them. Considering physicians alone, the hard reality is that there is little incentive to specialize in burn treatment. A disproportionate number of burn patients come from lower income families who cannot afford to pay the bills for treatment. And that treatment is expensive. Clearly, the needs of burn patients will never be adequately met unless the treatment is heavily subsidized. **The Commission recommends that Congress, in providing for new burn treatment facilities, make adequate provision for the training and continuing support of the specialists to staff these facilities. Provision should also be made for special training of those who provide emergency care for burn victims in general hospitals.**

The most experienced specialists in burn treatment are quick to admit that the state-of-the-art is limited by lack of knowledge. For example, understanding of the fluid shifts and transfusion requirements in burn patients is limited. There is uncertainty among medical scientists about the best techniques for warding off infection, a major killer of burn patients. How burn injuries affect a patient's immunity is another matter little understood.

In fiscal year 1972, the National Institutes of Health spent about $1.25 million on research connected with burns and their treatment. The Social Rehabilitation Service of the Department of Health, Education, and Welfare spent an additional $380,000 on special studies having to do with the rehabilitation of burn patients.

In contrast, NIH spent $34 million on renal disease research, $16 million on studies of hypertension, and $5.5 million on hepatitis research. (Renal diseases claim about 9,000 lives every year; hypertensive heart disease about 16,000; there are about 54,000 cases of hepatitis every year, few of them fatal.)

The Commission recommends that the National Institutes of Health greatly augment their sponsorship of research on burns and burn treatment. A minimal and very realistic goal would be $3 million, which would correspond with an investment of $10 per year for each of the 300,000 Americans who are injured by fire each year.

Another aspect of the fire injury problem, largely overlooked for many years, urgently needs research investigation : smoke inhalation injury. More than half--53 percent-of victims succumbing at the scene of a fire die a a result of inhaling the products of combustion. Of those who live long enough to reach the hospital, 42 percent succumb from inhalation injury.'

Surprisingly, even some of the simplest questions remain to be answered. Which are the best simple methods for a person in a fire to protect himself from smoke inhalation? What really does the damage to the lungs? How does smoke inhalation affect the ability of the lungs to resist

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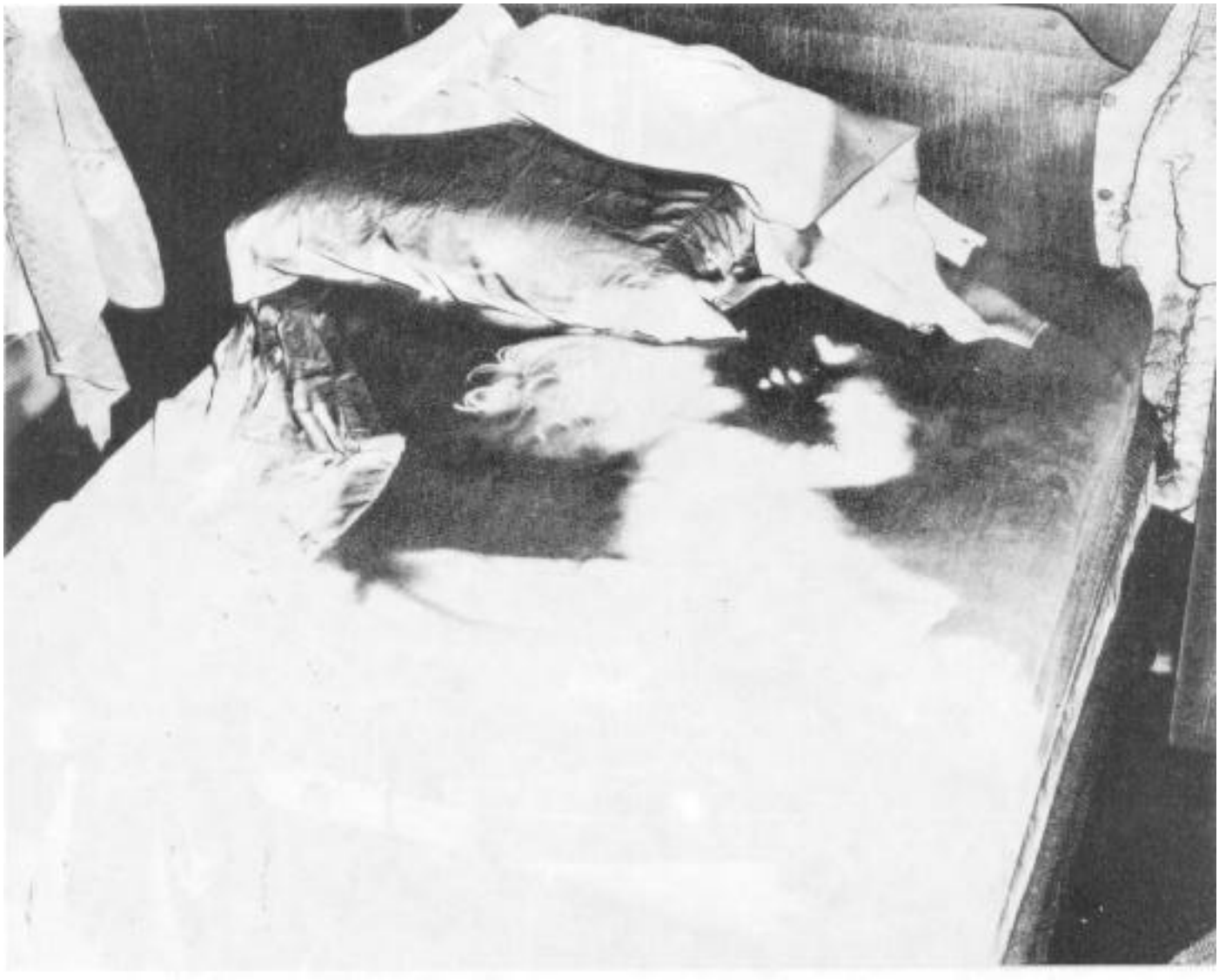
'I. Feller, and K. H. Crane, "Classification of Burn Care Facilities in the United States," ***Journal of the American Medical Association,*** Jan. 18, 1971.

[2] Anne W. Phillips and Oliver Cope, "Burn Therapy II, The Revelation of Respiratory Tract Damage as a Principal Killer of the Burn Patient," ***Annuls*** of Surgery, January 1962 (pp. 1-19).



Many of fire's victims never awaken. Smoke, toxic gases, or lack of oxygen kills them while they sleep.

infection? What emergency measures at the scene of the fire could counteract the effects of irritants?

These and other questions deserve more attention than they have received. **The Commission recommends that the National Institutes of Health administer and support a systematic program of research concerning smoke inhalation injuries.** At a minimum, NIH should receive an additional $250,000 in the coming fiscal year for this purpose.

A Final Word

Accidents happen-but not randomly. There is increasing evidence from research that deep emotional disturbances lead to accident-proneness. In one study of children with burn injuries, personality disorders (such as delinquency) and family disorders (such as alcoholism and strained marriages) were found to be commonplace conditions prior to the accidents."

Strengthening of affection in American families, it can be inferred, would do much to counteract the problem of fire injuries. That imperative lies beyond our powers to recommend, but not beyond our fervent hopes.

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[3] Robert T. Long and Oliver Cope, "Emotional Problems of Burned Children," New England ***Journal of Medicine,*** 264: 1121-1127, 1961.

3

ARE THERE OTHER WAYS?

Smoke is pouring from the windows of a vacant apartment on the third floor of a tenement. A passerby runs to the nearest fire alarm box and pulls the lever. Instantly a gong sounds in the fire station eight blocks away, the pattern of its ringing indicating the location of the alarm box. Firefighters jump into their heavy boots, don their helmets and canvas coats, and sprint aboard a pumper. Other men board the ladder truck sitting next to the pumper. In less than a minute after the sounding of the gong, the pumper and the truck are racing down the street toward the fire, their sirens wailing. Simultaneously, engines from other fire stations head toward the fire.

This is a scene that is repeated hundreds of times a year in every city. Except that internal combustion engines have replaced horses, this is the way fire departments have responded to fires for as long as anyone can remember. Seldom does the question arise : Is this the best way to respond?

It is the duty of every fire department to save lives and reduce injuries and property losses when fires occur. Our Nation's record in each of these areas needs vast improvement. Because human carelessness accounts for most fires, it is the public, not the fire departments, that must shoulder the major burden of improving the Nation's fire record. Moreover, the vast majority of firefighters are volunteers who take grave risks without compensation, and they are giving all the time to their fire companies that their busy lives permit. Many fire departments, both paid and volunteer, are performing as well as their resources allow. Yet the Nation's fire record gives them no ground for complacency.

How can fire protection be improved? The easy answer is to augment the budgets of fire departments by 20, 30, or 40 percent so that more equipment can be bought and more firefighters hired. But it does not follow that increases of 20, 30, or 40 percent will be matched by like reductions in losses of life and property. Nor is it realistic, at a time when most local governments are financially squeezed, to speak in such terms.

The more realistic solution, for most communities, lies in careful assessment of what future investments (whether in men, equipment, or new programs) will maximize effectiveness, then a gradual shift of priorities toward the most cost-effective measures.

In such an assessment, basic questions need to be asked. Communities for which the scenario at

the beginning of this chapter is typical might ask : How many firefighters should respond to every single-alarm fire? How many pieces of equipment? (One study shows that less than 1 percent of all calls for service require greater effort than can be handled by two or three men and one fire engine.) On the other hand, does sophisticated and expensive equipment make a critical difference in the time it takes to suppress a fire? Does it save more lives and reduce property losses?

Paid fire departments typically spend most of their money and efforts on fire suppression; usually less than 5 percent of the budget is devoted to fire prevention. If part of the money spent on responding to the tenement fire had been spent instead on enforcing a tough fire prevention code, would the fire have occurred at all?

Other questions for communities to ask: How should firefighters be scheduled and deployed to ensure effectiveness and efficiency in fire department operations? When a volunteer or paid department has recruited all the members it can (or can afford), might help be found elsewhere? Should a town or small city have its own fire department? Or should it consolidate fire services with neighboring communities to avoid duplicating costs?

As communities undertake a basic reassessment of their fire services, they will have to find solutions best suited to their conditions. Some communities are at an early stage of growth where they can consider a number of alternatives to their present system of fire protection. Others have a heavy investment in their present system and can consider only a gradual shift of priorities. Solutions appropriate to large cities are not likely to work for small towns and bedroom communities.

For years fire chiefs and local governments have been listening to one outside voice telling them how to improve their fire services. That outside voice has been the score their community receives on the Grading Schedule of the Insurance Service Office (formerly of the American Insurance Association). The Grading Schedule was devised as a tool to assist in setting fire insurance rates for each community. It was not intended as a guide to fire department decisions, though circumstances have invited that kind of use. When a community's score has indicated that two or more fire engines would earn it a lower insurance rate, local governments have felt pressed to buy them.

Now local administrators are beginning to recognize that their community's interests and those of the Grading Schedule do not necessarily coincide. The Grading Schedule, for example, is directed primarily toward preventing property losses. Deaths and injuries are also prevented as a result of this concern, but they are not the foremost consideration.

The Grading Schedule attaches only small importance to fire prevention. Ironically, few local governments expend as much on fire prevention as the Grading Schedule recommends. As we discuss in Chapters 11 and 16, more attention by fire departments to fire prevention--through fire safety education, building inspection, and approval of the fire protection features of building plans-would significantly reduce life and property losses and injuries from fires.

Fire departments can't be blamed for the ignorance and indifference that cause unsafe buildings to be built, that account for shoddy wiring and hazardous storage, that contribute to people's carelessness with matches and cigarettes, that explain the counterproductive behavior of people when a fire breaks out. But if the tides of ignorance and indifference are to be turned back, as surely they must, then fire departments are the natural place for the effort. As educators and enforcers, fire departments can do much to lessen the incidence and destructiveness of fire. The importance of the prevention role is underscored by the fact that fire departments can do so little when fires have gotten out of hand before they were notified. **The Commission recommends that local governments make fire prevention at least equal to suppression in the planning of fire department priorities.**

The Present System

One reason large cities and smaller communities are likely to arrive at very different solutions to enhancing fire protection is that they tend to have distinctly different fire departments. Most large cities have paid fire departments; many smaller communities are protected by volunteer departments.

About 1 million Americans serve as volunteer firefighters-five times the number of paid firefighters in the Nation. By one estimate, based on

The Nation's fire departments range from large metropolitan ones to small volunteer companies serving rural areas.

what it would cost to replace volunteers with paid firefighters, the Nation's volunteers are rendering a public service worth at least $4.5 billion annually.

The huge diversity among volunteer fire departments makes generalization about them difficult. While some are strapped for manpower, others are endowed generously enough to send all of their active members to State firefighter school each year. Some serve isolated rural towns on budgets as low as $3,500 a year. Others are called upon to serve a densely populated area of 50 square miles with substantial budgets and manpower. The hazards they protect against range from widely scattered houses and barns to heavily populated urban areas.

The striking aspect of volunteer departments, of course, is that they cost far less than paid departments. Then, too, volunteers are often people of standing in the community, are dependent on other citizens for contributions to the department, so that a broad segment of the community is supportive of the department and conscious of the fire problem. On the other hand, volunteer departments often can afford only a low level of training and an inadequate dispatching and communications system. When a fire occurs, turnout can be uncertain. Their part-time members usually lack the experience of full-time firefighters. They also, in many cases, lack the manpower to do building inspection and other fire prevention work.

Since paid departments are generally larger, and have more men on duty more of the time than volunteer departments, they tend to be more complex oragnizations. In addition to having specialized companies, e.g., engine, ladder, snorkel, rescue-of from two to seven firemen, paid departments often have special staffs for training, fire prevention, communications, purchasing, community relations, and other purposes.

With such complexity, typical problems of bureaucracies emerge : lack of coordination among separate units, the subordination of central purpose---public service-to petty rules and red tape,

the stifling of innovation. Presiding over this tenuous alliance is the fire chief, who wears two hats-one, the administrative hat required to run the organization; the other, the helmet he dons when the alarm is sounded to lead his firefighters in the suppression of a fire. Since the fire chief usually has come up through the ranks, the second hat probably fits comfortably. It is the administrative duties of today's complex municipal department for which the chief is less likely to be adequately prepared.

Alternatives for the Future

Whether the fire department is volunteer or paid, fire prevention and protection can be improved in every community in the Nation. Few, if any, communities can say they have reduced life and property losses from fire to the extent humanly possible.

For most communities, improving the effectiveness of the fire service calls for gradual changes within the present structure: a shift of priorities toward fire prevention, better deployment systems, improved management practices. Other communities will want to consider a major shift from their present system. In the next few pages we explore some of the alternatives open to them.

Part volunteer, part paid. Communities that have grown in size or complexity beyond the capabilities of their volunteer fire departments need to consider a shift toward paid departments. Among the advantages of a paid department is the fact that, if it replaces several volunteer companies, it can ensure that fire protection resources are spread equitably in the community. One source of criticism, of course, is the increased cost of paid manpower. But the shift need only be partial. For example, many volunteer departments can summon adequate manpower during evening and nighttime hours but are hard pressed for manpower during daylight hours when volunteers are at their jobs. In such instances, it would make sense to have paid firefighters on duty during the daytime.

Auxiliary firefighters. An alternative source of supplemental manpower sometimes used is municipal employees who can be called away from their main jobs without serious detriment to the chief function they perform. Reliance on such personnel for first-alarm capability would certainly be ill-advised. However, if adequately trained as firefighters, they can be a source of secondary manpower.

Womanpower. When a small Florida community organized a volunteer fire department several years ago, it faced the classic problem: The 15 male members were not available during the daytime. The solution : Nine wives took over the daytime obligations. They have responded to as many as six brush fires in a single day, and the fire chief describes the system as working "beautifully." In a suburb of Columbus, Ohio, wives are similarly organized as a daytime rescue squad.

Fire departments that face physically strenuous tasks day in and day out will understandably be reluctant to hire women as firefighters. But reluctance to hire women for less taxing duties, such as dispatching, ambulance-driving, and inspecting buildings, is harder to defend and, indeed, is likely to be challenged legally with increasing frequency in coming years. **The Commission recommends that communities train and utilize women for fire service duties.**

Police-fire consolidation. A small number of communities have consolidated, partially or fully, their police and fire departments. One recent source [1] lists 23 cities and towns with fully consolidated departments (usually called public safety departments), 10 with partial consolidation, and two with "selected area" consolidation-that is, confined to certain neighborhoods.

Of the cities with fully consolidated departments, 17 of the 23 are in communities with fewer than 10,000 residents. Generally they are affluent residential communities, lacking the hazards associated with aging urban centers or large industrial districts. They do not have the crime problems of urban areas; hence, the absence of patrolmen during a fire is less risky than it would be in larger cities.

The 23 communities all have some form of *co*-operative patrolmen or public safety officers--that is, men with some firefighting training who are primarily police officers, but who respond to fire alarms and provide various forms of assistance. In one city, for example, neighborhood patrols carry resuscitators and large fire extinguishers in their vehicles. Patrolmen are *not* called away from

'Harry W. More, Jr., ***The New Era of*** Public ***Safety,*** Springfield, 111. : Charles C Thomas, 1970.

crime control if a fire occurs. In another, public safety units staffed by two firefighters, cross-trained as police officers, patrol an assigned area in station wagons equipped with firefighting equipment, first aid equipment, and protective clothing. Two additional firemen are assigned to each piece of equipment at the fire station; hence, total manning is four men per company. Ninety percent of the time the station wagon arrives first at fires in its district, and one-third of the time its patrolmen are able to handle the fire unassisted.

Consolidation appears to work in areas where neither the crime problem nor the fire problem is serious. As either problem rises in seriousness, so does the potential for conflict of purposes, with the result that attention to one problem will be sacrificed to attention paid to the other. Indeed, the more serious is either problem the more important it is to have personnel specially suited for attacking the problem. Fighting fires and fighting criminals call for very different skills; they also call for men with very different motivations and very different assessments of the kinds of risks they are willing to take. That firemen and policemen

PROMETHEUS SCORNED

From colonial times down to the twentieth century, fire was a dreaded threat to the advancing American civilization. Fire wiped out farms; time and again, conflagrations leveled whole sections of towns and cities.

But citizens organized fire companies, and they fought back. Proud of their roles and the risks they took, volunteer companies became true fraternities of men. Often a community was served by several different companies, each trying to be the best in town-the strongest, fastest, shiniest. Rivalry sometimes led to brawls and even sabotage.

The shift to paid departments in the larger cities came only gradually. Boston established the first, after a great conflagration in 1679, but for the next 200 years separate volunteer companies survived in most cities.

With their strong fraternal traditions, the volunteer companies resisted change, They fought against relinquishing their place at the tow line in front of the hand pumper to a horse; they fought against efforts to reorganize the companies into a municipal organization,

But inevitably, change came to the fire services. Hand-drawn pumpers gave way to horse-drawn steamers, which gave way to gasoline engine pumpers. Coordinated municipal fire services were established. Fire laws were enacted to give some responsibility for fire control to the citizenry. Technology reduced the risk of major fires.

But the risks to firemen themselves have not diminished. They still push themselves to the outer edge of endurance-and sometimes beyond. Even with advances in technology, there still comes a moment when the fireman must turn away from the lashing tongues of fire. The struggle is still there, and it is still a heroic struggle.

One result of regional cooperation can be an improved dispatching system to reduce response time significantly.

are different kinds of people is attested to by studies which find that firemen make much better paramedics.

Several other cautions are in order. While consolidation plans make valuable use of firefighters' non-emergency time, there are functions related to fire protection that deserve higher priority: fire prevention inspections, fire safety education, rescue and paramedic services among them. Moreover, no community can say with full assurance that its fire problem is small.[2]

An additional consideration : If firefighters also have law enforcement duties, they will be bad choices for conducting residential fire safety inspections. Suspicions about their true intentions will make them unwelcome in many homes.

Reduced services. An additional alternative for communities is to freeze suppression services of the fire department at the present level, while at the same time placing more of the future burden for fire protection on the residents of the communities. This is not as novel as it may sound. Many communities require buildings of a certain size or type of occupancy to have sprinkler systems, in whole or in part, and many require that major industrial plants have their own fire brigades. By spreading such requirements to other classes of buildings, communities can reduce fire losses without further taxing the capabilities of the fire department. In many countries, we might add, preventing destructive fire is regarded primarily as the responsibility of the property owner, not the fire department.

Private contracting. A further choice, laden with controversy, is to contract for fire services with a private firm. Many of the Nation's early fire companies were incorporated under State law and provided their services on a contract basis. Private contract companies exist in parts of Tennessee and Arizona.

Some city managers have been attracted to the idea of private contracting on the grounds that a private company is more likely to exhibit sound management practices, efficiency, and innovation than an arm of the government. On the other hand, the pressures to make a profit run counter to the fundamental aims of the fire services---to save as many lives, and to reduce as many injuries and property losses, as possible. A community considering contract service must define its requirements and standards of performance very carefully. It must have continuing proof, through the company's records of performance, that community expectations are being met. (Once it has drawn a contract with adequate provisions, a community must face the possibility that no entrepreneur will come forward to assume the risks.)

Governmental contracting. Many communities have mutual-aid agreements with neighboring communities so that they work together to cope with major fires. A more formal banding together occurs when a community pays a neighboring or encompassing political jurisdiction to provide it fire protection. The Los Angeles County Fire Department serves 35 communities on this basis. Services provided range from paramedic teams to forest fire suppression. Communities benefit from the availability of equipment and specialized services that they could hardly afford on their own.

Regionalization. Contracts between governments are but one route to a very successful method of improving the fire services. Another route is through regionalization.

The experience of Great Britain with regionalization is instructive. During World War II, that country's fire services were nationalized for the sake of defense. After the war, the fire services were denationalized but, rather than being divided into the 1,500 jurisdictions that had existed before the war, they were consolidated into about 150 fire jurisdictions. Resources were pooled, and economic efficiency was gained through the elimination of duplicated services. In particular, the advantages cited of the British experience were:

- More efficient manning through the combining of small companies;
- Greater operational effectiveness through better manned companies, uniform fire suppression methods, direct control of response of all companies (rather than depending on mutual aid arrangements like those in many American communities), and the ability to concentrate manpower rapidly at major fires;

[2]Crescent City, Ill., learned this painful lesson in the summer of 1970. when a derailed tank car filled with pro-Dane gas tore open and burned. and six other tank cars exploded in a chain reaction, sometimes hurtling like rockets hundreds of feet. Despite the efforts of 250 firefighters and 58 pieces of apparatus, 64 people were injured, 24 living quarters were destroyed, and 90 percent of the business district was wiped out.

- Better communications;
- Better training facilities as a result of a larger tax base supporting them;
- More uniform regulatory code enforcement;
- Economies effected through large volume purchases and standardization of parts;
- Better recordkeeping with less total effort.

While regionalization has succeeded in some areas of the United States, it has been stoutly resisted in other areas. Fire departments, especially volunteer departments, have developed an esprit de corps and a pride in their achievements, and they are understandably reluctant to sacrifice the measure of autonomy that regionalization would require. Having raised, through donations, $50,000 to buy a fire truck, they are reluctant to relinquish any control of it. Companies that have developed personnel and operational policies which they feel are superior to those of other companies in the region fear they might have to give them up for the sake of regional uniformity. Others argue that enlarged jurisdictions put control in the hands of people not familiar with local conditions, lessen civic interest in the fire services, and introduce morale problems as a result of less personal relationships in the larger organization. And some fear that regionalization would phase out some companies in the name of efficiency, thereby increasing response distances to fires in some areas.

With careful planning, however, fears can be abated and the real problems overcome. Furthermore, if the protection of the public is not first-rate, then the effort needs to be made. It behooves county governments, and municipal governments in which several independent fire companies still exist, to explore means of effecting regionalization of their fire services, At a minimum, such explorations should cover formal arrangements for mutual aid, especially during large fires; the sharing of management and of specialized functions, such as arson investigation and fire safety education; centralization of purchasing and training; uniformity in all important practices; standardization of reporting procedures; and the institution of an area-wide communications and dispatching system.

State governments have an obligation to promote regional approaches to fire protection. As it is now, many States have laws that hamper cooperative arrangements among local jurisdictions. **The Commission recommends that laws which hamper cooperative arrangements among local fire jurisdictions be changed to remove the restrictions.**

Fire Protection Planning

Which, if any, of the foregoing alternatives is appropriate for a community will depend on its careful analysis of present conditions and directions of future growth.

Fire protection is only one of many community services. Not only must it compete for dollars with other municipal needs, such as the education system and the police department, but, in planning for future growth, the fire protection system must take into account the changes going on elsewhere in the community. For example, if a slum area is to be torn down and replaced with high-rise apartment buildings, that will change the fire protection needs of the area. Changes in zoning maps will also change the fire protection needs in different parts of the community.

To cope with future growth, local administrators are turning increasingly to the concept of *muster* planning of municipal functions. Such plans include an examination of existing programs, projections of future needs of the community, and a determination of methods to fill those needs. They seek the most cost-effective allocations of resources to help assure that the needs will be met.

A major section of a community general plan of land use should be a *Master Plan for Fire Protection.,* written chiefly by fire department managers. This plan should, first of all, be consistent with and reinforce the goals of the city's overall general plan. For example, it should plan its deployment of manpower and equipment according to the kind of growth, and the specific areas of growth, that the community foresees. It should set goals and priorities for the fire department. Not only is it important to set objectives in terms of lives and property to be saved, but also to decide allocations among fire prevention inspection, fire safety education, and fire suppression as the best way to accomplish the objectives.

Having established goals, the plan should seek to establish "management by objectives" within the fire department. This operates on the principle

that management is most effective when each person is aware of how his tasks fit into the overall goals and has committed himself to getting specific jobs done in a specified time.

Because fire departments exist in a real world where a variety of purposes must be served with a limited amount of money, it is important that every dollar be invested for maximum payoff, The fire protection master plan should not only seek to provide the maximum cost-benefit ratio for fire protection expenditures, but should also establish a framework for measuring the effectiveness of these expenditures.

Lastly, the plan should clarify the fire protection responsibility for other groups in the community, both governmental and private.

The Commission recommends that every local fire **jurisdiction prepare a master plan designed to meet the community's present and future needs in fire protection, to serve as a basis for program budgeting, and to identify and implement the optimum cost-benefit solutions in fire protection.** Wherever possible, this should be a regional jurisdiction embracing several political jurisdictions-for example, county-wide or larger in rural areas and metropolis-wide in urban areas. (In Chapter 4 we discuss the tools to carry out this program.) In other chapters we recommend Federal assistance, in the form of grants for equipment and training, to local fire departments to improve their reduction of fire losses.

Such assistance should be in response only to well-substantiated needs. Hence, **the Commission recommends that Federal grants for equipment and training be available only to those fire jurisdictions that operate from a federally approved master plan for fire protection.**

The Commission recognizes that the planner who sets out in search of the most cost-effective solutions to his local fire problems is faced with scanty data on which to make such decisions. What is the difference in performance, if any, between a fire station that serves a 12-block radius and one that serves a six-block radius? How is performance affected by the addition or subtraction of one man on a pumper? What are the hazards most important to eliminate through building and fire prevention codes and enforcement?

There is a 'dearth of systematic studies of methods of fire protection. We have advocated that master plans include provisions for evaluating various approaches to fire protection, but until such time as evaluation can be made, master planning will be a very inexact approach to rationalizing fire protection. The need is not only for more systematic studies of methods of fire protection, but for a centralized office to collect and disseminate evaluation data, so that communities can learn from each other. **The Commission recommends that the proposed United States Fire Administration act as a coordinator of studies of fire protection methods and assist local jurisdictions in adapting findings to their fire protection planning.** In this endeavor the U.S. Fire Administration should work closely with other Federal agencies, such as the National Bureau of Standards, the Department of Agriculture, and with private fire protection groups such as the Joint Council of National Fire Service Organizations and the National Fire Protection Association.

4

PLANNING FOR FIRE PROTECTION

Setting sights upon the future of fire protection in this Nation, as this Commission is charged to do, brings into focus a major need underlying many others: *Planning.*

Fire protection has been largely a local responsibility, and for good reasons it is destined to remain so. Each community has a set of conditions unique to itself, and a system of fire protection that works well for one community cannot be assumed to work equally well for other communities. To be adequate, the fire protection system must respond to local conditions, especially to *changing* conditions. Planning is the key: Without local-level planning, the system of fire protection is apt to be ill-suited to local needs and lag behind the changing needs of the community.

Excellent fire protection-for example, in the form of automatic extinguishing systems-lies within technical grasp, and certainly lies within the resources of most communities to provide. Even with considerable public support, this protection would require many years to accomplish. In the meantime, in every fire jurisdiction-whether a municipality, county, or region-standards aiming at a significant increase in fire protection must be set. Among the concepts to be defined:

- *Adequate level of fire protection..* The question of "adequacy" addresses itself not only to day-to-day normal needs, but to major contingencies that can he anticipated and to future needs as well. What is needed is a definition of "optimal" protection-in contrast to "minimal" protection, which fails to meet contingencies and future needs, and "maximal" protection, which is more than the community can afford.
- *Reasonable community costs.* Fire, both as threat and reality, has its costs: property losses, deaths, injuries, hospital bills, lost tax revenues, plus the costs of maintaining fire departments, paying fire insurance premiums, and providing built-in fire protection. Each community must decide on an appropriate level of investment in fire protection. Some costs beyond the public's willingness to bear should be transferred to the private sector-as when buildings over a certain size or height or with a certain occupancy are required to have automatic extinguishing systems.
- *Acceptable risk.* A certain level of losses from fire must be accepted as tolerable simply because of the limited resources of the community. Conditions that endanger the safety of citizens

and firefighters beyond the acceptable risk must he identified as targets for reduction.

Consideration of these matters helps to determine what functions and emphasis should be assigned to the fire department, other municipal departments, and the private sector, both now and in the future, It helps to define new policies, laws, or regulations that may be needed. Most important, consideration of these matters makes clear that fire safety is a responsibility shared by the public and private sectors. Because the fire department cannot prevent all fire losses, formal obligations fall on owners of certain kinds of buildings to have built-in fire protection. For the same reason, private citizens have an obligation to exercise prudence with regard to fire in their daily lives. But prudence also requires education in fire safety, and the obligation to provide that education appropriately falls in the public sector, chiefly the fire department. The public sector-again, chiefly the fire department-also has an obligation to see that requirements for built-in protection in the private sector are being met.

A fire department, then, has more than one responsibility. Nor are the responsibilities just mentioned exhaustive. At least eight important functions for fire departments can be identified:

- *Fire suppression.* Firefighters need proper training and adequate equipment for saving lives and putting out fires quickly, and also for their own safety.
- *Life safety-paramedical services.* Capabilities needed during fires and other emergencies include first aid, resuscitation, and possibly paramedical services. (By "paramedical services" we mean emergency treatment beyond ordinary first aid, performed by fire service personnel under supervision-through radio communication, for example--of a physician.)
- *Fire prevention.* This includes approving building plans and actual construction, inspecting buildings, their contents, and their fire protection equipment, public education, and investigating the causes of fires to serve as a guide to future priorities in fire prevention.
- *Fire safety education.* Fire departments have an obligation to bring fire safety education, not only into schools and private homes, but also into occupancies with greater than average fire potential or hazard to people, such as restaurants, hotels, hospitals, and nursing homes.
- *Deteriorated building hazards.* In coordination with other municipal departments, fire departments can work to abate serious hazards to health and safety caused by deteriorated structures or abandoned buildings.
- *Regional coordination.* Major emergencies can exceed the capabilities of a single fire department, and neighboring fire jurisdictions should have detailed plans for coping with such emergencies. But effectiveness can also be improved through sharing of day-to-day opera-

Master Planning for fire protection requires consideration of a community's future pattern of growth and its likely needs.

tions--as, for example, an area-wide communication and dispatching network.

- *Data development.* Knowledge of how well a fire department is doing, and of how practices should change to improve performance, depends on adequate record-keeping.
- *Community relations.* Fire departments are representative of the local community that supports them. The impression they make on citizens affects how citizens view their government. Volunteer departments dependent on private donations must, of course, also be concerned with their community relations. Moreover, since fire stations are strategically located throughout the community, they can serve as referral or dispensing agencies for a wide range of municipal services.

As communities set out to improve their fire protection, it is not the fire department alone they must consider. The police have a role in reporting fires and in handling traffic and crowds during fires. The cooperation of the building department is needed to enforce the fire safety provisions of building codes. The work of the water department in maintaining the water system is vital to fire suppression. In the realm of fire safety education, the public schools, the department of recreation, and the public library can augment the work of the fire department. Future development and planning will influence the location of new fire stations and how they will be equipped.

These are just the obvious examples of interdependence. So seemingly trivial a matter as the manner in which house numbers are assigned and posted can affect the ability of fire departments to respond quickly and effectively to emergencies.

The Master Plan for Fire Protection

In Chapter 3 we proposed that each local fire jurisdiction in the Nation develop a master plan for fire protection. The master plan, we pointed out, should set goals and priorities for the fire services, designed to meet the changing needs of the community. It should seek to allocate resources for the maximum payoff in fire protection, and it should provide for a data system for continual monitoring of cost-effectiveness.

A look at how one city has developed a master plan is instructive. Several years ago, the city of Mountain View, Calif.,[2] began to prepare its General Plan of Land Use. As a statement of fire department needs, the city manager's office was prepared to accept the recommendations of the American Insurance Association (which at that time had responsibility for the Grading Schedule). These recommendations called for eight fire stations in Mountain View, with five men per engine company and six to seven men per truck company if the city wanted to improve the insurance grading.

The fire chief interceded to suggest that deeper study would lead to a different set of goals for the fire department. He proposed a "philosophy of fire protection" for Mountain View with two aspects. First, emphasis should be on *preventing* fire losses, chiefly through code enforcement and control of contents and activities within structures. Second, the fire department can cope with emergencies only to a certain level. "Where the normal anticipated potential for emergencies exceeds the planned capability of the on-duty fire force, developers and operators of buildings and businesses will be responsible for providing the balance of fire protection." Usually this would mean some form of built-in fire protection.

In developing a master plan for fire protection, the Mountain View fire chief and his staff took a careful look at recent fire experience. From that study, they were able to project that apartment house and industrial fires would be an increasing burden on the department. By examining the causes of recent fires, they were able to set priorities for fire safety education and code enforcement. They were also able to arrive at a definition of "adequate" fire protection service, which included the provision that firefighting forces arrive within 4 minutes after the emergency has been reported.

The chief and his staff also examined the capabilities of the fire department's equipment to suppress large fires. This led to recommendations that the building code be amended to require all nonresidential occupancies over 5,000 square feet to have approved fire detectors, and all over 10,000 square feet to have automatic sprinkler systems

[1] As we recommended there, wherever possible this should be a ***regional*** jurisdiction embracing several political jurisdictions-for example, county-wide or larger in rural areas, and metropolis-wide in urban areas.

[3] Appendix VI contains the Mountain View Master Plan for Fire Protection. This is part of the overall General Plan of Land Use.

DEVISING A FIRE PROTECTION PLAN

The following can serve as guidelines to fire department administrators for developing and presenting a master plan for fire protection:

Phase I

1. Identify the fire protection problems of the jurisdiction.
2. Identify the best combination of public resources and built-in protection required to manage the fire problem, within acceptable limits :
   (a) Specify current capabilities and future needs of public resources ;
   (b) Specify current capabilities and future requirements for built-in protection.
3. Develop alternative methods that will result in trade-offs between benefits and risks.
4. Establish a system of goals, programs, and cost estimates to implement the plan:
   (a) The process of developing department goals and programs should include maximum possible participation of fire department personnel, of all ranks;
   (b) The system should provide goals and objectives for all divisions, supportive of the overall goals of the department;
   (c) Management development programs should strive to develop increased acceptance of authority and responsibility by all fire officers, as they strive to accomplish established objectives and programs.

Phase II

1. Develop, with the other government agencies, a definition of their roles in the fire protection process.
2. Present the proposed municipal fire protection system to the city administration for review.
3. Present the proposed system for adoption as the fire protection element of the jurisdiction's general plan. The standard process for development of a general plan provides the fire department administrator an opportunity to inform the community leaders of the fire protection goals and system and to obtain their support.

Phase III

In considering the fire protection element the governing body of the jurisdiction will have to pay special attention to:

1. Short- and long-range goals,
2. Long-range staffing and capital improvement plans,
3. The code revisions required to provide fire loss management.

Phase IV

The fire loss management system must be reviewed and updated as budget allocations, capital improvement plans, and code revisions occur. Continuing review of results should concentrate on these areas :

1. Did fires remain within estimated limits? Should limits be changed?
2. Did losses prove to be acceptable?
3. Could resources be decreased or should they be increased?

in addition. In recognition that most deaths in residential fires are from smoke inhalation, they recommended that smoke detectors and sprinkler heads be required at the top of the stairwell in all two-story residences.

The Mountain View chief and his staff inventoried the fire department, in terms of both personnel and equipment, and then projected additional needs of manpower and capital investments over a lo-year period. In developing the master plan, the chief and his assistants made a detailed list of objectives, in order of priority, not only for the department as a whole, but for the chief, assistant chiefs, battalion chiefs, and captains. They established a timetable for implementing special events, such as company inspections and arson seminars. To make sure the fire prevention bureau and firefighters understood their responsibilities in fire inspection, they listed every kind of occupancy in the city and assigned each category to one or the other. Another detailed listing set forth clearly the fire protection responsibilities of other city departments, such as the police, water, engineering, and planning departments.

The kind of study Mountain View has been conducting is not costly. Certainly it is not expensive in light of the cost-effectiveness it promises taxpayers of that city. The data from which its projections are derived are mostly data fire departments ought to be collecting every day as a means of continually monitoring their effectiveness. Yet we recognize that many local and county govern-

ments are financially strapped ; they are hard put to provide adequate services for today, much less to plan for better services tomorrow. They will need help tomorrow to improve fire protection, but they need help today to determine what those improvements should be.

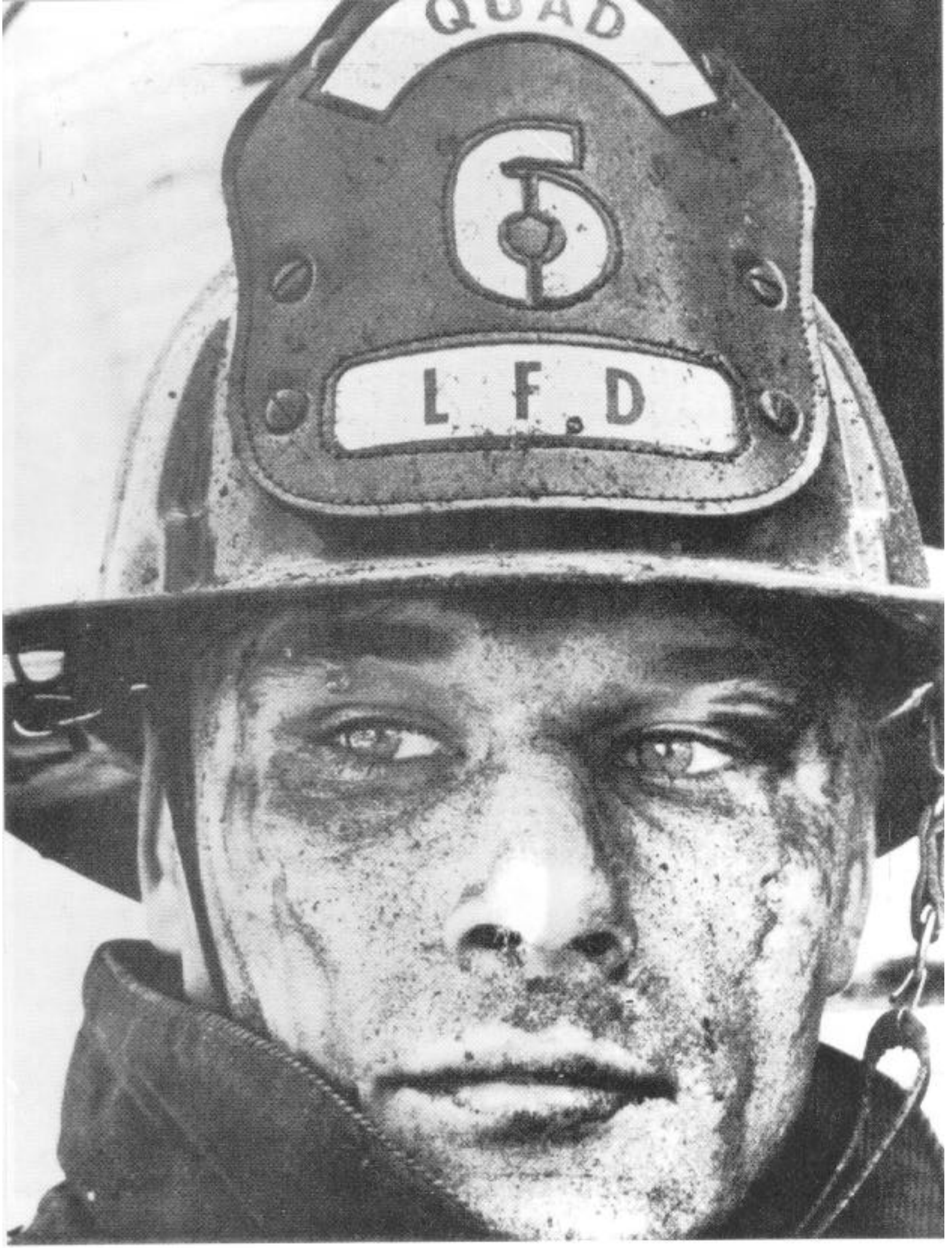
The planning we have called for does more than place fire department activities on a rational footing; it requires fire departments to consider means of reducing fire losses beyond mere fire suppression. It calls for a broader approach, which may require changes in laws and codes as well as increased emphasis on fire prevention and fire safety education by fire departments. This broader approach, which might be termed "fire loss management," is a radical departure for many communities.

Some fire departments will lack the expertise and management ability to devise master plans on their own. If they have been relying solely on the Grading Schedule, they will find that the master plan involves attention to many more factors and calls for custom-tailoring future priorities to meet local conditions. For the first time, they may find it necessary to call in fire protection engineers and management consultants to aid in establishing levels of fire protection and methods to obtain those levels. **The Commission recommends that the proposed United States Fire Administration provide grants to local fire jurisdictions for developing master plans for fire protection. Further, the proposed U.S. Fire Administration should provide technical advice and qualified personnel to local fire jurisdictions to help them develop master plans.**

The Impetus for Change

Every system has advantages and disadvantages. No one is motivated to change a system or pattern of behavior when the advantages seem to lie with the status quo and the disadvantages with the contemplated change. Change toward fire loss management will be attractive only if the rewards of the proposed practices and the penalties of existing practices are seen to outweigh the rewards for existing practices and the penalties associated with change. If the opposite holds true, then there will be little impetus to move in the direction of fire loss management.

One of the jobs of the US. Fire Administration will be to persuade local governments that the rewards lie in a change toward fire loss management, penalties in the status quo. A few of the advantages of the fire loss management approach deserve mention here. It puts planning for the future on a sound basis and makes it easier to defend budget requests each year. It brings the top levels of local government, who don't understand fire department program needs, into active participation in planning the community's total fire protection. It brings from "under the carpet" emergency situations beyond the capabilities of the fire department and makes clear what will be done in such cases. The approach provides fire departments with a management system that can weed out outmoded practices and justify the practices they retain. Lastly, it can restructure firefighters' jobs to make them more productive to the citizenry-and more rewarding to the firefighter.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FIRE SERVICE PERSONNEL

Common sense tells us that, once a destructive fire has begun, the effectiveness of the fire department in reducing life and property losses depends, to a large extent, on (1) how soon firefighters arrive at the scene and (2) what they and their equipment do after they have arrived.

Thus, manpower is a key factor in fire suppression. Quick response requires not only that fire stations and fire trucks be placed in enough locations, but that the fire houses be adequately manned. And while it is important that equipment at the fire scene be adequate to the task (a concern we discuss in Chapter 7), it is equally important that there be enough firefighters, adequately trained, to use the equipment effectively.

Manpower is also a key factor in fire prevention. Efforts to inspect buildings for fire safety and to educate the public about fire hazards require the actions of specially trained people,

Common sense tells us, therefore, that changes in manning of fire departments (especially if they have responsibilities for fire prevention as well as suppression) affect the ability of those departments to control life and property losses from fire. Changes in manning, one would expect, also affect the rate at which firefighters sustain injuries. By changes in manning we mean not only the addition or subtraction of firemen, but changes in departmental entrance requirements, changes in training, changes in physical conditioning, and changes in the way manpower is deployed.

But precisely how do such changes affect fire losses or firefighter injuries? As was true of some of the questions in Chapter 3, good answers do not exist. Almost no data-gathering and almost no systematic studies have been performed to correlate various manpower strategies with effectiveness.

Such questions are not idle ones. In a poll conducted for *Nation's Cities* in February 1972, 33 percent of the responding cities reported that their fire departments were manned at under authorized levels. The International Association of Fire Fighters, among others, is concerned that cuts in manpower, made in the name of economy, may be exposing firefighters to greater risks of injuries. Fire chiefs worry because layoffs of younger men are robbing their departments of future leaders. The fire insurance industry is concerned that manpower cuts may lead to an increase of large-loss fires. Citizens, too, worry about reduced fire protection and the effect of undermanning on their insurance rates.

In the absence of cost-effectiveness studies of various manpower strategies, who can say what the effects of manpower cuts are likely to be? But this is not solely a scientific question; it has a moral dimension as well. Saving lives, reducing property losses, and preventing firefighter injuries are far more important considerations than efficiency in government. It is far better to err on the side of overmanning than to risk the public's safety through manpower cuts. Economy-minded governtments should be concerned with getting greater productivity from their fire departments, not with saving dollars to the possible detriment of their citizens' safety.

Pressure Toward Better Utilization

Fire departments cannot continue to base their manpower practices on past experience and hunches. The economic pressures on local governments translate into a need to base manpower policies on a firm foundation of proven cost-effectiveness, There are other pressures in this direction as well :

Public expectations. Fire departments are not the only municipal service under pressure to justify their policies. The fact that other departments of local government are under similar pressure suggests that the departments that come forward with the best analyses are likely to convince local officials and the public that their needs are valid. If fire departments lag behind, they are likely to be treated with indifference. If fire departments come forward with bond issues for new equipment and facilities based on inadequate studies, they are apt to encounter stiff resistance from those public officials and influential citizens who live in a world of cost-benefit analyses and trade-off studies.

Other pressures arise when public expectations exceed what the fire department is delivering. Many citizens arc bothered by their perception of the paid firefighter as one who spends most of his duty time in idleness. While in many communities this impression is out of date, the fact that the impression lingers should concern fire department administrators. In some communities, on the other hand, the public has come to expect the fire service to handle any life safety emergency. If the fire department does not live up to this expectation, the public may conclude that fire department manpower is not worth its costs to taxpayers.

The changing environment. Another pressure toward placing manpower practices on a more rational basis stems from changes that have occurred in our urban society and in fire problems. Take, for example, the high-rise building, a special problem to which more and more fire departments are being introduced. Heights exceed ladder reach. Air and heating ducts, in many cases, rapidly spread fire and smoke, sometimes faster than a heavily populated building ran be evacuated. Windows may be sealed, caus-

Using firefighters in fire prevention work increases their productivity and helps to reduce fire losses.

ing heat to build up. These and other special problems require not only an adequate number of firefighters at the scene, but firefighters who are trained to deal with the special hazards and who are effectively managed in the team effort to put out the fire.

Fire departments have been growing larger as the Nation becomes more urbanized. Shopping centers and other commercial complexes are sprouting up in rural areas, putting increased demands on their fire departments, With the growing size of fire departments and the growing complexity of the hazards in the environment, the desirability of specialization within the departments increases.

Equal opportunity considerations. Moral considerations dictate, and Federal law requires,[1] that entrance-level requirements for fire depart-

[1] The equal employment opportunity provisions of the Civil Rights Act of 1964 (as amended) apply to all fire departments except those that are purely volunteer and without any quasi-governmental attributes, and those departments with fewer than 15 employees. In court decisions, purely volunteer departments have been found exempt from the provisions only if they function without any significant governmental sponsorship or aid and without any privilege to claim government benefits.

ments be related only to the performance requirements of the job. This is to prevent discrimination against minorities in hiring. It is our observation that many fire departments have quite some distance to go to fulfill this need. Too many entrance tests expect skills unrelated to firefighting; some put so much emphasis on administrative skills that they appear to be saying, "In every firefighter there must be a fire chief waiting to be discovered." Too few tests, on the other hand, relate to the skills a firefighter needs. Only recently, in fact, have any attempts been made to correlate entrance examination scores, fire school scores, and on-the-job performance.

What Can Be Done?

What we have said thus far about manpower considerations in the fire services suggests several areas of research that need to be pursued. Specifically, **the Commission recommends that the proposed United States Fire Administration sponsor research in the following areas:**

productivity measure of fire departments. How do various manning strategies affect the ability of a fire department to put out fires and rescue fire's victims? How can firefighters' responsibilities be extended into new areas, especially into fire prevention efforts or non-fire emergency rescue, without jeopardizing fire suppression and rescue?

job analyses. Different fire departments render different kinds of services, depending on their assigned responsibilities and the kinds of hazards that exist in the environment they serve. What skills are required of firefighters and officers under these varying conditions? How should candidates be screened for these positions?

firefighter injuries. How can injuries be reduced? For example, are firefighters taking unnecessary risks to save abandoned buildings? (In this area there is a need for studies of firemen's protective equipment, which we discuss in Chapter 7.)

fire prevention efforts. What kinds of educational programs effectively reduce burn injuries? What kinds of hazards are most important to eliminate? How can fire department inspections and educational programs be made most effective?

In all these areas of research, a very useful method is to compare the performance of fire departments using different strategies in attacking the problem under study, and then to isolate the factor that makes the difference in perfomance. This means that fire departments under study must keep adequate records of their performance. Impact must be considered. In evaluating the relative importance of a particular fire hazard, for example, it is not enough to record the number of inspections made (input) and then the frequency with which the unsafe practice occurs (output). It is necessary that the number of fires attributable to-or aggravated by-the unsafe practice be evaluated (impact), (Note that input over impact in dollars is the cost-benefit ratio.)

Since the research needs are urgent and should not await pursuit until a U.S. Fire Administration is established, **the Commission urges the Federal research agencies, such as the National Science Foundation and the National Bureau of Standards, to sponsor research appropriate to their respective missions within the areas of productivity of fire departments, causes of firefighter injuries, effectiveness of fire prevention efforts, and the skills required to perform various fire department functions,**

The emergence of guidelines for fire services development through federally sponsored research will be a long step forward. But to implement the findings to meet local conditions, expert leadership in fire departments is needed.

The linking of "expert" with "leadership" is vital. Most American fire departments are strong in leadership and weak in management expertise. The typical hiring and promotion system-in which everyone from the chief on down started as a rookie fireman-has guaranteed good leaders who understand the needs of the men under them and are respected by their subordinates. But fire departments could profit from competition for certain leadership positions from outside fire departments. They need qualified planners whose expertise lies in fire protection engineering, operations research, and systems studies rather than firefighting. This is especially true in larger departments where, further, specialists in budgeting, personnel, and community relations need not be firefighters. The experience of other kinds of organizations, moreover, shows that thinking can be-

come stale and practices inbred when no outside entry is permitted. **The Commission recommends that the Nation's fire departments recognize advanced and specialized education and hire or promote persons with experience at levels commensurate with their skills.**

Presently, the retirement systems of most fire departments discourage hiring from outside at any level above that of basic firefighters. For example, in many departments, only those who join between the ages of 21 and 30 arc eligible for retirement benefits. Seldom are retirement system credits portable; a fireman who transfers to another department must begin building credits anew, as though he were a rookie firefighter. **TO** encourage greater opportunity for. choice for firefighters and officers, the vesting of retirement rights and transfer of retirement credits to other jurisdictions needs to be made possible. The subject of lateral transfer should be studied in detail through a project sponsored by the proposed U.S. Fire Administration. A major objective should be to determine ways in which personnel can transfer between fire departments and retain all retirement rights.

As important as we consider flexible hiring practices, we do not mean to depreciate the value of training within fire departments. At the outset of this chapter we said that one of the important ways to change fire department manning is to change training programs. Improvements in training can favorably influence a department's effectiveness-in saving lives, reducing property losses, and preventing injuries to firefighters.

The quality of training given America's firefighters and officers varies widely. It is not difficult to see why. There are no national training requirements for firemen, and only 15 States have training standards which all firemen must meet. For volunteer firefighters there are no financial incentives and sometimes little opportunity to further their training. For paid departments as well as volunteer ones, training is an expensive undertaking that removes the trainees from useful service for a period of time. Many communities, if called upon to augment their fire department training, simply could not afford to. **The Commission recommends a program of Federal financial assistance to local fire services to upgrade their training.'** To qualify for this assistance, a fire jurisdiction should be required to present a master plan for fire protection substantiating the need for further training.

As we indicated earlier, entrance requirements for the Nation's fire departments also vary widely, and too few tests meet the Federal requirements that they be related only to the performance requirements of the job applied for. Because of the conservative hiring and promotion practices of fire departments, too many tests emphasize the applicant's potentiality for moving far up in rank. Better training programs, together with greater willingness of departments to hire at all ranks from outside, would diminish the need for this emphasis. **A** fair and job-related test, which the Joint Council of National Fire Service Organizations is now working on, will, in turn, create pressures for better training and more liberal hiring and promotion practices,

It is our concern for the rights of America's racial minorities which prompts our urging that entrance tests be fair and job-related. But we believe even further steps are necessary to overcome the effects of years of discrimination in many departments. It is not enough for fire departments to establish fair standards in hiring; they must reach out to minority communities and actively seek recruits. **In the administering of Federal funds for training or other assistance to local fire departments, the Commission recommends that eligibility be limited. to those departments that have adopted an effective, affirmative action program related to the employment and promotion of members of minority groups.**

Increasing Productivity: Two Possibilities

The nature of the job of most firefighters requires much standby time which is not devoted to reducing fire losses. Most leaders in the fire services agree that the productive time of firefighters ought to be increascd. And most agree that whatever additional services firefighters are called

[a] In the next chapter, we recommend the establishment of a National Fire Academy. primarily to provide special training for fire department management. It would be appropriate for the U.S. Fire Administration, through the National Fire Academy, not only to channel funds to local and regional training programs, but to develop curricula for local use. train local instructors. and provide special instructors 'to local and regional' fire training centers.

upon to render, the services ought to utilize firefighters' special capabilities. Painting street signs and registering bicycles are useful activities, but they don't meet this criterion.

Activities which meet this criterion, and which ought to receive topmost priority in extending firefighters' productivity, lie in the area of fire prevention. A recurring theme of this report is that a much heavier investment of time and resources in fire prevention is the most expeditious route to reduce life and property losses from fire. While many departments recognize responsibilities in fire prevention, too few are doing all they should or could.

There are many fire prevention activities that fire departments can undertake. They can conduct inspections to enforce local codes, ordinances, and common-sense fire prevention practices. They can supplement the efforts of other code inspectors-for example, by reviewing building plans in cooperation with the building department. They can inspect special items of importance, such as hydrants, sprinkler systems, and standpipes. They can check high-risk areas, such as wooden-structured slums and areas where buildings are under construction. For the sake of pre-fire planning, they can conduct familiarization inspections of structures and areas where their services may be needed someday.

Last but not least, fire departments can conduct educational programs-not only to teach school children and heads of households, but also to teach employees of hospitals, hotels, and other public buildings of their special responsibilities. These programs should be continuing, year-round efforts, not simply projects for fire prevention week.

The payoffs of such efforts lie in reduced demands for fire suppression, and reduced deaths, injuries, and property losses. Which of these efforts have the greatest payoff is, as we have indicated, a question on which appallingly little research has been done. But greater efforts in fire prevention cannot await the arrival of better data. Not for the sake of productivity alone, but for the sake of the public's safety, the time to get on with it is now.

Another kind of activity that meets the criterion of utilizing firefighter's special capabilities is emergency ambulance and paramedical service. From time to time, nearly every fire department is called upon to respond to emergencies having nothing to do with fire. Indeed, in some departments, responding to non-fire emergencies is an official responsibility and a major part of the department's workload. But many departments have moved gradually toward heavier assumption of this responsibility without adequate planning and preparation. As a result, they are still responding to non-fire emergencies with fire trucks -an expensive and inappropriate use of equipment. Or they are requiring firefighters to handle some patients they are not trained to handle. Or they are compiling a poor record of response to non-fire emergencies because they have an inadequate communications and deployment system.

There are sound reasons for fire departments assuming emergency ambulance and paramedical functions. If fire stations are logically located to guarantee quick response to fires, then ambulances placed in fire stations will be logically deployed as well. Secondly, firefighters are, by temperament and training, people-rescuers, and handling all emergency patients is not a major shift of responsibility. Thirdly, a communications system designed to get emergency vehicles to the fire scene is well along the way to sufficiency for handling all emergencies. Lastly, a consideration not to be discounted : The provision of ambulance services will enhance the value of the fire department in the eyes of the community that supports it.

The Commission recommends that fire departments lacking emergency ambulance, paramedical, and rescue services consider providing them, especially if they are located in communities where these services are not adequately provided by other agencies, We recognize that assumption of these responsibilities requires investment in new equipment, in additional training programs, and-most likely-in additional manpower. Also, careful planning is required to ensure that the general rescue responsibility does not compromise the fire department's responsibilities in fire protection-and vice versa.

Paramedical and rescue services have, in many communities, become an important part of firefighters' duties.

6

A NATIONAL FIRE ACADEMY

Fire department managers have difficult tasks thrust upon them. Every second counts in the battle against a fire, and they must make quick but well-informed decisions affecting, at the same time, the outcome of a fire and the safety of the firefighters under their command. They must see to it that their firefighters arc adequately trained---not only to fight fires, but to handle frightened fire victims and administer first aid. Since firefighters have other duties, especially in fire prevention education and inspections, their officers must ensure that the duties are carried out effectively. Fire department managers must also deal with the public—making sure that the department meets public expectations, and seeking, in turn, public support of the department. What makes these responsibilities particularly difficult is that, in thousands of smaller departments, they are bound up in a single individual, the fire chief, often a man elected from among the volunteer membership.

Those who bear these responsibilities know that the key to their performance, and the performance of those under them, lies in training. At both State and local levels in this Nation, the quality of training ranges from excellence to total absence. Usually the quality of training is tied to economic circumstances. But poor training programs could be improved, at little cost, if they followed the example of outstanding programs. At present, however, there is no systematic, interchange of information among educators in the fire services.

One possible remedy has almost ananimous support within the fire suppression and protection fields—namely, a National Fire Academy. What most experts envision is an institution that not only has advanced education programs of its own, but also lends help to State and local training and educational programs. In addition to conducting classes and seminars at its own facility, the Academy would serve as the hub of an educational network. The Academy system would use existing fire training school programs, fire science education programs in community colleges, and fire management and fire protection engineering programs at the college or university level in each State. The Academy would function as the core of the Nation's efforts in fire service education--feeding out model programs, curricula, and information, and at the same time receiving helpful advice from those schools and the fire services.

The list of advocates of a National Fire Academy includes the International Association of Fire Chiefs and the International Association of Fire Fighters. It includes, as well, the National Fire Protection Association, the Committee on

Fire Research of the National Research Council, the Joint Council of National Fire Service Organizations, the National Association of Mutual Insurance Companies, and many more. As other organizations have done, **the Commission recommends the establishment of a National Fire Academy to provide specialized training in areas important to the fire services and to assist State and local jurisdictions in their training programs.**

A National Fire Academy could have a number of salutary effects upon the fire services. For example:

- The Academy would help fire departments to reduce injuries, deaths, and property losses. Individual fire departments have discovered superior techniques for coping with fires, but their successes have not been shared with other departments except through informal channels. Academy courses in command strategy and tactics could be attuned to specific categories of risk, such as congested cities, industrial complexes, and wildlands. Courses in such fields as arson investigation, code enforcement, and fire safety education would address themselves to major ways of reducing fire losses.
- The Academy would increase the attractiveness of fire service careers. The training opportunities offered by the Academy would make positions in the fire services intellectually more stimulating.
- Academy training would equip fire service officers with the technical expertise they need in today's competitive environments. Courses in management techniques would help chiefs of paid departments compete for budgetary dollars with other municipal departments; such courses would also help them recognize antiquated practices that should be abandoned Special engineering courses would help fire service managers to assess the relative advantages of different pieces of equipment on the market.
- At the same time, the Academy could help fire departments shift priorities toward fire prevention. One major barrier to such a shift has been official doubt about the effectiveness of fire prevention measures. Academy courses could acquaint fire services officers, not only with fire prevention practices that work, but also with sound record keeping methods that prove that they work.
- Officers educated by the Academy probably would be sought far and wide, with the effect that fire departments would be encouraged to abandon parochial hiring practices.

Volunteer as well as paid fire departments have need of a National Fire Academy. Many volunteer departments lack the resources for training beyond a rudimentary level. Indeed, there are many volunteer firefighters who, having never been exposed to adequate training, don't fully appreciate how it could improve their performance and their safety. Their communities harbor the same lack of appreciation, believing that "adequate" fire protection is wholly a matter of trucks and men to ride them. Because volunteers are part-time firefighters with insufficient time to undertake fire prevention activities, training in that area has often been neglected. With a limited vision of their community role, many volunteer departments-but many paid departments as well-have neglected training in such important fields as arson investigation and fire-safe design of structures.

As we have indicated, the Academy would not supplant State and local training programs but would assist them: by identifying and making available course material and demonstration projects, by accrediting programs, and by lending special instructors to these programs. In general, State and local programs would continue to train firefighters; the Academy's own specialized courses would be for officers and officer candidates.

In addition, the National Fire Academy could assist in the development of effective materials for public education in fire safety. Assistance to community fire prevention efforts could include, in addition to information, financial support and the lending of special personnel. The Academy could also offer architects, engineers, code writers, and code inspectors short courses in the fire aspects of those professions.

One problem that cries out for Academy attention is that of arson. As we pointed out in Chapter 1, the National Fire Protection Association estimates that about 7 percent of the Nation's fires are likely the work of arsonists. Many urban fire chiefs believe the local incidence of

deliberately set fires is far higher. To mount a concerted attack on arson will require the communication of intelligence and expertise from every region and locality of the Nation. **The Commission recommends that the proposed National Fire Academy assume the role of developing, gathering, and disseminating, to State and local arson investigators, information on arson incidents and on advanced methods of arson investigations.** Short courses, newsletters, and bulletins would be appropriate means of communication.

Lastly, through newsletters and other media of continuing education, the Academy could bring to the attention of the Nation's fire service leadership emerging problems and trends of the fire services, pioneering efforts by individual fire departments, and new developments in fire protection technology.

While there is near-unanimity among fire protection organizations on the need for a National Fire Academy, proposals regarding its structure vary widely. **The Commission recommends that the National Fire Academy be organized as a division of the proposed United States Fire Administration, which would assume responsibility for deciding details of the Academy's structure and administration.** We see the Academy as a growing organism, the pattern of its growth being determined by a careful and continuing assessment of the fire services' needs. The U.S. Fire Administration would be in the best position to conduct this assessment.

One thing is certain: Federal support of the National Fire Academy, both in its own programs and those it assists at local levels, is vital. Volunteer firefighters and officers should not be expected to pay for their specialized training and would probably be unable to take advantage of the Academy's offerings in great numbers if they were required to do so. Paid firemen in many communities are in no better position to get local funds to subsidize their special training. **The Commission recommends that the full cost of operating the proposed National Fire Academy and subsidizing the attendance of fire service members be borne by the Federal Government.** Federal assistance for members of paid and volunteer fire departments would cover cost of travel, tuition, teaching materials, and accommodations. Paid fire departments would be obligated to continue to pay the salaries of students. Full Federal financing would not preclude acceptance by the Academy of grants and other forms of support from government and private sources.

Federal support of the National Fire Academy is a worthwhile endeavor. Through the Academy, the management capabilities of the fire services can be improved. Priorities of fire departments can be effectively shifted, through Academy training, in the direction of more fire prevention effort, Man's environment can be made less hazardous through special courses in fire-safe design. And most important, the National Fire Academy can help to reduce life and property losses and injuries from fire.

The National Fire Academy would not supplant local training programs but would provide guidance and assistance.

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EQUIPPING THE FIRE FIGHTER

Of the fire chiefs and firefighters who responded to our nationwide survey early in 1972, more than seven out of ten said there is a need for greater innovation to improve the equipment and protective clothing they use every day.

And no wonder. A quick glimpse at firefighting practices yields a sampling of where improvements can be made:

- The breathing apparatus designed for 30 minutes' use typically weighs 30 pounds. Often firefighters reach exhaustion long before their 30 minutes are up, The weight of the apparatus, it seems likely, contributes to the exhaustion. In actual use, moreover, a 30-minute apparatus often provides less than 20 minutes' protection because great exertion requires more air.
- Most firefighters' helmets readily conduct heat to the inside of the helmet. Beyond certain temperatures, helmets made of hard plastics lose strength and begin to deform.
- Helmets and breathing apparatus alike tend to get snagged by protruding objects. In many instances, firemen wearing face masks cannot put on their helmets; the two don't fit together.
- "Turnout" coats can be virtual sweat boxes, even when there are air vents under the arms. To the extent that turnout coats hinder body movements or build up body heat, they contribute to the firefighter's exhaustion.
- A fireman manipulating the controls of an aerial ladder must peer upward many stories to see how to guide the ladder into position. If the smoke is too thick to see through, he must have another firefighter, perched precariously at the top of the ladder, giving him instructions as he swings the ladder into position. As Howard W. Emmons, professor of mechanical engineering at Harvard, pointed out in 1968, "A man in Houston, Tex., can manipulate a space ship photographing the moon, but the fireman must climb up to the top of a 100-foot ladder to find out just where it is."

These and many other deficiencies have been around for years, despite the great power of American ingenuity to innovate to overcome technological problems. Few equipment manufacturers can afford to invest heavily in research and development, especially when the payoff in a fragmented and conservative market is so un-

certain. Marketing is affected by the fact that many fire departments simply cannot afford to buy innovative equipment. Others purchase conservatively because they lack the technical expertise to evaluate innovative equipment. Because firemen typically spend their careers with one department, they become attached to the "tried and true" methods of that department.

Of course the fire services are not alone in facing barriers to innovation. In recent years there has been growing recognition that the innovative process-by which needs get translated into research and development projects, and the results of research and development get translated into new products or processes-throughout American society can be improved. In his Message on Science and Technology in March 1972, the President assigned to the National Science Foundation and the National Bureau of Standards responsibilities for finding ways to spur innovation. In response, the National Science Foundation established an Experimental Research and Development Incentives Program to seek ways of "increasing the efficiency and speed of conversion of research and development to new or improved products, processes, and services." The National Bureau of Standards launched a similar effort, called the Experimental Technology Incentives Program.

The blockages to innovation in the fire services are many, and they offer a rich vein for scientific prospectors. Moreover, the blockages together form a major impediment to "improvements in the quality of life," which the National Science Foundation lists foremost among the kinds of innovations to be spurred along. **The Commission urges the National Science Foundation, in its Experimental Research and Development Incentives Program, and the National Bureau of Standards, in its Experimental Technology Incentives Program, to give high priority to the needs of the fire services.**

Guidelines for Research and Development

The fire services do not need innovation for the sake of innovation, the way car manufacturers need styling changes to assure themselves new customers. The fire services need innovations in equipment to improve their performance. Improved performance, in turn, can mean any of the four following : saving more lives, reducing deaths and injuries to firefighters, reducing property losses, and protecting the public at lower cost.

Clearly, reducing life loss, reducing firefighter injuries, and reducing property losses are prime considerations. Improvements in these areas can be made simultaneously. A firefighter better protected against injury to himself is, of course, better equipped to suppress fires and rescue people. No technological innovations designed to reduce life and property losses should create new risks to firefighters.

In all research and development efforts, then, effectiveness in lowering firefighter injuries as well as life and property losses should rank ahead of dollar savings as a goal. Current technology, for example, makes feasible automated control of hose pressure at the scene of a fire and could free an additional fireman-the one now operating the controls on the truck manually-for service at the nozzle end of a hose. Yet the job of the man on the pumper is a complicated one. He must see to it that men holding a hose line do not get thrown by surges in pressure caused by unequal demands from different hose lines. He must cut water pressure when crews are endangered by ladder sway and cut pressure when hoses rupture. He must act as a relief man for crews, a reserve for rescue of fire victims, and a protector of the pumper from vandalism. An automated system that left any of these protective functions unprovided would be an unacceptable substitute.

A second requirement of research and development is that they stem from an accurate assess-

With few exceptions (such as this one), firefighters' helmets have changed little in design and materials in 50 years.

ment of fire service needs. Almost any piece of fire apparatus, for example, can be built bigger, better, and more expensive, with a greater capacity to perform its expected functions and impress the citizenry. But in the real world of tight fire department budgets, trade-offs are needed. Thus, the chief emphasis in the development of improved firefighting equipment should be on apparatus designed to meet most potential fire situations, rather than on equipment rarely needed. More research is also needed to help settle questions of diversity versus standardization. Standardization of fire engine components is desirable from the standpoint of bringing down costs. Diversity may be needed to meet the varying needs of different communities. The best solutions may lie in the middle-that is, with standard modules that permit add-on features.

One fire department need that should not be subjected to trade-off or compromise is *safety.* A two-step program of research is needed: to identify features of firefighting equipment that do not adequately protect firemen, then to explore means of providing such protection.

Thirdly, research and development must take whole systems, rather than piecemeal, approaches. The complete firefighter's uniform consists of turnout coat, trousers, boots, breathing apparatus, gloves, and helmet. It may also consist of a walkie-talkie radio strapped to the body 'and a hand-held flashlight. Each of these elements has been designed separately without thought to its relation to other parts of the uniform. One result has already been cited: a breathing apparatus so incompatible with the helmet that the two cannot be worn together, whereas a face mask and helmet could be an integrated unit. Turnout coat, trousers, and boots are separate items that take time to don, whereas they could be replaced by a one-piece, zip-up suit. Walkie-talkies and flashlights are cumbersome appendages, whereas both could be integrated into the helmet. A further example: Only the helmet is designed to protect against impact injuries (and that, very inadequately), whereas many impact injuries occur on the trunk of the body.

Much of the technology exists for better protective gear. Ideally, product development of an integrated system, not unlike the life support system built into the individually tailored 'astronauts' suits, would afford optimum protection. On the other hand, the hard realities of costs and ready availability of the equipment must be considered in approaching the ideal. The National Aeronautics and Space Administration, in fact, has put its space exploration capabilities to work on the problems of developing better breathing apparatus and better protective clothing for firefighters. As for helmets with built-in communications systems, they have long been in use by fighter pilots. To provide protection from impact injuries, technology might be borrowed from bulletproof vests or even from football players' protective gear.

At the same time, research and development are needed to make incremental improvements in existing kinds of equipment. The search for major departures from existing equipment, based on a systems approach, should not be pursued at the expense of development of improvements in traditional equipment. There are two reasons for this. First, the search for major departures is a long-term investment, and results are not likely to reach the market for several years to come. Secondly, fire departments cannot afford to discard all the equipment they have now, and adoption of major departures will be a slow process, extending over many years. Better versions of current types of equipment will be needed for some time to come.

A single example will suffice. Tests of six types of turnout coats by the Boston Fire Department have shown that, in each case, the material fails the flammability test for drapery fabrics used in places of public assembly. That more firefighters' coats do not catch fire is due largely to the fact that the heat on the fireman's exposed hands and face drives him from flames before his coat is endangered. If hands and face can be adequately protected-and the technology exists to do just that-then there will have to be a corresponding improvement in the flame resistance of turnout coats.

A fifth consideration for research and development: improvements must be acceptable to fire departments. Barriers to acceptance of an innovation are of several kinds. A new piece of equipment may be too expensive in absolute terms: simply beyond a fire department's budget. It may 'be too expensive in relative terms-that is, offer too little improvement in performance for the in-

vestment required. It may require skilled operators which fire departments are unable to provide without further training. There can be psychological barriers as well; if an innovation departs too radically from traditional practice, it will be resisted.

A related consideration is that developed products need to be adapted to users' capabilities. Human factors engineering-that is, the modification of equipment design so that the equipment is comfortable, safe, and easy to use-has been applied with success to military and industrial equipment but never, to our knowledge, to fire trucks and other firefighting equipment.

A purchaser of fire equipment must be able to make comparisons among different pieces of equipment competing for his dollars. This means that names for particular kinds of equipment, descriptions of their functions, and measurements of their capacities should be uniform throughout the fire protection field. While some standardization exists, confusing discrepancies are commonplace. One result of these discrepancies is that data cannot be compared across different fire jurisdictions; for example, a "rescue truck" is an ambulance in some places, a pickup that carries firefighters' rescue equipment in another. The National Fire Protection Association has published many standards for fire equipment and an excellent guide called *Fire Terminology.* But long-established traditions and local custom have not given way totally to NFPA standards. **The Commission recommends that the proposed United States Fire Administration review current practices in terminology, symbols, and equipment descriptions, and seek to introduce standardization where it is lacking.**

Equipment R. & D.: Reducing Fire Losses

Research and development priorities ought to stem from careful assessment of the needs of the fire services. We can only suggest therefore, not define, areas where research would be useful. The following discussion is a mixture of subjects on which little or no research is being done, subjects on which progress is being made, and, indeed, subjects in which demonstration projects have already proved successful.

Notification. The beginning step in a fire department's effort to put out a fire is notifica-

Space Age wonders of automation have not yet supplanted the firefighter perched dangerously atop a 100-foot ladder.

tion of the fire's whereabouts-usually by telephone or alarm. Systems exist which sense smoke, products of combustion, heat, or water flow (in an activated sprinkler system) and notify the fire department automatically. Improvements in the technology of such systems, especially in bringing down their cost, might encourage more widespread use. Systems based on human activation might be developed which (1) meet the criterion of universal accessibility (as private telephones do in many communities) and, at the same time, (2) discourage false alarms (which account for a third of the fire calls in many cities), and (3) provide for the transmittal of qualitative information about the fire. Some cities are already using public telephones which require no coins for emergency calls. These telephones (if adequately maintained against breakdowns and vandalism), together with private telephones, would substitute for fire alarm boxes.

Response. Computerized systems for dispatching firefighters and fire trucks have been installed in a number of cities. Into such systems are being built retrieval mechanisms that transmit to firefighters floor plans and other helpful information about the building on fire.

Suppression. Lights, periscopes, or closed-circuit TV might be mounted atop aerial ladders. Sensors to locate trapped victims and chemical detectors to warn of dangerous concentrations of toxic gases are other possibilities. Infrared sensing devices are available that can locate fires in smoke-filled rooms and fires inside walls, but they need development and demonstration of their usefulness to the fire services.

More research is needed on extinguishing agents, hardware, and techniques, to improve the effectiveness of existing agents and to investigate the chemical and physical mechanisms of new agents. Water, particularly in its droplet or stream state, requires further study; there is a controversy, for example, as to whether keeping buildings closed and applying water fog is a suitable alternative to ventilating the fire and attacking with water streams.

Additives that reduce friction losses in hoses have proved their effectiveness, but are not widely used. Foams and dry chemicals have proved their effectiveness and are being continually improved, but exactly how these agents operate to extinguish fire is little understood. More important, lack of knowledge in flame chemistry inhibits progress toward radical departures from present extinguishing methods, such as the use of sound waves.

Lastly, development efforts should be directed toward reducing the weight of suppression equipment, especially hoses and couplings.

Equipment R. & D.: Reducing Fire Fighter Injuries

Especially in the realm of fire suppression, technological improvements which reduce firefighter injuries will improve the effectiveness of fire departments in saving lives and reducing property losses. Such improvements are worthy of pursuit in their own right, since the risks we currently ask firefighters to take are unconscionable. In many cases, we must assume, the proper protective equipment is not available to firefighters-or, if available, is not being worn. When firefighters do not wear equipment because it is cumbersome or uncomfortable, that is, to some extent, an indictment of the equipment.

Toxic *fumes*. The inadequacy of breathing apparatus systems is shown by studies which indicate that face masks used by fire departments leak to some extent. The National Bureau of Standards has proposed a program of research to improve breathing apparatus systems, taking into account the physiological, human factors, and engineering elements important to their design. **The Commission urges rapid implementation of a program to improve breathing apparatus systems and expansion of the program's scope where appropriate.**

Impact injuries. The only standard piece of equipment meant to protect against injuries from falling objects or other blows is the helmet. The most common standard (which many helmets fail to meet) is resistance against 40 foot-pounds of impact. The British standard is three times as high. No attention has been paid to impact protection in turnout coats, despite a Bureau of Labor Statistics study which shows that impact injuries to the trunk occur 26 times as often as trunk burn injuries.

Over-exertion. While the very nature of firefighting invites over-exertion, there are technological improvements that undoubtedly would reduce instances of over-exertion. Protective gear could be

improved from the standpoint of weight and freedom of bodily movement. In addition, lightweight power tools-for example, for prying open doors or cutting through walls-would also reduce the need for physical exertion.

Strains and sprains. Lightweight power tools would likely reduce strains as well. In addition, failure to apply human factors engineering to the design of firefighting equipment has led to strains and sprains, as it has to over-exertion and other kinds of casualties. What is needed, for these and other classes of injuries, is thorough study of the kinds of movements and stresses the body sustains in firefighting.

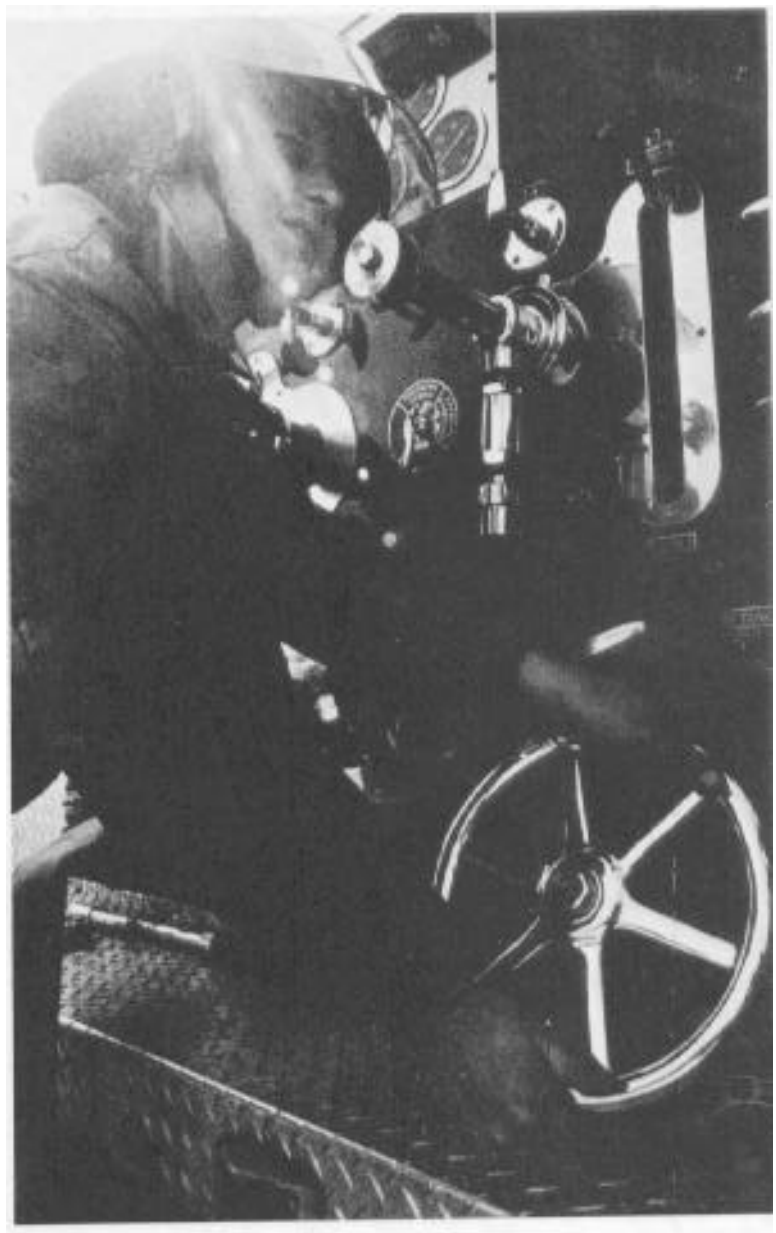
Heat and burns. Equipment that leaves any part of the body exposed, or which is easily ignited, openly invites burns and heat injuries. Development of protective clothing to reduce these hazards should be accompanied by the development of sensing devices that can warn the firefighter when surrounding temperatures are getting dangerous.

Getting on With the Job

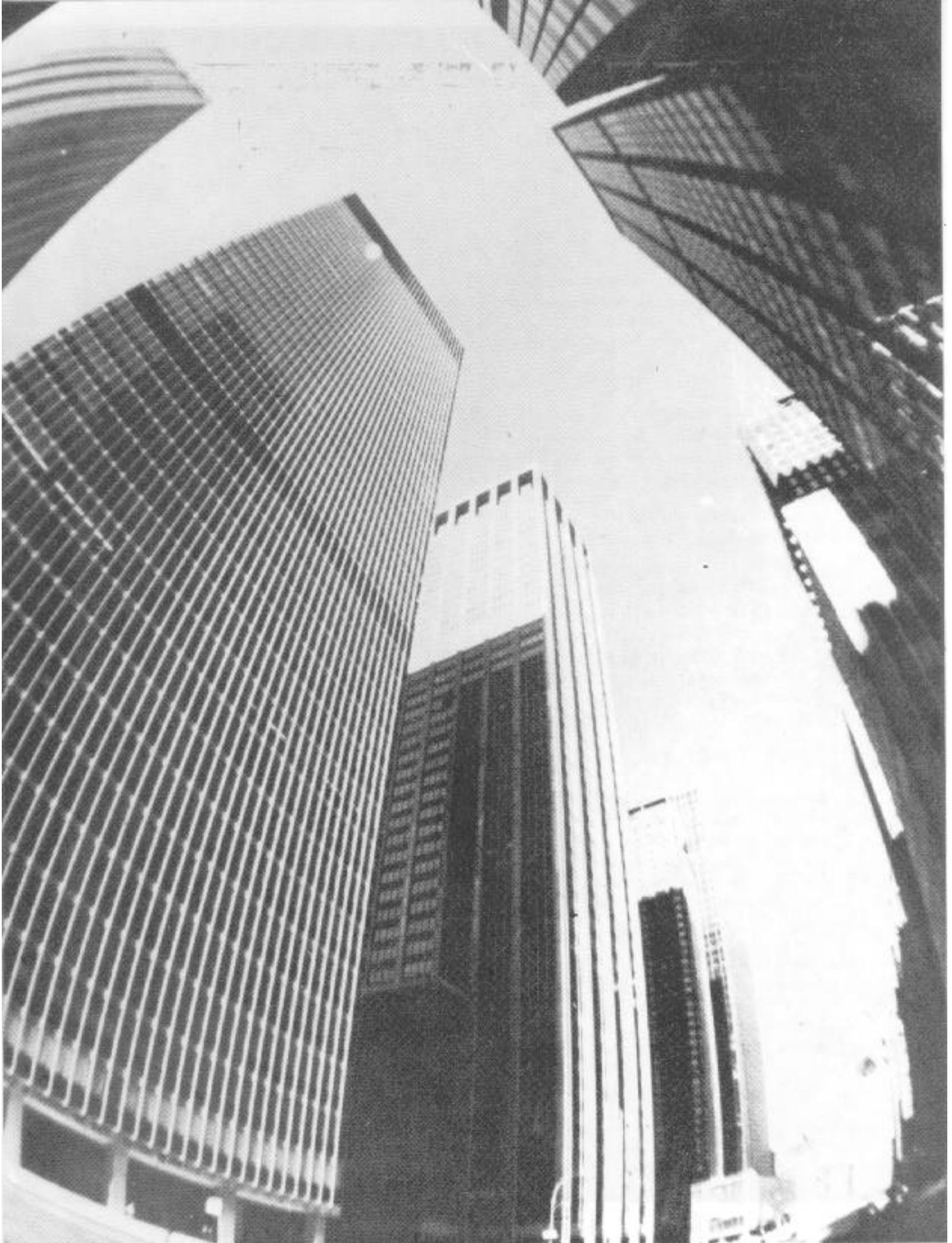
The foregoing discussion is hardly exhaustive. There needs to be undertaken a definitive study of the needs of the fire services. Such a study would have to do more than aggregate what fire departments say they want; it would have to identify needs growing out of demonstrable shortcomings of current equipment.

The Commission recommends that the proposed U.S. Fire Administration undertake a continuing study of equipment needs of the fire services, monitor research and development in progress, encourage needed research and development, disseminate results, and provide grants to fire departments for equipment procurement to stimulate innovation in equipment design. As an interim measure, pending establishment of a U.S. Fire Administration, the Commission urges the Join Council of National Fire Service Organizations to sponsor a study to identify shortcomings of firefighting equipment and the kinds of research, development, or technology transfer that can overcome the deficiencies. Funding would be appropriately sought from the National Science Foundation or from the Department of Commerce under the provisions of the Fire Research and Safety Act of 1968.

Capabilities for research and development to improve the effectiveness of the fire services lie in many places : universities, Federal agencies, nonprofit research firms, and the fire equipment industry. Research and development in these places will be useful if they are guided by clearly identified needs of the fire services.



Especially as firefighting equipment grows more complex, it must be designed to be comfortable, safe, and easy to use.



8

THE HAZARDS WE HAVE CREATED

The United States is an advanced nation technologically and is increasingly urban in character. Another way of saying this is that most Americans live in an environment of concentrated man-made objects. Their homes-which are generally close to neighboring homes (and sometimes in the same building) -are complexes of building materials, finishes, chemicals, paper, foodstuffs, and utility systems, all composed of objects processed by man. When the American breadwinner goes off to work in the morning, he may cross over a small patch of natural environment called a lawn. But when he arrives at the carport or the street corner, he enters another complex, man-made environment : a car, a bus, or a subway. At work-whether it is a factory bench, an office desk, or a sales counter-he is usually among a concentration of people in a similarly complicated environment of man-made objects, And when the vacationing urbanite seeks escape from this man-made environment, the usual conveyance is a man-made enclosure: if not a car or bus, then a train or airplane.

In this built environment, as it is called, Americans live side by side, day and night, with ignitable materials, combustible furniture and upholstery, and products and appliances which through wear or misuse may offer dangerous fire potential. Fumes from their gasoline, their paint thinner, or their cleaning fluid fill the atmosphere with combustion potential. The structures in which they live and work, through flaws in design and poor maintenance, often encourage entrapment rather than escape from fire. Few give these hazards any thought-until a fire occurs.

Available statistics give some idea, if not a complete picture, of where the hazards lie in the built environment. Certainly the vast majority-close to 95 percent-of America's fire losses, both life and property, result from fires in the built environment. Fires in buildings (as opposed to vehicle fires)' account for most of these losses. Of the nearly $2.7 billion in property losses sustained yearly, about 85 cents out of every dollar lost is attributable to a building fire. About two-thirds of the 12,000 deaths that occur annually result from building fires. What types of buildings are involved offer a key to where the emphasis should lie in the effort to reduce the Nation's fire losses (Table 8-1) .

[1] In 1971, 3,950 died in motor vehicle fires; property losses from such fires amounted to $112.7 million or about 4 percent of the total national fire problem. Fires in other transportation systems, such as airplanes, were insignificant in number. but are of concern to us because of the many lives risked in each fire incident.

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Table 8-1. Estimated 1971 Building Fire Losses and Relationship to Total Fire Record *

Category	Life loss		Property loss		Fires	
	Number	Percent of total	Dollars, Millions	Percent of total	Number	Percent of total
Residential (houses, apartments and hotels)[3]	6,600	56	874.1	31.9	699,000	25.6
Commercial (Public assembly, educational, institutional, mercantile and office)[3]	970	8	580.5	21.1	141,400	5.2
industrial (basic industry, storage, manufacturing and miscellaneous)			811.6	29.6	156,500	5.7
Building total	7,570	64	$2,266.2	82.6	996,900	36.5

* From published and unpublished NFPA data. Refer to Appendix V for complete table of fire losses in U. S.

Residences

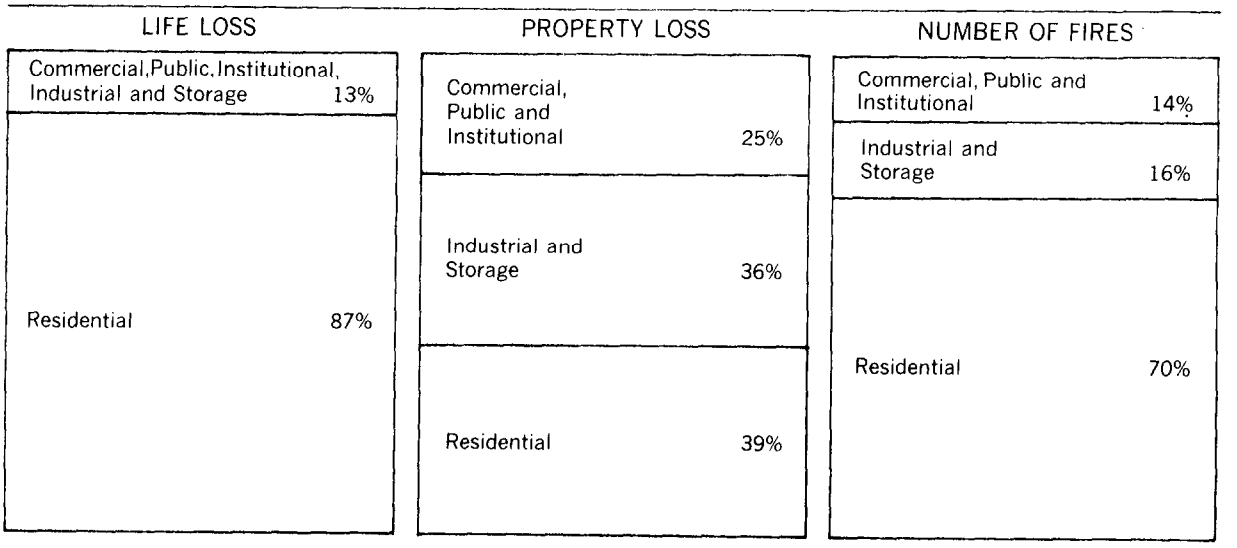
Of the nearly 1 million building fires that occurred in 1971, almost seven out of ten occurred in residential occupancies (Table 8-1)[2]. The chances are that the average family will experience one fire every generation serious enough to have the fire department respond. Residential fires account for about half of all fire deaths and a third of all property losses. (If the losses from non-building fires are excluded, residential fires account for about 87 percent of the deaths and 39 percent of these property losses [Figure 8-1]) From the standpoint of life loss particularly, the structures in which Americans live must be the prime focus of the national effort to reduce fire losses.

[3] This includes apartments, dwellings, hotels and motels, rooming and boarding houses, summer cottages, trailers, mobile homes, and miscellaneous structures.

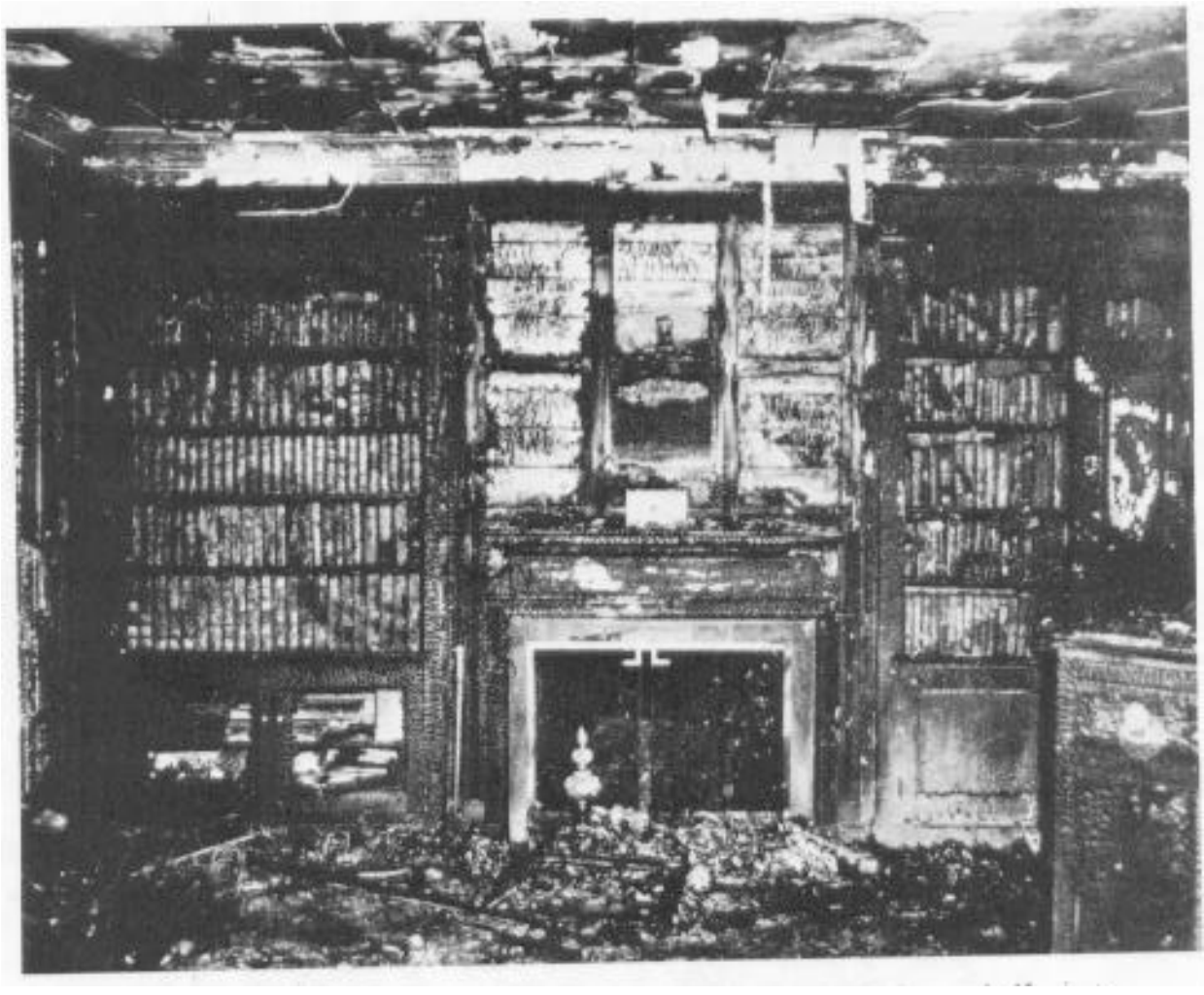
The experience of every urban fire department confirms what statistics only suggest: that a disproportionate number of residential fires-and fire deaths-occur in low-income neighborhoods. It is not difficult to see why. Crowded conditions, dilapidated buildings, unsafe heaters, and the heavy use of alcohol-all contribute to a higher incidence of fire and a heavier toll in injuries and deaths. The higher proportion of working mothers means more children are left unattended and, hence, more exposed to fire accidents. The ignorance among the poor about fire hazards is matched by the indifference or inability of landlords to get rid of the hazards.

But as every urban firefighter can attest, fire does not victimize the poor only. There is no ground for complacency about residential fires among more affluent citizens. There, too,

Figure 8-1. Fires in Buildings, 1971, United States*



*Estimates from published and unpublished NFPA data.



Fire knows no class distinctions. In this 16-room home in Ohio, it caused $150,000 in damages in 15 minutes.

ignorance breeds indifference. No less than in a slum, a single spark can set off a chain of events that guts a mansion and kills its inhabitants. Fire, like sin, knows no class distinctions.

Commercial and Industrial Fires [3]

While commercial occupancies make up about 14 percent of all building fires, they result in 25 percent of the Nation's property loss in building fires. Likewise, industrial fires are only about 16 percent of all building fires but account for 36 percent of the building property loss. Together, industrial and commercial fires account for 13 percent of deaths in building fires (Figure 8-1) .

Major Fires

The National Fire Protection Association defines as a major fire one in which three or more die, or one in which property losses are $250,000 or greater. (Some fires, of course, meet both criteria.)

In 1971, there were 208 fires in which three or more persons died, but together these fires accounted for 8 percent of the fire deaths that occurred during that year. In eight out of ten cases, these major fires occurred in residences. In many instances, late detection of the residential fires contributed to the heavy losses in lives and property-as indicated by the fact that about 80 percent of the multiple-death fires occurred between 11 p.m. and 6 a.m. when most people are asleep, as compared with the 20 percent that occurred between 6 a.m. and 11 p.m. when people are active.

Those fires producing major property losses were also a tiny fraction of total fires (0.02 per-

[3] "Commercial" includes public and institutional occupancies, and "industrial" includes storage occupancies.

Industrial and warehouse fires occur infrequently, but are difficult to control and often result in huge losses.

cent), but they accounted for 11 percent of the dollar losses in 1971. In all these cases the Building was not sprinklered in the area where the fire originated.

Causes and Remedies

It appears that considerably more than half the Nation's fires are caused by the careless actions of man. The rest have environmental causes, such as hazardous products, defects in the home, and lightning. A more detailed analysis of the causes of building fires is provided annually by the National Fire Protection Association (see Table 8-2). These are approximations only, based on experience in typical States. As for causes of fire-related deaths, data from Canada (there are no comparable U.S. statistics) attribute 71 percent of deaths to man's actions, 9 percent to products or processes, and 20 percent to defects in buildings.

Table 8-2. Estimated U.S. Building Fire Causes*

	Percent of fires	Percent of dollar losses
Heating and cooking	16	8
Smoking and matches	12	4
Electrical	16	12
Rubbish, ignition source unknown	3	1
Flammable liquid fires and explosion	7	3
Open flames and sparks	7	4
Lightning	2	2
Children and matches	7	3
Exposures	2	2
Incendiary, suspicious	7	10
Spontaneous ignition	2	1
Miscellaneous known causes	2	6
Unknown	17	44
Total	100	100

*NFPA estimates.

The consequences of a fire depend, however, not only on how it starts, but on what happens after ignition. Human beings can intervene to lessen the consequences of a fire caused by a defective product. Products can be designed to lessen the consequences of human carelessness, as for example, with matches and cigarettes. And whatever the cause of a fire, buildings can be designed and maintained to ease fire suppression and the evacuation of potential fire victims. The

INDUSTRIAL FIRE SAFETY

Although it is recognized that there are still other important areas for problem solving, it would be a serious omission if no note were taken of the many positive strides which have been made in the prevention and control of fires by industry, Comparisons of the industrial and residential losses in the United States show that industry appears far in advance in terms of the relative number of lives lost and the dollar amount of property destroyed. In 1971, for example, the National Fire Protection Association reported the dollar losses to basic industry and manufacturing occupancies to be $390,-700,000, versus $874,100,000 for residential occupancies; and of the 11,850 lives lost to fire in 1971, it is estimated fewer than 1,000 were lost in industry. In addition, the chart below shows a trend in decreasing numbers of fires annually in industry.

Industrial Fire Record"

Year	Number of basic Industry and Manufacturing fires
1968	66,000
1969	58,500
1970	56,200
1971	41,300

*NFPA published estimates.

Industry's success in lowering fire incidence is attributable to the incorporation of features such as sound construction, special attention to hazards, emergency planning, and wide use of automatic detection, alarm, and extinguishing devices.

consequences of fire, in short, depend on man-environment interactions.

We have already addressed the issue of what fire departments can do to reduce fire losses. In Chapter 20 we discuss what citizens can do to reduce fire losses. In this and the next four chapters, our concern is not with the human factors but with ways of altering the built environment to reduce fire hazards-through changes in fire safety technology, materials characteristics, building design and construction, and code regulation and enforcement.

The Environment as a Security Blanket

Before turning to environmental factors alone, it is appropriate to consider one aspect of the **man**-environment interaction that tends to be overlooked. The ways in which man acts upon the environment to cause fire come readily to **mind.** What is not so obvious is that the built environment influences the behavior of man in a way that aggravates the fire problem.

The modern urban environment imparts to people a false sense of security about fire. Crime may stalk the city streets, but certainly not fire, in most people's view. In part, this sense of security rests on the fact there have been no major conflagrations in American cities in more than half a century. In part, the newness of so many buildings conveys the feeling that they are invulnerable to attack by fire. Those who think only of a building's basic structure (not its contents) are satisfied, mistakenly, that the materials-concrete, steel, glass, aluminum-are indestructible by fire. Further, Americans tend to take for granted that those who design their products, in this case buildings, always do so with adequate attention to their safety. That assumption, too, is incorrect.

Around the turn of the century, in the wake of many conflagrations so-called fireproof buildings began to be constructed. They had thick walls and floors to keep fire from spreading. Like older buildings, they still had windows that could be opened to allow heat and smoke to escape. They had fire escapes or internal fire stairs, and seldom were they too tall for the topmost occupants to escape.

Fires, some of them disastrous, occurred in these buildings nonetheless. Then, after World War II, a new generation of buildings began to appear : the modern high-rise building. Lighter construction systems and many new materials were used, especially for interiors. Windows were permanently sealed so that central air conditioning would operate efficiently. Walls and floors were left with openings for air conditioning ducts and utility cables. Each of these features compromised the fire safety of these buildings.

The built environment was created to serve the needs of people. When a portion of that environment goes up in smoke, those needs are not being served. How the hazards in the built environment can be reduced is the subject to which we now turn.

Major turn-of-the-century fires, such as Baltimore's in 1904, aroused concern about fire safety in buildings.

9

THE HAZARDS CREATED THROUGH MATERIALS

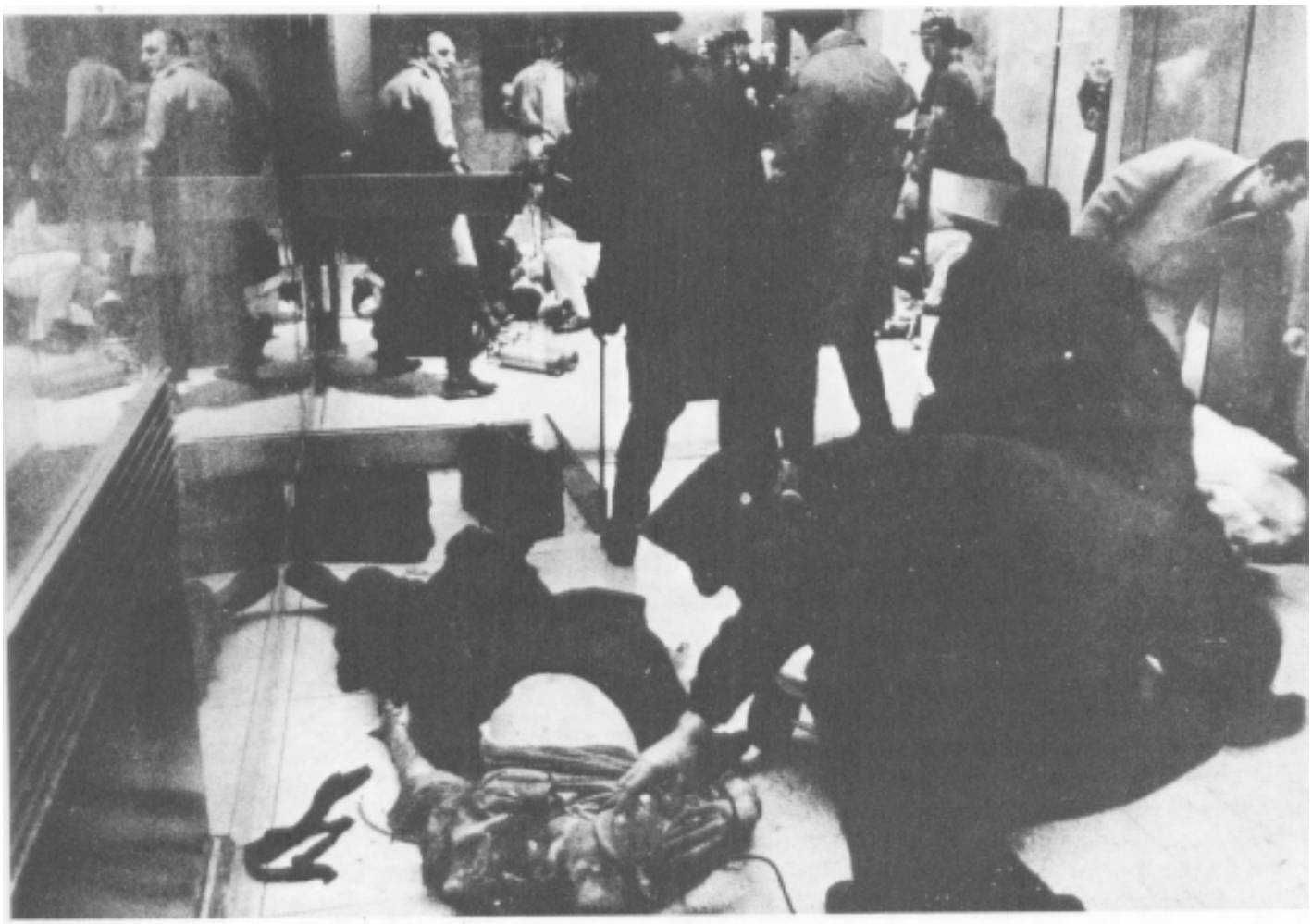
The dazzling terminal buildings at New York's John F. Kennedy Airport are virtually a museum of contemporary architecture. But one of those buildings has demonstrated that man's monuments to his technological genius can turn on him with a vengeance, at the mere touch of a flame.

The new west wing of the British Overseas Airways Corporation building at Kennedy International had not yet been opened to the public when, on August 26, 1970, it caught fire-probably at the hands of an arsonist. Swiftly, flames moved from one seat to the next along the 330-foot length of the wing. Gases from the incomplete combustion of the seats gathered in clouds along the ceiling. When flames approached the clouds, the gases ignited explosively, spreading the fire and igniting other groups of seats. The explosions knocked out the terminal's huge glass windows. As the ceiling melted, combustible liquid dripped toward the floor, further spreading the fire. In the end, all 600 seats in the wing were consumed. Damages totaled $2 million. The seats, which played the predominant role in spreading the fire, were like those in many airline terminals: layers of plastic and rubber foam covered by plastic upholstery material.

No lives were lost in the BOAC terminal fire. But 3 months later, a synthetic material was implicated in a fire that killed 145 teenagers. It happened in a door-locked dance hall in St. Laurent-du-Pont, France, that had been lavishly sprayed with a plastic foam to give the appearance of a cave. The fire raged furiously within seconds after it began, leaping "like a red panther in a small cage," in the words of one survivor,

By no means do synthetics stand alone as hazardous materials. A frame house can be a tinderbox. Restaurants decorated with natural materials, basements full of old newspapers and warehouses storing lumber or paper products provide the fuel for major fires. Inadequately protected structural elements of steel or concrete still collapse if a fire is intense enough. Burning silk and wool release deadly quantities of carbon monoxide and cyanide gas-and these and many other natural materials ignite at lower temperatures than many synthetics do. Plastics manufacturers contend that synthetics based on carbon, hydrogen, and oxygen exclusively are generally no more toxic, when burned, than natural materials. On the other hand, other synthetics containing sulfur and the halogens are not so innocuous

Although plastics production has doubled in the



In the modern environment of synthetic materials, smoke and toxic gases have become increasingly important hazards.

past 7 years, it is only about one-tenth that of wood, paper, and associated products. The contribution of plastics to the fuel load in buildings, especially older buildings where fires occur more frequently, is therefore certainly well under 10 percent. But their use is increasing. Wool rugs are giving way to synthetic fibers, wooden desk tops to plastics made to look like wood, glass lighting diffusers to clear plastic panels. There is hardly a use to which "classical" materials have been put that has not been challenged by synthetics. Clearly, the advantages which plastics offer to consumers and manufacturers are many, and plastics will fill an increasingly large proportion of the built environment.

What makes plastics relevant to our discussion of materials is not only that many of them have introduced hazards previously uncommon, but that they are sold and used without adequate attention to the special fire hazards they present. The major investigation of the 'fire problem of some plastics by the Federal Trade Commission has highlighted a form of misleading representation of the combustion behavior of certain plastics.

How to Die in a Fire

Most people, when they think of fire as a killer, think of flames. Those who have set fire safety standards for materials have emphasized flame resistance. Yet, in a list of the five ways in which fire can kill, when arranged in declining importance, flames rank last.[1]

Asphyxiation. Fire consumes oxygen from the surrounding atmosphere, thus reducing its concentration. If the oxygen concentration falls below

[1] This ranking and much of the following discussion is from Irving N. Einhorn, director of the Flammability Research Center, University of **Utah.**

17 percent, thinking may be an effort and coordination difficult. Below 16 percent, attempts to escape the fire may be ineffective or irrational, wasting vital seconds, With further drops, a person loses his muscular coordination for skilled movements, and muscular effort leads rapidly to fatigue. His breathing ceases when the oxygen content falls below 6 percent. At normal temperatures, he would be dead in 6 to 8 minutes.

Attack by superheated air or *gases.* With temperatures above 300° F., loss of consciousness or death can occur within several minutes. In addition, hot smoke with a high moisture content is a special danger since it destroys tissues deep in the lungs by burning.

Smoke. Inhalation of smoke-or, more correctly, of the products of incomplete combustion-kills people who suffer no skin burns at all. In addition to carrying toxic products, such as carbon monoxide and hydrogen cyanide, thick smoke may be laden with organic irritants, such as acetic acid and formaldehyde. In the early stages of a fire, the irritants, which attack the mucous membranes of the respiratory tract, are often the more important danger. Smoke often blocks the visibility of exits.

Toxic products. Many toxic components of smoke are responsible for the damage done-including oxides of nitrogen, aldehydes, hydrogen cyanide, sulfur dioxide, and ammonia, to name only a few. There is ample evidence that the hazard of two or more toxic gases is greater than the sum of the hazards of each. Moreover, low oxygen and high temperatures increase the toxic effects. In addition to toxic gases that attack the lungs, there are irritants that attack the eyes with blinding effect, preventing escape. Some fire gases dull the senses of the victim or his awareness of injury.

Flames. Since the aforementioned factors can debilitate, confuse, blind, or kill without warning, the person who goes to sleep confident that advancing flames will provide sufficient warning for escape may be taking a fatal gamble.

Until such time as all five of these hazards have been well-studied and controlled by materials standards, too little will have been done to control the built environment and thus reduce the gamble Americans take in their daily lives.

Ironically, efforts to make materials fire-retardant-that is, with less tendency to ignite or spread flames-may have increased the life hazard, since the incomplete combustion of many materials treated to increase fire retardancy results in heavy smoke and toxic gases. The technology of fire-retardance is often unsatisfactory in other respects: The additives are generally costly, can reduce the strength and weather resistance of the material to which they are applied, and often lose their effectiveness through washing or prolonged exposure to the elements.

Where There's Smoke, There's Damage

That concern about flames alone is insufficient is pointed up by the ample evidence that smoke and toxic gases are powerful forces of destruction. Smoke from restaurant fires renders uncontained food unusable ; fabrics permeated by smoke can be altered beyond use even after cleaning. And a little smoke can go a long way: A department store recently lost $100,000 of its merchandise and 3 days' business for cleanup-all because of smoke that seeped through walls from an adjoining building on fire.

Again, efforts to make materials flame-resistant have not always been beneficial. The sooty smoke given off by many of these materials leaves a thick, black coating on whatever it touches. Moreover, the chemical compounds added to reduce combustibility often contain halogens (bromine, chlorine, and fluorine) which are corrosive and toxic.

Why Be Half Safe?

According to the Society of Plastics Industry, Inc., manufacturers of plastics spend $40 million annually on research to improve the fire safety of their products. That organization issued to manufacturers, in 1964, a fire safety bulletin setting flammability standards for cellular plastics, Fire resistance or fire classification standards for all sorts of construction materials are set by such organizations as the American Society for Testing and Materials and the National Fire Protection Association. Building codes incorporate many of these standards. Underwriters' Laboratories, Factory Mutual Research Corp., and other organizations test materials to see that they comply with such standards.

Yet, for all these efforts, the American public remains inadequately protected from combustion hazards in their midst.

Smoke and toxic gases have been underrated hazards. Recognition of these hazards has come belatedly, with the result that there is still little understanding, and hence little quantifiable knowledge, of the destructive effects of smoke and toxic gases.

As a result, *there are no nationally recognized test methods for measuring smoke production (both rate and amount),* The American Society for Testing and Materials does have a tunnel test which measures the density of smoke produced. Development of more sophisticated tests-for example, ones which would measure toxic and corrosive products of combustion-is hampered by the complexity of the smoke problem. A single material can give off many different products of combustion under varying conditions of temperature, humidity, pressure, and other factors; burning cellulose, for example, can produce 96 different compounds.

Most tests do not simulate complexities of real fires. Nationally recognized test methods for evaluating the ignition and flame-spread hazards of conventional materials in conventional applications may not be appropriate for evaluating these materials when used in new ways or for evaluating new materials.

For example, the ASTM's tunnel test for building materials, devised long before the advent of plastics, would register a low rate of flame spread for a particular plastic, whereas, in a real fire environment, that same material will burn with an explosive intensity. As a result, architects, design engineers, building contractors, and ultimately the consuming public may grossly misinterpret or inappropriately extrapolate those test results as indicative of fire safety.

Existing large- and small-scale tests suffer from an inability to predict exact consequences of a real fire, particularly those involving foamed plastics. Improvement of test methods is dependent, to a large degree, on a better understanding of the basic processes of ignition and combustion and the mechanisms of fire retardancy and smoke generation and correlating these with actual fire experiences, **The Commission recommends that research in the basic processes of ignition and combustion be strongly increased to provide a foundation for developing improved test methods.**

The economic interests of manufacturers, installers, vendors, and others often run counter to stringent fire safety requirements. For example, in many West Coast communities, because of industry pressures and public preferences, building codes do not outlaw untreated wood shingle roofs, despite their potential for spreading fire.

Some important hazards are not covered by building codes. The fire safety requirements of building codes apply mostly to construction materials and interior materials used on walls and ceilings. Comparatively little attention has been paid to floors and floor coverings, since in the past their contribution to fire spread was minimal. The advent of synthetic rugs and tiles has made greater attention to floors imperative.

Building codes do not cover interior furnishings. While most political jurisdictions that have building codes also have fire prevention codes, designed to ensure fire safety after a building is constructed and occupied, the fire prevention codes, too, have little to say about interior furnishings. Moreover, seldom do fire prevention codes apply to private dwellings. Interior furnishings are not regulated partly because they are felt to be the province of the owner or tenant and partly because until recently there was no motivation to develop tests on which to base code provisions. They would, indeed, be difficult to regulate, since they are subject to continuing change.

While furnishings are likely to remain outside of code provisions, the fact that they contribute significantly to combustion hazards means that building codes only partly satisfy the demands of fire safety. The present practice can be compared to installing a burglar alarm at the front door and leaving the back door wide open. Only to a limited extent is this mitigated by Federal flammability standards for fabrics.

Consumers use materials with inadequate knowledge of their combustion hazards. Except for flammable liquids and the materials that are used in appliances and wiring, few of the materials that go into the home carry labels vouchsafing their fire resistance or warning of their hazards. The unlabeled hazards are found in draperies, rugs, storage cabinets, upholstered chairs, and other furniture. At present, the housewife working at the kitchen range has no way of knowing that her shiny new kitchen cabinets over-.

Although considered “safe” by standard tests, this foamed plastic wallboard burns furiously in a “corner” test.

The plastic drawer fronts lack the fire resistance of the wood they simulate, and some synthetic garments burn furiously.

head are an invitation to a disastrous fire if their surface is a hot-dip polystyrene coating. A sudden flare-up from burning grease in a skillet might readily ignite the finish on the cabinets, and in no time at all fire could spread explosively throughout the kitchen.

Clearly, homeowners and building tenants need to know the relative hazards of furnishings as well as other materials so that they can minimize the risks, Fire inspectors, whether enforcing a fire prevention code or educating homeowners and tenants, need to know the hazards to carry out their tasks effectively,

New Efforts by Government and Industry

Federal initiative is needed to help close the gaps left by the voluntary action of industry and the loopholes in material standards and building codes.

In 1972 Congress created the Consumer Product Safety Commission, authorizing it to "conduct research, studies, and investigations on the safety of consumer products and on improving the safety of such products." The Commission can set standards of composition and design which

consumer products must meet; it can require labeling of hazards or instructions for safe use; it can ban products that present "an unreasonable risk of injury."

The materials that go into the built environment come under the purview of the Consumer Product Safety Commission. **This Commission recommends that the new Consumer Product Safety Commission give a high priority to the combustion hazards of materials in their end use.** Specific needs are refined understanding of the destructive effects of smoke and toxic gases, development of standards to minimize those effects, development of labeling requirements for materials, and outright ban of materials in uses that present unreasonable risks.

The development of a labeling system identifying combustion hazards is especially important. The purpose of such a system is not to regulate the lives of Americans, as an overly rigorous set of standards would do, but to enable consumers to evaluate the combustion hazards of the materials and products they bring into their homes. Further, in public buildings, nursing homes, and other occupancies subject to regulation, the labeling system would enable inspectors to verify adherence to fire load requirements. Though considerable research and testing would be needed, the eventual goal of the labeling program should be to identify fuel contribution, smoke production, and the production of toxic and corrosive gases, as well as such characteristics as ignition temperature and flame spread.

We feel we should be candid in expressing our concern that, because the Consumer Product Safety Commission is still in its formative stages, and because other hazards (many of them better publicized than combustion hazards) will be competing for attention, the problem of fire safety may become a delayed priority. The Consumer Product Safety Commission could, on the other hand, give early and deserved attention to the problem of fire safety by tapping the research capabilities of the National Bureau of Standards, universities, the national standards and testing organizations, and private industry, through contracts and cooperative arrangements.

Indeed, we do not see the Consumer Product Safety Commission supplanting the efforts in the private sector, but complementing them, For one thing, the program we have recommended is extensive and long-range. Protection of the public cannot await completion of such a program; other steps must be taken. Material producers owe to various publics----building designers, code officials, fire service personnel, and consumers an expanded and more candid effort to explain the fire charactertistics of the materials they sell.

Further, the emergence of labeling requirements for materials will not eliminate the need for technical reports-that is, papers describing test data in detail. There will continue to be a body of technically oriented users who need detailed analyses.

Technically oriented users will, for example, have to have knowledge of fuel loads beyond that provided by the labeling system. In this connection, **the Commission recommends that the present fuel load study sponsored by the Gcnera1 Services Administration and conducted by the National Bureau of Standards be expanded to update the technical study of occupancy fire loads.** The information in the National Bureau of Standards' "Building Materials and Structures # 149," a report on various fire loads found in different occupancies, published in 1957, is now largely out of date.

Flammable Fabrics

In 1971, the Department of Health, Education, and Welfare reported that, in recent years, more than 3,000 Americans die annually after their clothing catches on fire, and more than 150,000 are injured from this cause. One out of four whose clothing catches fire is a child under 10. Those 65 and over account for 15 percent of the clothing fires, even though they are less than 10 percent of the Nation's population. The very young and the old are also the persons least able to tolerate burns.

When clothing catches fire, the extent and depth of burns arc more severe than skin burns on uncovered areas; from the standpoint of fire safety, the human species would be better off naked. A recent study by the National Burn Information Exchange showed that clothing burn victims were four times more likely to die than burn victims spared clothing fire. Their burns covered nearly twice as much body surface.

The power to set flammability standards for

fabrics now resides with the Consumer Product Safety Commission. During the 5 years that the flammable fabrics program was shared by the Department of Commerce, the Federal Trade Commission, and the Department of Health, Education, and Welfare, only a few standards were promulgated : those for young children's sleepwear (up to size 6X), rugs, small carpets, and mattresses.

These standards do nothing to protect the elderly smoker, the housewife whose sleeve passes over the kitchen burner, or the group of 8-year-olds playing with fire in a vacant lot. Notably they bypass most children between the ages of five and nine, who account for 13 percent of clothing fire accidents.

The Commission recommends that flammability standards for fabrics be given high priority by the Consumer Product Safety Commission. Specific needs are research to improve fire retardant processes, extension of flammability standards to further categories of fabric use, development of labeling requirements for other categories, and educational efforts to make consumers aware of fire hazards from clothing and other fabrics. The Commission does not favor unbridled extension of flammability standards to all categories of fabrics. Only grossly hazardous fabrics and fabrics implicated in a very large number of fire accidents should be banned from the marketplace. A preferable direction of emphasis is toward labeling requirements as to combustion hazards. This would honor the cherished principle of free choice, while at the same time informing consumers of potential risks and reminding them of the importance of fire. If reinforced by consumer education on fire safety, labeling requirements would have the effect of spurring manufacturers to improve the flame-resistance of fabrics.

Fireworks

One material hazard that has declined over the years, but not to the point of negligible concern, is fireworks. In recent years, fireworks have claimed an average of about 600 reported injuries and 10 deaths annually. Sixty years ago the annual toll from fireworks was more than 5,000 injuries and 200 deaths.

In 1938, the National Fire Protection Association published its "Model State Fireworks Law" (NFPA 494L), which, where enacted, prohibits the use of all fireworks except those in supervised public display?. Today, a majority of Americans remain insufficiently protected from fireworks accidents, since only 18 States have laws as stringent as the NFPA's model law and an additional eight have laws similar to the model but with exceptions. **The Commission recommends that all States adopt the Model State Fireworks Law of the National Fire Protection Association, thus prohibiting all fireworks except those for public displays."**

The Importance of Research

Adequate regulation of materials in the built environment depends upon adequate testing, and adequate testing, in turn, depends on adequate understanding of combustion and its hazards. That is not to say, however, that progress cannot be made at all three levels simultaneously.

Improved testing methods are being pursued. Scientists and engineers at the National Bureau of Standards, for example, are utilizing a smoke chambler which measures, in addition to the density and rate of smoke produced by a sample, the concentration of specific gases emitted. Experts there and elsewhere arc improving devices for measuring heat release, ignitability, flame spread, and fire endurance. Other scientists are working on model testing techniques to simulate the conditions of full-scale fires,

The technology for more sophisticated testing and the technology for basic research on fire overlap, and the two activities go hand-in-hand. It is appropriate that the National Bureau of Standards continue to provide leadership in both these areas. The Consumer Product Safety Commission should champion the strengthening of NBS efforts in these areas. At the same time, ongoing efforts of university scientists, manufacturers, and industrial testing laboratories should be encouraged and expanded.

[3] The National Society for the Prevention of Blindness. Inc., lists the following groups as supporting the limitation of all fireworks to licensed public displays only: the American Academy of Pediatrics, the American Public Health Association, the California Fire Chiefs Association, the Fire Marshals Association of North America, the International Association of Fire Chiefs. the National Fire Protection Association, the National Safety Council the National Society for the Prevention of Blindness, Optimist International.

One basic goal of research should be to improve understanding of the dynamics of fire-not of flames alone, but of smoke, heat, toxic gases, and oxygen depletion, which together cause more deaths than flames do. **The Commission recommends that the Department of Commerce be funded to provide grants for studies of combustion dynamics and the means of its control.**

Medical research is also pertinent. In Chapter 2 we recommended that the National Institutes of Health undertake a major program of research concerning smoke inhalation injuries. One outgrowth of that research should be new knowledge concerning human tolerances of various products of combustion. From this knowledge standards can be derived setting maximum allowable outputs of various products of combustion for materials. **The Commission recommends that the National Bureau of Standards and the National Institutes of Health cooperatively devise and implement a set of research objectives designed to provide combustion standards for materials to protect human life.** It would be appropriate for NIH to bring these objectives to the attention of the community of medical scientists, to incorporate appropriate objectives in its own research programs, and to transmit to the Consumer Product Safety Commission pertinent research results.

A Question of Priorities

The hazards of materials in the built environment will never be eliminated completely, and they cannot be significantly reduced overnight. Tinderbox houses will remain in the environment until economic circumstances favor their replacement or until wear and tear dictate their removal. In settings where we are forced to live with hazardous materials, we must turn to engineering means-automatic sprinklers, for example, or early-warning detection and alarm systems-to compensate for the dangers. But for the future, we as a Nation cannot rely on these systems alone to protect us; the materials themselves must be improved for fire safety. True, a building constructed of fire-safe materials and having an automatic extinguishing system as well offers a certain redundancy of protection. But one without the other leaves open possibilities of disaster.

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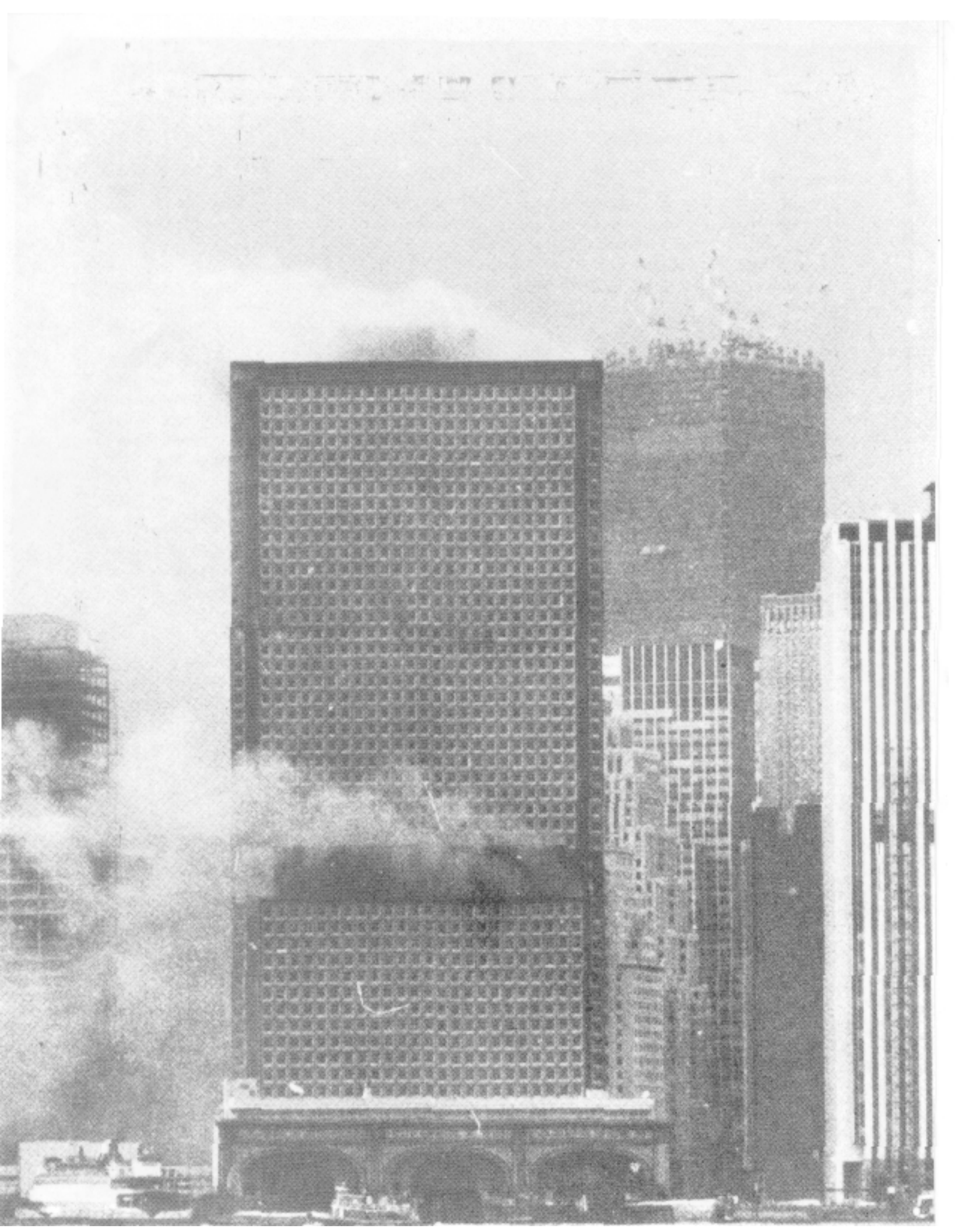


10

HAZARDS THROUGH DESIGN

In the afternoon of August 5, 1970, fire broke out on the 33rd floor of One New York Plaza in lower Manhattan. The air conditioning system spread smoke throughout the building. Smoke and hot gases shot upward through the gaps between floor slabs and exterior walls. An elevator was automatically summoned to the 33d floor, the products of combustion activating the call button. The elevator jammed there, and two people died.

Other features of high-rise design contribute to the hazards of fire: sealed windows that cause heat to build up, interior materials that give **off** thick smoke and toxic gases when afire, utility channels and other gaps in walls and floors that spread smoke and gases. Elevators can be death traps. Exitways can very quickly become overcrowded. When fire breaks out on upper floors, beyond the reach of ladders, firefighters must lug heavy hoses up the stairways.

From the standpoint of life loss, high-rise buildings have made a very small contribution until now. But they are a matter of special concern. Recent high-rise fires in other countries with heavy life loss suggest that luck may run out for the United States. On Christmas Day, 1971, 163 died in a hotel fire in Seoul, Korea. Two months later, 16 died and 375 were injured when fire consumed a high-rise in Sao Paulo, Brazil. As more and more Americans choose to live or work in high-rise buildings, their importance as a fire problem will increase.

But high-rise buildings are not the only modern creation in which design impairs fire safety. In many homes, stairwells help to carry fire and the products of combustion upward to sleeping areas. Slim horizontal windows under the eaves of single-story dwellings-a fashionable feature of ranch-style homes-hamper rescue efforts. Two children died in a Maine fire because firemen couldn't get through windows of this type. Tragedies of this sort have recurred many times,

Clearly, fire safety lags behind other considerations, such as aesthetics and economy, in the design of buildings. There are a number of reasons for this.

Fire safety analysis is lagging behind innovation in building design. For example, there is an understandable trend toward ever-lighter structural members which reduce the cost without significantly reducing strength. Building designers introduce these innovations while two important questions go unanswered. First, arc the structural

members adequately protected from fire for the entire life of the building as well as during a fire that may occur tomorrow? Second, are existing tests for fire safety adequate for measuring the fire protection afforded by the particular innovation?

There is little incentive to invest in fire safety. Clients of building designers, to the extent that they think of fire safety at all, believe fire is a small risk in the future of their building. Or they judge that potential losses are adequately covered by their insurance policies. Owners of private homes might build in fire protection if their insurance premiums were thereby reduced, but no such incentive exists. While the reduced-premium exists for builders of commercial and industrial building?, the fire safety requirements for reduced rates often are not extensive.

For the designer, the chief goals are to plan a building that serves its intended architectural function, as pleasing in appearance as can be done, and as cheaply as possible. With top priority being placed on these goals safety becomes, for most designers, nothing more than a necessary evil for compliance with local codes.

Building codes have characteristics which encourage the outlook that they are nuisances. New requirements are piled on top of old and outmoded ones, with the effect that the codes become increasingly inflexible. Often the requirements are excessive : For example, in places where the contents that will be added would all burn in about half an hour, requirements for 3 to 4 hours of fire resistance in bearing walls are not uncommon. While excessive requirements exist for some characteristics, early warning of occupants, smoke movement, and toxic gas production are virtually ignored.

Tested uses and actual uses of materials can be two different things. The set of conditions under which materials are tested by manufacturers and private test laboratories may represent only a segment of the uses to which those materials are actually put. When a designer uses a material in a way that has not been tested, he has no way of knowing how or whether the fire safety characteristics are different.

The knowledge on which fire safety standards are based is deficient. Fire safety standards are based mostly on judgments gained from actual fire experience and on a limited range of conditions used in testing. They are based, in other words, on empirical knowledge rather than fundamental understanding of the behavior of fire. This lack of theoretical and experimental underpinnings contrasts sharply with such fields as mechanical or electrical engineering. In the latter field, for example, the effects of changing the diameter of a wire, or the design of a circuit, **or** the amount of current pushed through the system can be expressed as mathematical equations and predicted quite accurately. If such equations could be written to predict the effects of fire and its combustion products, then changes in a material or its use would lead to known changes in fire safety characteristics-without expensive testing.

From Research to Application

In 1969, the Committee on Fire Research of the National Research Council published its report, *A Proposed National Fire Research Program.* Thorough in its scope, the report will provide a helpful guide to fire research priorities in the decade of the Seventies. Much of the basic research on fire behavior recommended by the report will have a bearing on how buildings ought to be designed to minimize fire hazards.

Four years have passed since the report was issued. An assessment of what has been accomplished thus far is imperative. In areas of research where an added push is needed, additional research should be encouraged. In areas where results have begun to come in, efforts should be made, to incorporate the new information into a systematic body of fire analysis and to explore the implications for codes and building design.

The Commission urges the National Bureau of Standards to assess current progress in fire research and define the areas in need of additional investigation. Further, the Bureau should recommend a program for translating research results into a systematic body of engineering principles and, ultimately, into guidelines useful to code writers and building designers. No less important than the needs of designers of large structures are the needs of designers of single-family houses. The National Bureau of Standards should carry out these responsibilities in cooperation with other government agencies, nationally

This new Third Avenue building met New York City's building code, yet three died and 20 were injured in the fire.

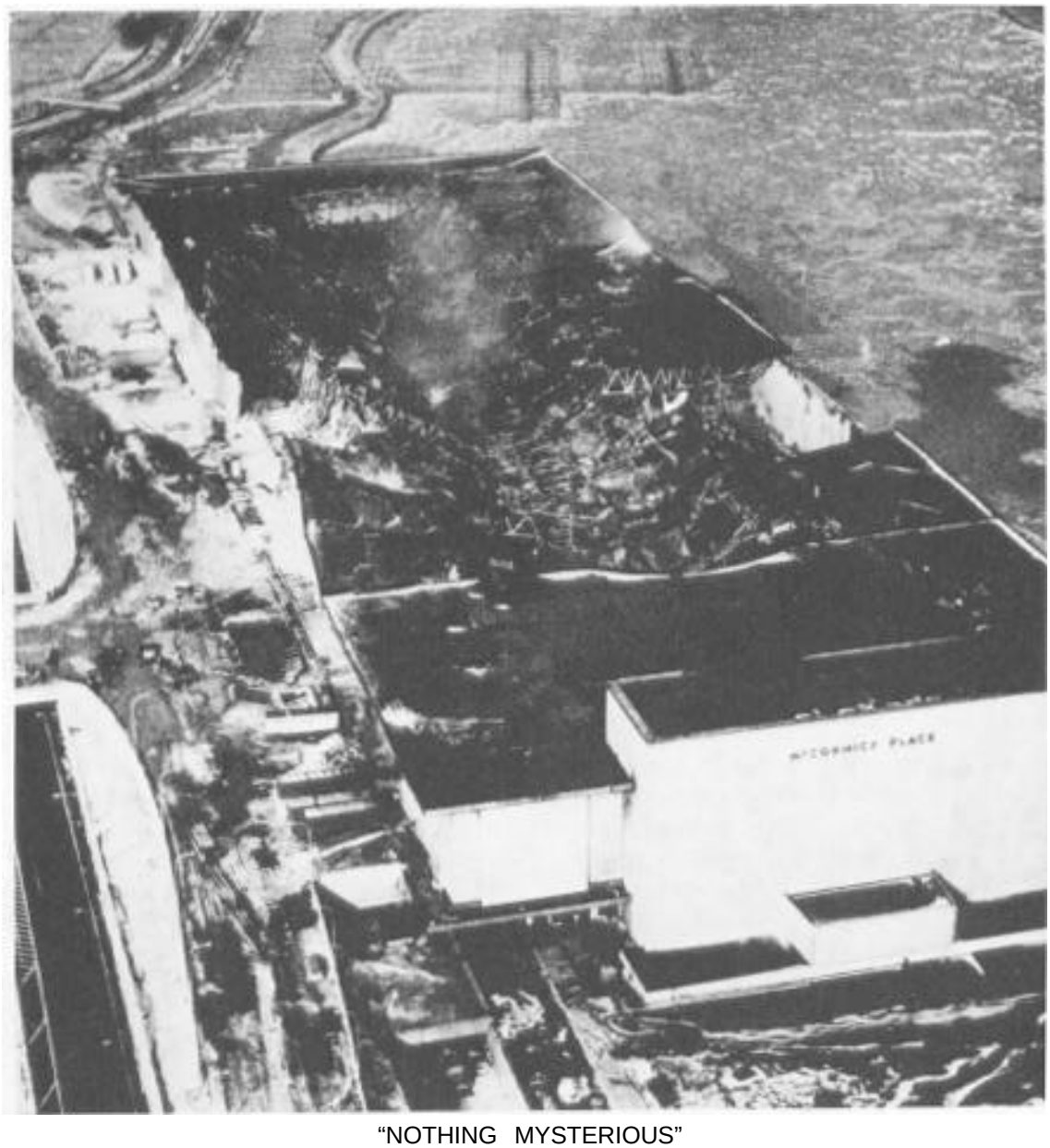
recognized testing and research laboratories, and with the major standards-writing organizations : the National Fire Protection Association, the American National Standards Institute, and the American Society for Testing and Materials.

What Can Be Done Today

The present state of fire protection engineering does not leave today's building designer in a condition of helplessness. Much of what is known about fire safety is simply being ignored. Indeed, enough is known about fire safety to permit a reliable application of a sophisticated systems approach to fire safety design. In the systems approach, in contrast to the "that's the way it's always been done" approach, objectives are set for the building as a whole, and then the most cost-effective technology is applied to meet those objectives, In such an approach, relationships among components are important, and trade-offs are sought. For example, if alarm and sprinkler systems are installed to provide quick and effective response to a fire, then fireproofing requirements for walls and floors may be reduced. Another important aspect of the systems approach is that backup measures are provided in case part of the system fails. But redundancy for the sake of redundancy is avoided.

A systems approach was taken in the design of San Francisco's Transamerica Building in 1971. In addition to a full sprinkler system, smoke detection devices, and a central alarm system, the designers provided the building with emergency refuge areas, two-way voice communications with public areas, and an underground communications and command control center. Windows pivot so that burning rooms can be vented. In the event of a power failure, diesel pumps will maintain water pressure, and a diesel-run generator will light exitways and power the elevators. Should city fire mains be disrupted, there is an emergency water supply. While these provisions are costly, they are offset by savings they allowed : lower fire resistance requirements for floors and corridors, the elimination of fire dampers from the air conditioning system, and a sprinkler system that permitted the use of smaller pipes.

The General Services Administration has also adopted a systems approach, its first result being the Federal Office Building in Seattle. The build-



"NOTHING MYSTERIOUS"

Poor judgment often results in unnecessary fire potential in buildings. In the fire that consumed McCormick Place, Chicago's convention hall, in 1967, two gross errors in design contributed to the extensive damage. On the assumption that temperatures could not reach a level to threaten the roof structure, the designers left the steel joists unprotected ; the roof collapsed during the fire. Second, large aluminum space dividers were installed directly over expansion joints in the floor, with the result that molten aluminum flowed through the expansion joints into the lower level. In addition, exhibitions in McCormick Place often added a heavy fuel load in the form of flammable displays, yet the building had no sprinkler system.

As a result of its investigation the National Fire Protection Association concluded that "the principles of good fire protection have been known for many years and there was nothing mysterious about the destruction of McCormick Place. The building was almost entirely unprotected from a fire hazard so great that one wonders why it was not obvious all along."

ing was given a structural integrity three to four times as strong as the most severe situation will call for it to withstand. Each story was made a self-contained, fire-resistant compartment. When a fire breaks out-and the GSA estimates that about 100 ignitions will occur in the next 50 years-one of several alarm systems will notify the Seattle Fire Department and the emergency control center in the building. Immediately, a prerecorded tape will broadcast instructions to people on the fire floor. Air flow will be adjusted to prevent smoke and other products of combustion from spreading. Elevators will be "captured" and reserved for handling the emergency. As with the Transamerica Building, the costs of these provisions are largely offset by savings in other aspects of the building's design.

The systems approach used by the architects of the Transamerica Building and the GSA Applies to one class of buildings. Similar approaches could be devised for other classes of buildings, including one-family residences. **The Commission recommends that the National Bureau of Standards, in cooperation with the National Fire Protection Asssociation and other appropriate organizations, support research to develop guidelines for a systems approach to fire safety in all types of buildings.**

A different kind of study, though a natural outgrowth of a fire safety systems analysis, is what we have designated as *a fire safety effectiveness statement.* This is an attempt to state, in quantified terms, the potential losses of life and property (both inside and surrounding the structure) should the structure catch fire. The better the design and built-in fire protection of the building, the closer these quantities will approach zero. The effectiveness statement should pay particular attention to the consequences of fires starting in areas of the structure where people or highly flammable materials are concentrated. An additional set of calculations, designed to measure the adequacy of back-up measures, should be based on assumptions of system failures, such as power blackouts or non-functioning smoke detectors. While revealing whether adequate safeguards have been provided, the effectiveness statement has the added value of stating, through implication, the demands that would be put on local fire services should a fire occur. Fire safety effectiveness statements are particularly important for high-risk structures, such as shopping centers, public buildings, fuel storage depots, tankers, and chemical plants.

The Federal Government, through the General Services Administration, has set a valuable example for the private sector through its pioneering work in fire safety systems analysis. A governmentwide example should also be set in the area of fire safety effectiveness statements. Accordingly, **the Commission recommends that, in all construction involving Federal money, awarding of those funds be contingent upon the approval of a fire safety systems analysis and a fire safety effectiveness statement.** The funding agency would certify that the analysis and effectiveness statement have met its fire safety standards.

Product Design

It is not just the large structures of the built environment that need improved design if fire losses are to be reduced. Many products need design improvement. Heating and cooking equipment, faulty wiring, and electrical appliances are major causes of fires. Together with fires caused by smoking and matches, these categories account for nearly half the fires that occur (see Table 8-2).

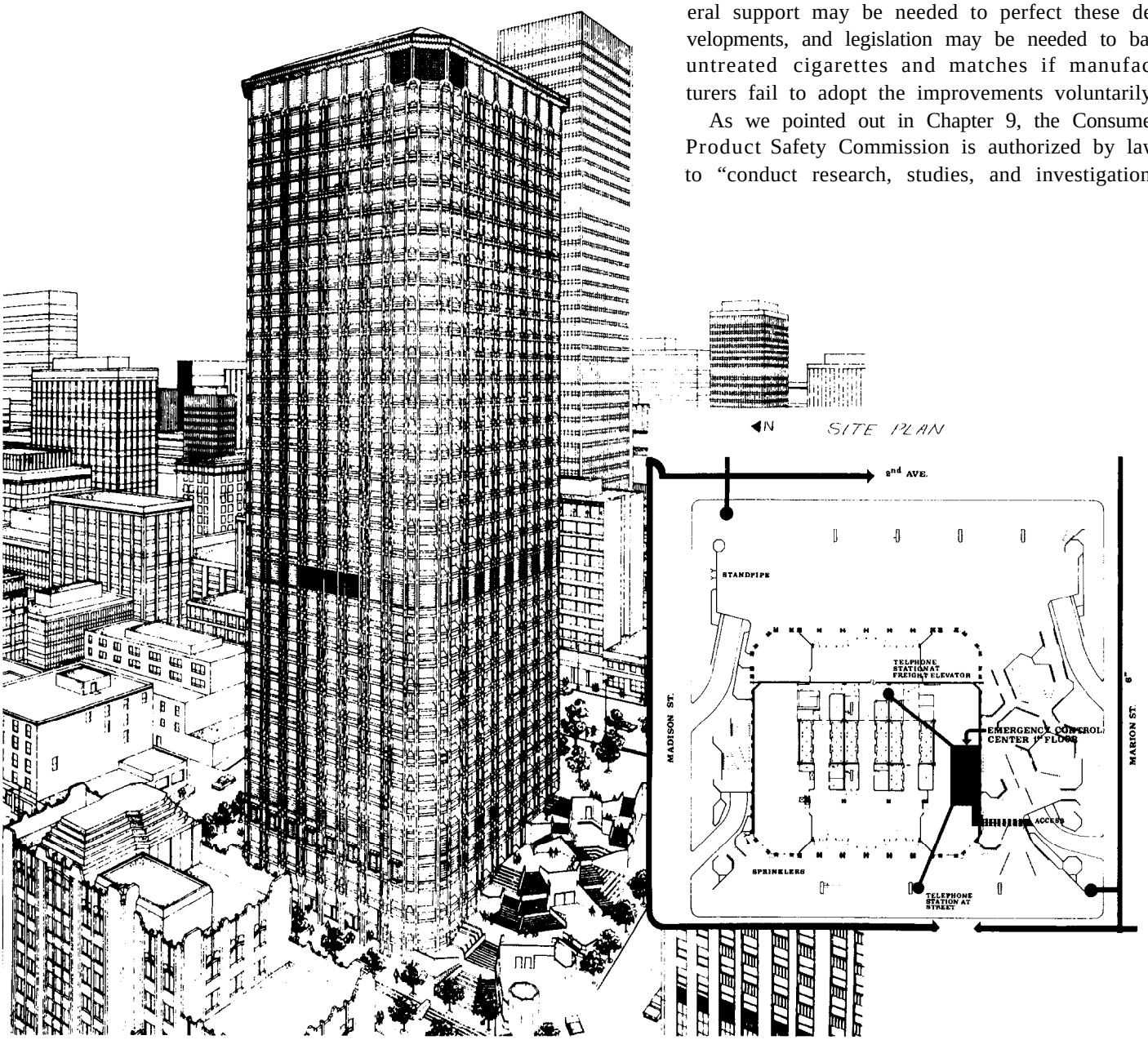
Over the years, manufacturers and standards-writing organizations have developed ever-improving safety standards in the design of consumer products. Yet some hazards have not been adequately covered. The National Commission on Product Safety, in its 1970 report, identified color television sets, floor furnaces, hot-water vaporizers, and unvented gas heaters as specific fire or burn hazards. Under "unfinished business"-possibly hazardous products the Commission did not study-were listed electric blankets, dryers, hotplates, extension cords, and space heaters. Further studies of fire experience might bring other hazards to light, particularly those that arise from wear and tear. Such studies now lie within the purview of the Consumer Product Safety Commission.

The business of making consumer products safe from fire and burn hazards is, in many cases, recognizably a complicated matter. When kitchen range controls were at the front of the stove, children could reach them and cause burner acci-

dents; now that they are at the back, they can be hazardous to the clothing and skin of people reaching for them over hot burners. No doubt today's appliances could be made completely safe, but food wouldn't get cooked, toast wouldn't get toasted, and clothes wouldn't get ironed. But advances are possible. Within the grasp of technology are burners that can only be activated by the weight of specially designed, snugly fitting pans. (Here, too, one must settle for imperfection; there is residual heat in the burner once the pan is removed.) Further, scientists are working on the principle of generating heat within the substance to be heated, through induction of friction between molecules.

Technology is also being developed to treat cigarettes and matches to minimize their potential for accidentally igniting destructive fires. Federal support may be needed to perfect these developments, and legislation may be needed to ban untreated cigarettes and matches if manufacturers fail to adopt the improvements voluntarily.

As we pointed out in Chapter 9, the Consumer Product Safety Commission is authorized by law to "conduct research, studies, and investigations



For the Federal Office Building in Seattle, the General Services Administration has used a systems approach to fire safety.

on the safety of consumer products and on improving the safety of such products." Since burns are a major form of injury from consumer products, it will be appropriate for that Commission to devote a significant portion of its energies and resources to fire and burn hazards. **This Commission urges the Consumer Product Safety Commission to give high priority to matches, cigarettes, heating appliances, and other consumer products that are significant sources of burn injuries, particularly products for which industry standards fail to give adequate protection.** All of the Commission's important weapons might be brought to bear against these hazards: the setting of standards of performance, design, or materials for consumer products; the requirement of adequate warning labels and user-instructions; and the banning of products that are unreasonable risks to consumers.

Educating the Designer

Few formal education programs anywhere in the United States for architects and engineers have course requirements in fire protection engineering. (Only the University of Maryland and the Illinois Institute of Technology offer 4-year Bachelor of Science degree programs in fire protection engineering.) While some professional societies have committees concerned with fire safety, few designers take an interest in the committees' work. For lack of training, many designers are unable to understand highly technical reports in fire safety design.

This absence of training helps to explain the unenthusiastic attention which architects and engineers, when designing buildings, give to fire safety provisions. If the situation were turned around--that is, if architects and engineers were schooled in the principles of fire safety--then undoubtedly they would participate enthusiastically in the search for alternative solutions and better codes consistent with the principles of fire safety.

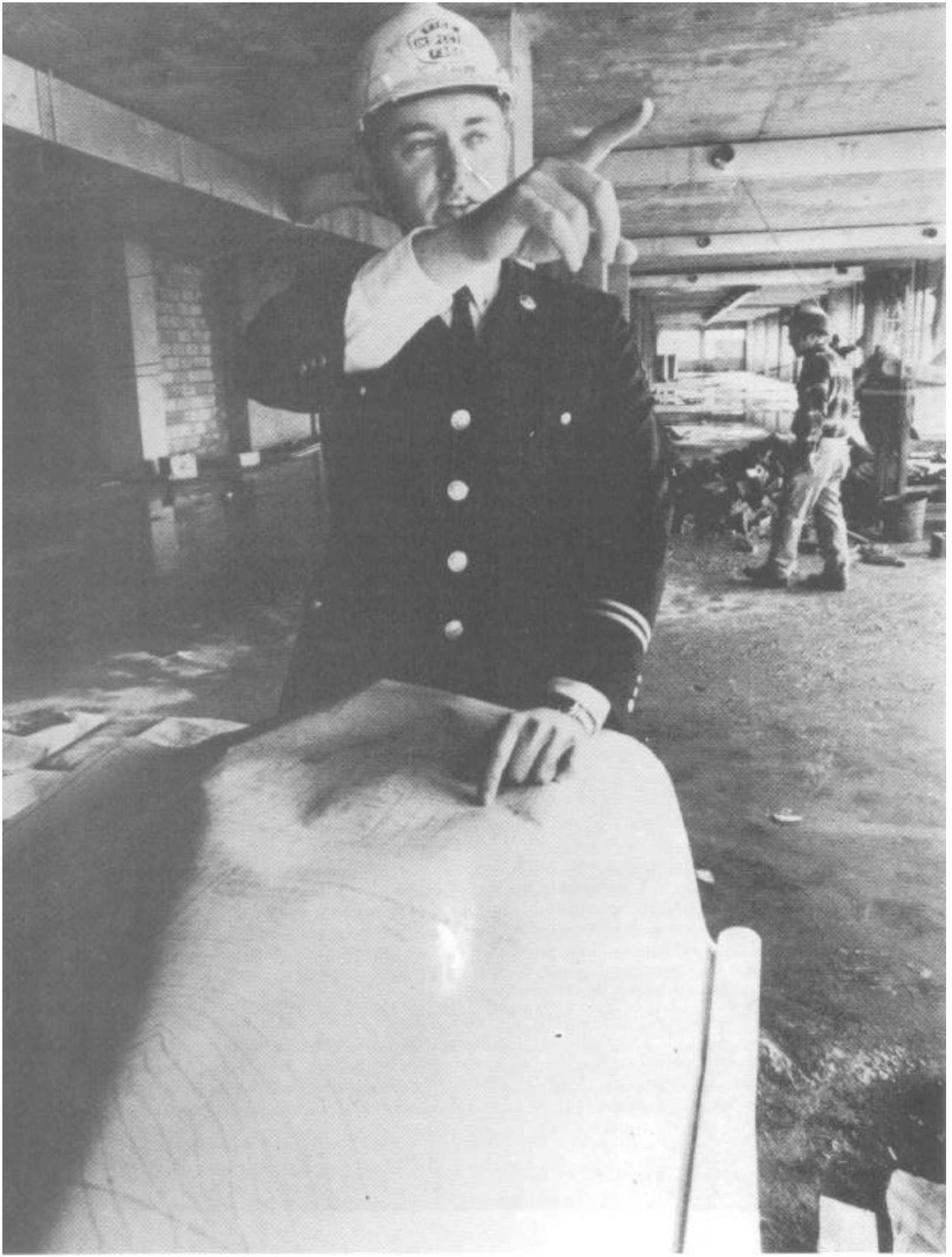
The Commission recommends to schools giving degrees in architecture and engineering that they include in their curricula at least one course in fire safety. Further, we urge the American Institute of Architects, professional engineering societies, and State registration boards to implement this recommendation. Registration boards could require a specific number of credit hours of fire protection engineering to qualify for State licensing for appropriate disciplines within architecture and engineering. After a suitable time to allow local initiative on this recommendation, Federal funds for engineering and architectural schools might be contingent upon those schools having adequate fire protection engineering requirements as part of the degree curriculum.

We recognize that, at present, if the emphasis is to be on basic principles, there is not a great deal available to be taught to architects and engineers in the realm of fire protection engineering. Deciding what *can* be taught-and what should be taught-requires careful study. **The Commission urges the Society of Fire Protection Engineers to draft model courses for architects and engineers in the field of fire protection engineering.** To this end, the Society should call together educators in architecture and the principal engineering disciplines to discuss what information would be desirable to teach architects and engineers.

Since it will take several years to develop fire safety courses in architectural and engineering schools, then several more years before those who have had this training begin to practice, the impact of these curricular additions will not be felt for some time to come. Practicing building designers must also be educated in fire safety. **The Commission recommends that the proposed National Fire Academy develop short courses to educate practicing designers in the basics of fire safety design.**

There is presently enough information and a wide range of technological choices (for example, total communicationssystems, fire retardants, fire-resistant coatings) to permit architects, engineers, and other building designers to plan buildings that are safeguarded from fire. What is needed, in many cases, are incentives.

Positive incentives are likely to come about through example. We are encouraged that the Federal Office Building in Seattle is serving as a beacon to the community. Now owners of Seattle office buildings still on the drawing boards are applying the same kind of systems approach to provide the best building possible as a way of insuring full rental. They feel they must be able to show potential renters that their building is, among other things, fire-safe.



11

CODES AND STANDARDS

For centuries, governments have exercised the right to regulate how buildings are built for the sake of the public's protection. In the time of Julius Caesar, Roman laws regulated the height of buildings and the distances between them. During Queen Anne's reign, the English found it necessary to have a code to require non-combustible roofs. By the time of America's settlement, the legal concept of codes was well-established. In 1796, for example, the city of New Orleans, then a Spanish province, passed an ordinance against the use of wood roofs.

The public interest justifies these intrusions on individual liberty, but what constitutes the public interest has been a subject of debate and change. Is continuity of business operations in the public interest? States maintain that it is, thus justifying strict code requirements in private industrial plants.

Fire safety is only one aspect of the public interest-and, hence, only one of many matters governed by codes-but in the wake of major conflagrations that struck a number of American cities at the turn of the century, it became a concern of major importance. In 1905, the National Board of Fire Underwriters (now the American Insurance Association) developed and published the National Building Code, the first "model" building code. It had no legal status of its own, but was intended to provide guidance to State and local jurisdictions for the enactment of legal codes. Because its concern was principally central city areas, the code emphasized converting downtown areas from combustible construction, providing adequate separation between buildings, and providing area limits and fire-resistive separations within buildings.

Other model codes have been developed over the years: that of the Pacific Building Officials Conference (now the International Conference of Building Officials) in 1927, that of the Southern Building Code Congress in 1945, and that of the Building Officials Conference of America (now the Building Officials and Code Administrators International, Inc.) in 1950. All of these codes are subject to periodic updating.

None of the model codes is sufficient unto itself. All make references to extensive lists of standards developed by other organizations. These standards usually specify the performance a material or structural member must achieve under certain conditions. Standards are written by such organizations as the American National Standards Institute, the American Society for Testing and Materials, and the National Fire Protection Association.

In addition to the model building codes, there exists the Life Safety Code, published by the National Fire Protection Association. Its intent is ***to*** strengthen provisions for protecting the occupants of buildings, rather than saving the building itself. It covers construction, protection, and occupant) features relative to life safety.

Model codes are not the only source of construction regulations. The Federal Government exerts leverage on the construction industry through such documents as the Minimum Property Standards of the Department of Housing and Urban Development, the safety standards of the Occupational Safety and Health Administration, and the minimum requirements of the Department of Health, Education, and Welfare for grant programs or social security assistance.

Local Code Provisions

The situation of the model codes is complicated, but not nearly as complicated as matters at the local level of code adoption. In addition to the *building code,* for which the model codes are intended to provide guidelines, State and local jurisdictions may have more than half a dozen other codes. A building code, of course, applies principally to new construction and alterations, though it is sometimes made retroactive and applied to existing buildings if past deficiencies are discovered to be critical. Once a building is constructed, a *fire prevention code* may govern the maintenance of the building and the introduction of materials into the building for the sake of fire safety,

Frequently there are other codes as well :

- The *housing* code, which is concerned with livability and sets standards for sanitation and health facilities and building maintenance;
- The *electrical code,* which sets requirements for the materials and equipment used in the electrical system;
- The *plumbing code,* which provides for the delivery of potable water and the safe disposal of flushed wastes;
- The *mechanical code,* which applies to the heating, ventilating, and air conditioning systems;
- The *elevator code,* which governs the materials, equipment, and installation of elevators and their use.

In a city there may be as many kinds of inspectors as there are codes, of which only the fire prevention inspectors are likely to be members of the fire department.

The two most important codes from the standpoint of fire safety arc the Building code and the fire prevention code. Typically, two-thirds to three-fourths of the provisions of a building code apply to fire safety, as do all the provisions of a fire prevention code.

How these codes are adopted varies from one jurisdiction to another, but generally there are public hearings preceding action by the city council or the State legislature. Material manufacturers, suppliers, contractors, labor unions, trade associations, and civic groups are given the chance to support the proposed code or recommend changes. Considering that these groups often differ in their degree of expertise, that they make conflicting claims, and that some do not have fire safety uppermost in their minds, it is hardly surprising that codes are products of compromise amid competing aims and viewpoints. Nor is it surprising that there are wide differences among the 14,000 local building codes that exist in this country. As the National Commission on Urban Problems remarked in its 1968 report, “Building code jurisdictions are thousands of little kingdoms, each having its own way; what goes in one town won’t go in another-and for no good reason.”

Evidence of the diversity in local codes was discovered during that Commission’s survey of the Nation’s 52 largest cities. Only 14 were using one of the model codes, 20 had regulations based on the model codes but with significant changes, 13 had adopted codes of their own, and one followed a State-recommended code. (Four cities did not reply to the survey.) Differences among these local codes are not inconsequential; often the process of political compromise leads to serious compromise in fire safety. Here and there in this report we cite examples of tragic fires in buildings that met all local building code requirements.

Feeding the diversity among local codes are the differences among the national model codes. The model codes differ markedly in such matters as permissible heights and areas, interior finish requirements, and specifications of safe travel dis-

tances for occupants. At the local level, then, a spokesman for a particular point of view, whether on the side of leniency or stringency, can appeal to the authority of the one model building code which among the four best matches his position. If his subject is fire prevention codes, he has three model codes to pick from.

Attempts to develop some uniformity among the model codes have had limited success. The Model Code Standardization Council, which includes representatives from the Nation's building standards-writing organizations, has been working on uniform definitions of building construction terms and a common format for the model codes. The National Conference of States on Building Codes and Standards is working toward more uniformity in building codes on a state-wide basis. The Conference of American Building Officials is seeking to fill gaps in existing standards and to devise a system to promote and approve research toward better standards,

The most promising start toward greater uniformity came in 1971, when the four model code groups jointly published a "One- and Two-Family Dwelling Code." Having eliminated many of the past differences among model codes, the joint code has thus diminished the justification for wide differences in codes between one jurisdiction and another for single- and two-family residences. However, it has practically no fire safety provisions.

More disturbing than the wide differences among local codes is the fact that many jurisdictions have no codes whatsoever. When the National Commission on Urban Problems surveyed local governments in the United States (18,000 units surveyed), it found that only 46 percent had a building code. On the other hand, a more recent survey of 2,000 cities with over 10,000 population indicates that 97 percent of these cities have building codes.[1] It is the sparsely settled areas, it can be surmised, which are chiefly without building codes, Though there are no statistics on how many jurisdictions have a fire prevention code, it appears there are a significant number of communities which do not have one in force. **The Commission recommends that all local governmental units in the United States have in force an adequate building code and fire prevention code or adopt whichever they lack.**

[1] Milton Applefield, "Fire District Use in North Central Region Cities," Fire journal, January 1973, p. 28.

Local Implementation of Codes

A law is effective only to the extent that it is enforced, and so it is with a fire prevention or building code.

Many serious building fires have been the result, not of code deficiencies, but of lax enforcement (sometimes because of corruption). A fire-resistant floor, for example, is an insufficient barrier to smoke and fire if the architect allows gaps in the floor or a workman punches a big hole in the floor to allow a pipe to pass through. Vigilance is needed in the review of plans and in inspection during construction. Once construction is finished, compromises in fire safety may be hidden from view.

The training of inspectors is, in many places, woefully inadequate. In one major city, the only training for fire prevention inspectors consists of sending them out for a few days with a senior inspector. Architects and engineers complain about inflexibility in the codes, but one reason codes tend toward rigidity and detailed specifications is that local building officials and inspectors are not equipped, because of their inadequate training, to evaluate alternative solutions and trade-offs.

A fire-resistant ceiling is not effective if an architect or a workman allows wide holes for a pipe to pass through,

The effectiveness of codes is also compromised by lack of coordination among inspection programs. The building department generally has responsibility for enforcing building codes, the fire department for enforcing fire prevention codes. Because fire prevention bureaus are responsible for fire safety throughout the life of a building, they ought to be consulted by building departments during the design and construction phases. In many local jurisdictions, however, building departments act unilaterally, implementing the building code during these crucial stages without requesting the suggestions and advice of the fire prevention bureau. Since the two codes influence each other but require expertise specific to the enforcement of each, coordination of efforts between the two departments is needed to provide optimum fire protection. **The Commission recommends that local governments provide the competent personnel, training programs for inspectors, and coordination among the various departments involved to enforce effectively the local building and fire prevention codes. Representatives from the fire department should participate in reviewing the fire safety aspects of plans for new building construction and alterations to old buildings.**

Strengthening the Model Codes

Since the model codes exert a powerful influence on local codes, the quality of the model codes is a nationwide concern of considerable importance.

Historically, major changes in the model codes have been made when a particular fire problem achieves a certain magnitude (as is happening in response to high-rise fires) or when a dramatic fire or two focuses public attention on a problem (as happened in the wake of the Coconut Grove nightclub fire in Boston in 1942). The problem of smoke generation, which has been aggravated

Adequate fire safety in buildings depends upon cooperation between inspectors in the building and fire departments.

in recent years by the increased use of synthetic materials, has yet to receive adequate attention. Slowness of change except during crisis is typical of social institutions, but the consequences of that characteristic are, in this instance, vital to public safety.

One consequence of this mode of change is that new requirements tend to be piled upon old instead of replacing them. The result can be needless redundancy and added expense. In some model codes, for example, the addition of an automatic sprinkler system has not been accompanied by trade-off provisions on other fire safety features, such as height and area limitations, maximum travel distances, or the degree of fire-resistive construction.

The model codes have also been slow to respond to the rapid changes in materials and construction technology. Here the fault does not lie ghiefly with the code-writing organizations, since their requirements in these areas usually make references to the standards set by other organizations. As we pointed out in Chapter 9, changes in materials and construction technology have threatened to outrun the standards-setting organizations and testing laboratories striving to keep up with the changes. As we have also pointed out, a firmer grounding of standards in a scientific understanding of fire and its effects would streamline the process of approving for use new materials and technology. Progress in this direction would also improve the codes. As it is now, both specification requirements (such as 1/2-inch thickness for gypsum sheathing) and performance standards (such as 3 hours of fire-resistiveness in certain bearing walls) arc the product of judgments based on past experience or speculation, rather than firm knowledge of fire behavior.'

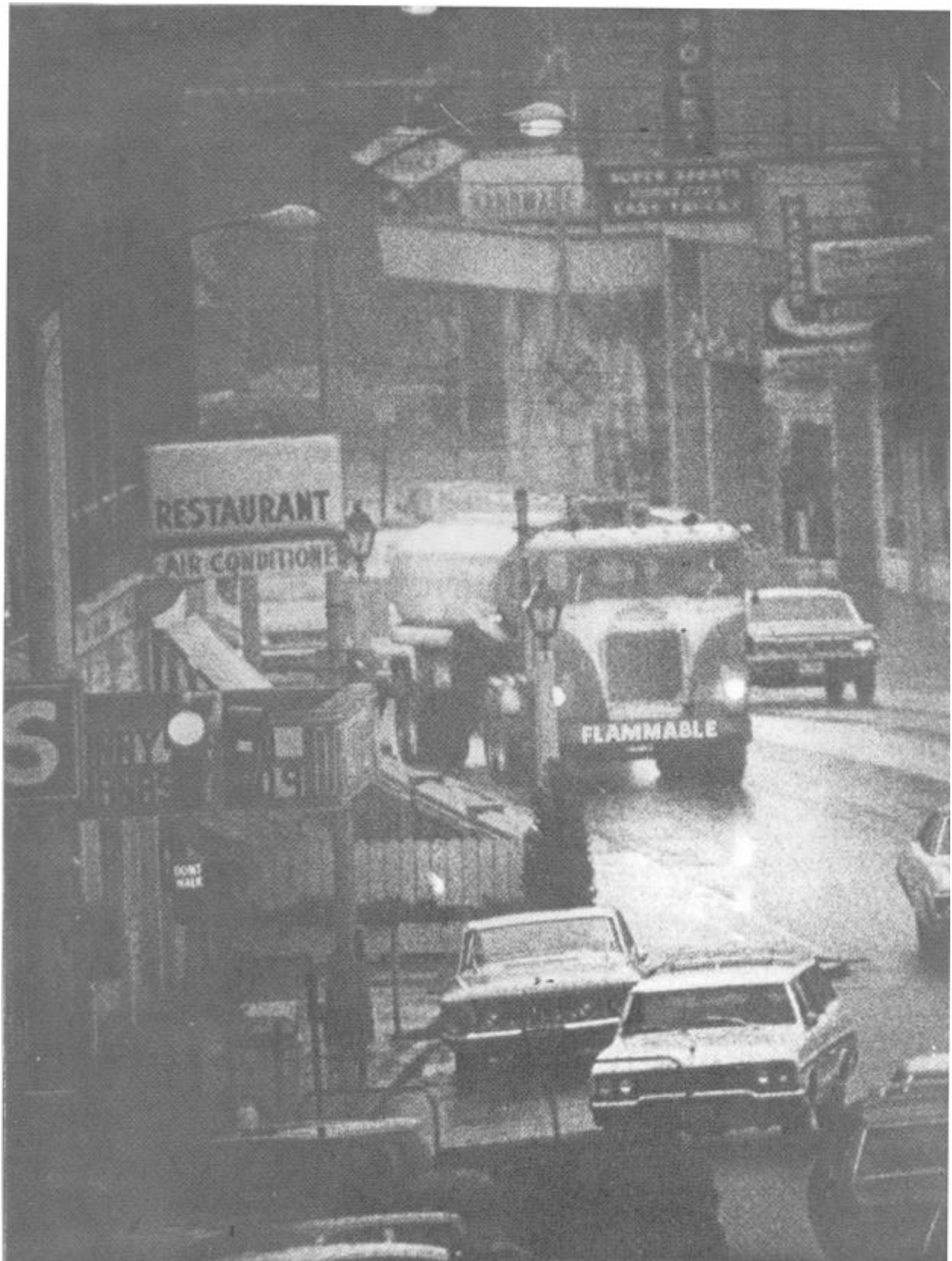
The mechanisms for change to the model codes are similar in the International Conference of Building Officials, the Building Officials and Code Administrators International, and the Southern Building Code Congress. When a change is proposed, a code change committee holds hearings to consider opposing views, then studies the matter further and issues its recommendation While the recommendation is voted on by the organization's membership, the committee's recommendation is usually adopted.

Sitting on these committees are local building officials, who often lack expertise in fire protection, and who in some instances are understandably reluctant to impose stringent requirements on industries which would directly affect local programs. The committee process is, moreover, a slow one.

While the Commission has no suggestions for improving the process whereby the model codes are amended, we do have two specific recommendations for strengthening the model codes. We are firm in our conviction that many lives could be saved, and many injuries averted, if homes were equipped with early-warning fire detectors and alarms. These can be effective sentinels, especially at night when so many tragic fires occur. No less important are early-warning detectors coupled with automatic extinguishing systems in buildings where many people congregate. Automatic sprinklers can pay for themselves in damages prevented, and the model codes should permit other savings by relaxing requirements for other fire safety features when automatic sprinklers are installed. **The Commission recommends that, as the model code of the International Conference of Building Officials has already done, all model codes specify at least a single-station early-warning detector oriented to protect sleeping areas in every dwelling unit. Further, the model codes should specify automatic fire extinguishing systems and early-yarning detectors for high-rise buildings and for low-rise buildings in which many people congregate.** (Examples of this last category include buildings of public assembly, such as theaters and exhibition halls, restaurants, and enclosed shopping center malls.) These recommendations apply as well to State and local jurisdictions, whether or not they follow one of the model building codes.

Of all the actions that can be taken to provide fire safety for Americans in their built environment, these, we believe, are the most important.

[2] The use of more scientifically based information would function both to increase the validity of code requirements and to perpetuate a more uniform scientific base for all codes.


RESTAURANT
FLAMMABLE

12

TRANSPORTATION FIRE HAZARDS

Ever since man learned there was a better way than a pair of feet to get from here to there, he has developed a propensity for not getting there at all. As he has honed his technology of transport, he has also dropped from the sky like a lead weight, sunk to the bottom of the sea, tumbled from the sides of mountains, and met in disastrous collision his fellow man traveling in the opposite direction. In the process he has managed to destroy a considerable amount of the wealth that he felt it necessary to carry from here to there. He has also destroyed human lives.

Fire is not the inevitable consequence of a transportation accident, but in an age of combustion fuels it is a frequent accompaniment. In 1971, about 4,260 Americans, or about one-third of all who died in fires, lost their lives in burning planes, trains, ships, or motor vehicles. The majority of these were lost on the highways. The National Fire Protection Association estimates that, in that year, 521,800 transportation fires caused property losses exceeding $332 million (see Table 12-1) . That was 20,950 more fires, and $63 million more in losses, than the year before.

Several factors have contributed to the growth of transportation fires. First, a citizenry growing in affluence and mobility is using transportation as never before. During the 1960's, passenger miles on U.S. airlines more than tripled, from 34 billion passenger miles in 1960 to 123 billion in 1970. Motor vehicle registrations went from 74 million in 1960 to 108 million in 1970, an increase of 46 percent. A second factor, related to the first, is the Nation's rapidly increasing consumption of goods, which requires more transport vehicles to travel more frequently to meet the demands. Third, hazardous materials which once traveled solely on one mode of transportation are now often exposed during transit to two or more (for example, "piggyback" truck-rail arrangements, and containerized shipping), increasing the amount of handling and straining the capacities of the containers. Fourth, new materials and new forms of old materials (such as liquefied petroleum

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Table 12-1. Estimated 1971 Transportation Fire Losses*

Category	Life loss		Property loss		Fires	
	Number	Percent of total	Dollars-million	Percent of total	Number	Percent of total
Aerospace vehicles and aircraft	125	1.1	$192.0	7.0	200	0.0
Motor vehicles-farm/construction	3,950	33.3	16.12	0.6	19,200	0.7
Motor vehicles-pleasure/transportation			96.54	3.5	482,400	17.7
Ships, railroads, etc.	185	1.5	27.60	1.0	20,000	0.7
Transportation (total)	4,260	35.9	$332.26	12.1	521,800	19.1

*National Commission on Fire Prevention and Control staff estimate for 1971.

gas) are being introduced at a rate that challenges regulatory measures and firefighting techniques to keep up.

Transport of Hazardous Materials

About 10,000 new chemical products are developed every year. Most never reach the commercial market; some do. And of those that do, there are some that can present severe fire threats as they are moved from place to place.

Real facts about the frequency and causes of transport fires involving hazardous cargoes are hard to come by. Within the Department of Transportation, such agencies as the Federal Aviation Administration, the Federal Railroad Administration, and the Federal Highway Administration investigate accidents in their respective areas of concern. In a study of reporting systems issued 4 years ago, the National Transportation Safety Board, another arm of the Department of Transportation, complained of the "parochialism" of accident reports, and the fact that they "have not contained information appropriate in character, depth, and detail to have much value in preventing hazardous accidents in other modes."

Some of this is changing. The Office of Hazardous Materials, still another Department of Transportation entity, has developed a system for receiving, storing, and retrieving information on hazardous materials accidents. The National Transportation Safety Board has the duty to investigate causes of transportation accidents (excluding aircraft and marine accidents), yet in 1971 the Safety Board reviewed and issued only '22 reports of separate rail, highway, and pipeline incidents. **The Commission recommends that the National Transportation Safety Board expand its efforts in issuance of reports on transportation accidents so that the information can be used to improve transportation fire safety.**

Despite the absence of complete statistics, some generalizations are possible:

- There are more fires and explosions involving tank vehicles during loading and unloading than during actual transit.
- Routine transportation presents little hazard; it is the interruption to smooth transit that causes accidents.
- Regulations concerning the transportation of hazardous materials lag behind current needs; as one commentator has put it, "the regulatory system is a part of the problem and not part of the solution." [1]

In addition, the hazards that are covered can be bewilderingly complex. Whether it is the State police, another enforcement authority, or the fire department that responds to an emergency, rudimentary knowledge is not sufficient. Complications are often present:

- *Physical properties.* A liquefied gas, for example, may have widely different fire and explosion hazards from those that exist when the fuel is shipped in a vaporized form.
- *Mixture of hazards.* A material may well be toxic, flammable, and reactive all at the same time, yet marked for only one of the hazards.
- *Similar names, divergent hazards.* One material with a name quite similar to another may present quite different hazards.

[1] W. M. Haessler, "The Four Problems of Transportation of Goods," ***Fire*** Journal, November 1971, p. 29.

Firefighters and the public alike would also be better served if trucks, tank cars, and other vessels for transporting hazardous materials carried clearly visible, readily understandable markings indicating the hazards therein. The two most universally recognized means of identification of hazardous materials are the National Fire Protection Association's "704M System" and the Department of Transportation's "Hazard Information System" (HI). While the systems are not dissimilar in the important respects, the Nation would be better served if a single system, incorporating the best aspects of each, were adopted universally. **The Commission recommends that the Department of Transportation work with interested parties to develop a marking system, to be adopted nationwide, for the purpose of identifying transportation hazards.** In carrying out this recommendation, the Department of Transportation should seek the cooperation and agreement of the Department of Labor, which, under the Occupational Safety and Health Act, is charged with developing a labeling system for hazardous materials for protection of employees. Since those who must utilize the information gained from these markings often must do so under poor lighting and hazardous conditions, representatives of the fire services should also be consulted.

The complexity of hazards complicates firefighting. While spillage of a highly flammable liquid into a stream may actually reduce hazards, spillage of a toxic liquid into a stream creates a new and major problem. Chemical foams effectively extinguish some tank fires, but are rendered useless if certain solvents are present. For their own safety, firefighters need to know the particular hazards and proper tactics to use with each material, so that they can cope with what is likely to happen next.

In a word, then, firefighters must be well-informed about the hazards they are asked to deal with. While the National Fire Protection Association, State firefighter schools, and some industry representatives have attempted to educate fire departments on chemical hazards and proper tactics to use on transportation fires, the results have been very uneven. Training is likely to be superior in urban areas. But trucks and trains cross vast patches of rural America (at greater speed than in urban areas), where training is likely to be minimal. **The Commission recommends that the proposed National Fire Academy disseminate to every fire jurisdiction appropriate educational materials on the problems of transporting hazardous materials.**

Even with adequate labeling and considerable training, fire departments may face new or unusual hazards in transportation accidents for which their knowledge of appropriate handling is, at best, uncertain. In such instances, they should be able to telephone for advice from a source knowledgeable about the particular hazard.

The Chemical Transportation Emergency Center (Chem-Tree) of the Manufacturing Chemists Association is a long step forward to meeting this need. By tapping its own resources and those of others (such as DOT's Office of Hazardous Materials and the Environmental Protection Agency), it is able to provide instant information for handling emergencies involving hazardous substances. The full potential of this system will not be realized until an adequate labeling system tells fire departments exactly what is inside the containers involved in accidents. **The Commission recommends the extension of the Chem-Tree system to provide ready access by all fire departments and to include hazard control tactics.** The hazard control tactics must come from joint efforts of the proposed National Fire Academy and representatives of the Manufacturing Chemists Association.

The public, too, should become more aware of the risks in accidents involving hazardous materials. An incident that happened near Waco, Ga., in June of 1971, illustrates the importance of this. As a result of an accident, a truck carrying 25,000 pounds of dynamite caught fire. Cars stopped, and people got out to watch. The driver, who escaped the fire, shouted to them to get away-but to no avail. Six people died and 33 were injured when the explosion came.

The awareness can be attained in many ways. Public fire safety educational materials should contain pertinent information. Basic markings (once one system is adopted) can easily be included in school fire safety education. Groups such as the American Association of Motor Vehicle Administration, the American Driver and Traffic Safety Education Association, the American Automobile Association, the North American

Professional Drivers Association, and the National Safety Council can, if given the proper information, include it in literature going to their audiences.

Interstate and, in fact, most intrastate transport can be effectively controlled by the Department of Transportation, but the system sometimes breaks down at international borders. Loading and unloading sometimes occurs in streets and lots, because the Bureau of Customs doesn't have the proper storage facilities. To correct this situation, **the Commission recommends that the Department of the Treasury establish adequate fire regulations, suitably enforced, for the transportation, storage, and transfer of hazardous materials in international commerce.** These efforts must be coordinated with local fire services.

Motor Vehicle Safety

The problem of transporting hazardous materials is dramatic, and failure of the system often causes large losses of life and property in a single incident. However, fires in motor vehicles cause almost 35 percent of all fire deaths in the United States. In fact, more than 450,000 fires occurred in cars and trucks in the United States in 1971, causing upward of 3,500 deaths and average losses of $200 per fire. That same year, the Bureau of Motor Carrier Safety received 729 reports of truck accidents involving fire. These accidents caused 132 deaths, 309 non-fatal injuries, and $7,831,728 in property damage.

For the truck accidents, principal ignition sources, in declining order of frequency, were collision impact, defective wiring, hot tires, and defective or hot bearings. Fires originating in cargo spaces were the most frequent, followed by those originating in other vehicles or objects, and those starting at tires or wheels.

Records kept by Oregon's State Fire Marshal indicate that the most frequent ignition sources in automobile fires are backfires, electrical short circuits, hot mufflers and exhaust pipes, smoking materials, and incendiarism-in that order. The materials first ignited are gasoline and other flammable liquids, electrical insulation, and upholstery.

A number of organizations, such as the National Safety Council, the American Trucking Association, and the National Fire Protection Association, have attempted to educate drivers and trucking companies to high standards of fire safety in the use and maintenance of motor vehicles. Power to prescribe safety features and levels of safety-related performance resides with the National Highway Traffic Safety Administration, established by the Highway Safety Act of 1970. In January 1971, that Administration published a flammability standard for the interior materials of passenger cars, trucks, and buses, to take effect September 1, 1972.

The Traffic Safety Administration also asked the Oklahoma University Research Institute to evaluate the new standard. The Institute found the standard lacking, in that it requires "too mild a test to achieve a significant reduction in property loss, much less injuries or fatalities, from vehicle fires." All that the standard accomplishes, the Institute's report said, is to "discourage use of new materials for vehicle interiors which are more flammable than those currently employed."

Since gasoline spillage is a common cause of vehicle fires, the location, construction, and security of fuel tanks are important design features for fire safety. The most severe losses, in terms of both life and property, occur from fires following rear-end collisions. Next in importance are rollover accidents, followed by front-end collisions. Fuel tanks for passenger cars must meet a Federal standard, which specifies a fixed collision barrier test and the allowable amount of fuel spillage from the tank and its connections in the test. (Somewhat more stringent requirements are imposed on large trucks and buses.) Studies made for the Department of Transportation have indicated that the current procedure is not adequate to evaluate the performance of a car's total fuel system in a fire situation. Studies by the Cornell Aeronautical Laboratory have shown that, while a mid-vehicle location for a fuel tank is probably best, location alone is not the total answer to the fire problem. Improvements can come only through a consideration of the entire system : fuel tank location, fuel line, electrical system and exhaust routing, and configuration of the surrounding structure. Consideration must also be given to the evaporation emission control devices installed on all cars in recent years.

The indications, then, are that motor vehicles,

especially cars, are not as fire-safe as modern technology would allow. Improvements could be made in design and materials, without significant additional costs. **The Commission recommends that the Department of Transportation set mandatory standards that will provide fire safety in private automobiles.** Both materials and structural design should be considered in these standards.

Aircraft Fire Safety

On December 8, 1963, a Pan American Airways jet exploded and burned near Elkton, Md., killing all 81 aboard. The frightening aspect for passengers contemplating such an occurrence is that there is no escape: no running from the scene, as on land, no climbing into a lifeboat, as at sea.

Yet fire is the greater killer when it happens after a crash landing. There have been numerous instances when the impact of the landing did not kill passengers, but the ensuing fire did. One such accident cost 43 lives when a commercial aircraft crash-landed near Salt Lake City in November of 1965.

From the standpoint of dollar losses, the most serious fires occur at airports and in hangars, usually during the course of maintenance operations. A spectacular fire of this sort occurred in April of 1969 at the Mercer County Airport, N. J. Before it was discovered, the flames were 25 feet high; before it was contained, it had destroyed 49 aircraft (mostly of the single-engine type), 13 helicopters, a large hangar, the passenger terminal facilities, and the offices of the airlines for a total loss of over $3 million.

Considering the many materials available to burn (propulsion fuels, hydraulic oils, lubricating oils, and ordinary combustibles and plastics), the many sources of ignition (electrical, contamination of oxygen lines or valves, lightning and electrostatic charges, hazardous cargoes, and human carelessness), and the many ways an ignition source can come in contact with the combustibles, it is obvious that there are a large number of potentials for disastrous fires in the relatively confined space that constitutes the aircraft environment.

There are a number of areas in which research and development could improve the fire safety of aircraft :

- *Reduce chance of ignition.* The fuel tanks, the fuels used, and the interior materials are the critical considerations in efforts to reduce the likelihood of fire in aircraft accidents.
- *Increase the chance of survival.* Once a fire has started, the buildup of poisonous fumes and heat is dependent upon many things, including compartmentation, ventilation, and materials used. Standards of construction must consider not only how easily something can be ignited, but also the effect on survival once it is ignited.
- *Detection and suppression* of fires. When on the rare occasion fire occurs during a flight, detection and suppression are normally swift and effective. Aircraft fires during servicing and maintenance are often not so efficiently dealt with. Early automatic detection and suppression systems for parked aircraft, including bet-

Every year, more than 3,500 Americans die in automobile fires. Better design for safety could reduce these tragedies.

Fire results from many airplane crashes. This Boeing 737 crashed near Chicago's Midway Airport in December, 1972.

ter fire suppression agents, seem to be needed at many airports.

Presently, research on various aspects of aircraft fire safety is scattered among several Federal agencies, both civil and military, and aircraft manufacturers. Much research not specifically connected with aircraft fire safety will nonetheless have a bearing on future improvements in that field. Coordination of these research efforts is important-first, to ensure that research priorities reflect the scale of needs for aircraft safety, and second, to promote the transfer of technology among the many segments of the aircraft industry and from outside the industry.

Many fire chiefs express considerable doubt that they can save lives in an aircraft crash if fire erupts before suppression forces arrive. Their fears are supported by Federal Aviation Administration records, which show that of the 57 aircarrier accidents during the decade 1959 through 1968 involving ground fire and fatalities, only 13 occurred at airports and thus within reach of airport firefighting equipment. In only one of these 13 cases were firefighters able to rescue passengers.

The chief emphasis in aircraft fire safety, therefore, will have to be improved design of airplanes and continuation of the careful operation of aircraft that has resulted in an admirably low accident rate for commercial aviation. Still, much can be done to improve the firefighting capabilities at airports. The National Fire Protection Association, the Federal Aviation Administration, the Air Line Pilots Association, and the International Civil Aviation Organization are upgrading standards for airport firefighting. Many airports lag behind current standards. It would he appropriate for airport authorities to review their fire suppression and rescue needs, to produce plans for coordinating the firefighting resources of the airfield and surrounding areas, and to set up capital improvement budgets to bring their firefighting capabilities up to NFPA, FAA, and ICAO standards. **The Commission recommends that airport authorities review their firefighting capabilities and, where necessary, formulate appropriate capital improvement budgets to meet**

current recommended aircraft rescue and fire-fighting practices. We recognize that a firefighting capability adequate to handle a major disaster is expensive, particularly in terms of manpower, considering the rarity of fire accidents. There are available, however, multiple turret fire vehicles which require smaller crews than the several trucks they replace, and progress is being made in the development of automated apparatus for airport fire safety.

Marine Fire Safety

The position of the Coast Guard in maintaining a high level of marine fire safety is a difficult one. Many factors work against them. Long experience in handling hazardous materials by crews and longshoreman can lead to complacency and carelessness. Pushed by schedules and financial incentives to unload quickly, shippers often fail to use the expertise of chemical tankermen, who are certified by the Coast Guard, or marine chemists, who are certified by the National Fire Protection Association. Since the incentives are often contrary to good fire safety practice, the Coast Guard needs the support of all who can help. Attention should be called to the fact that the Department of Labor has safety responsibilities for the shipbuilders, repairers, and longshoremen. The presence of increasing amounts of high energy fuels and other hazardous substances passing through ports demands special attention. **The Commission recommends that the Department of Transportation undertake a detailed review of the Coast Guard's responsibilities, authority, and standards relating to marine fire safety.**

Railroad Transportation Fire Safety

With 200,000 miles of main track lines, the Nation's rail network is vital to the economy. A fire accident that incapacitates even a small portion of the rail system has an effect far beyond the actual scene of the accident.

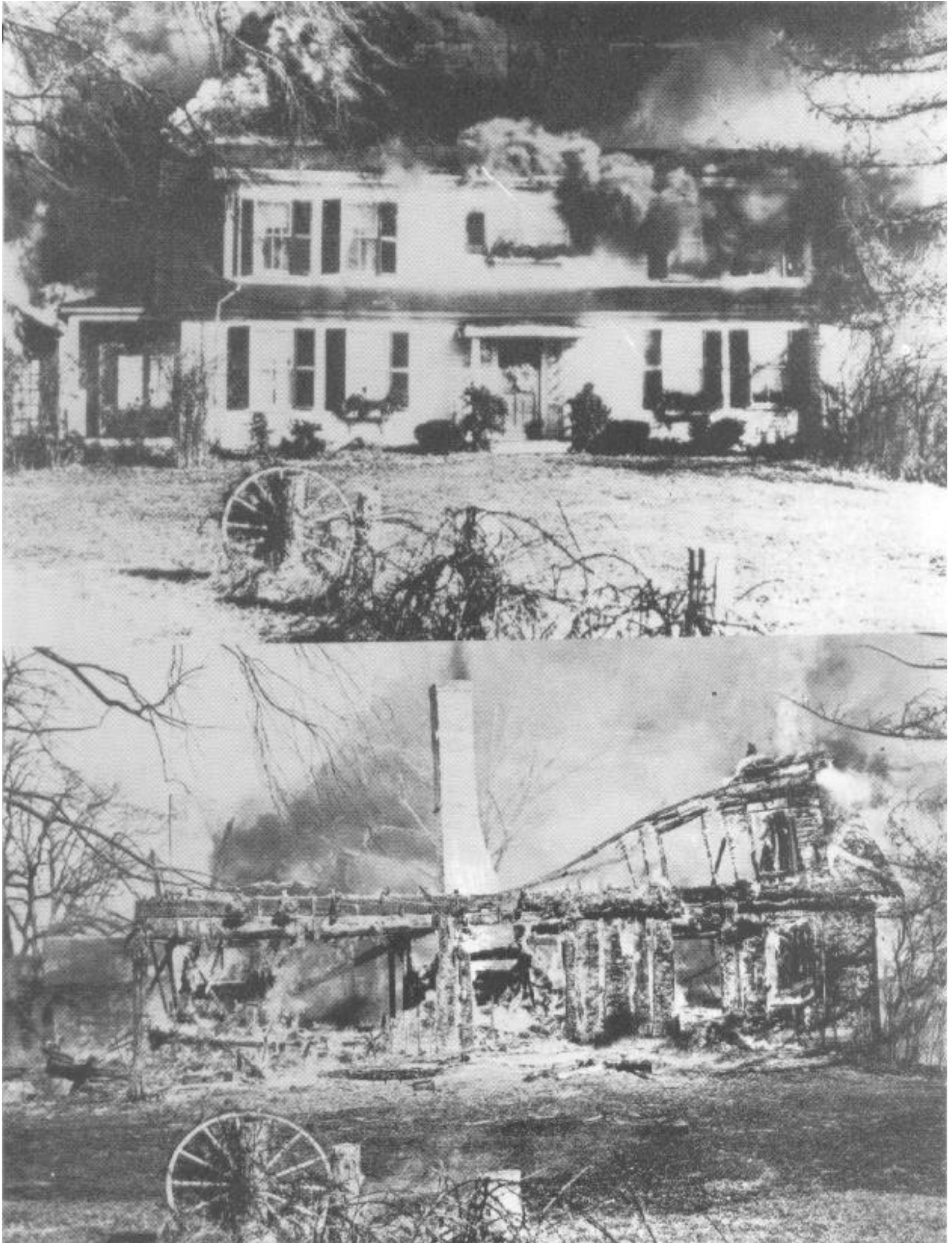
An accident can be a local disaster if hazardous materials are involved in the fire. Usually the fault is not with the materials themselves. In January of 1969, 15 exploding tank cars wreaked havoc in Laurel, Miss., all because of a defective wheel on one of the cars. Three weeks after that incident, a misaligned track derailed a train passing through Crete, Nebr., and derailed cars struck a tank car loaded with anhydrous ammonia standing on a siding. Escaping ammonia gas killed six persons and injured 53. In both instances, the cause of the accident was a mechanical failure; the results were thermal and toxic nightmares.

Chronic problems with railroads are fires along rights-of-way, usually started by brake shoe sparks or hot carbon sparks from diesel stacks. In 1970, there were reported 6,645 such fires in or near forest lands; unreported thousands of fires burned grass and croplands.

Responsibility for preventing fire accidents must reside with the railroads themselves. Sound maintenance practices are well known, but often not followed. Rights-of-way should be well-maintained, kept free of flammable materials, and inspected frequently; malfunctioning equipment should be quickly removed from service. **The Commission recommends that the railroads begin a concerted effort to reduce rail-caused fires along the Nation's rail system.** Equipping non-turbo locomotives with exhaust spark arresters, reducing the frequency of mechanical and rail failures, adopting braking procedures and equipment designed to prevent hot brake shoe fragments from spewing, training crews in fire suppression, and providing trains with appropriate fire suppression tools are measures for consideration.

San Francisco's Bay Area Rapid Transit, known as BART, has signaled the beginning of a new era of mass transit construction in the United States. As, these systems are developed, and as existing systems arc modernized, there will be a need to protect the lives of those who must travel through tunnels and over elevated tracks. Tunnels, especially, can be traps: In a Boston subway tunnel fire in February 1973, one person died and more than 100 had to be treated in hospitals, mostly for smoke inhalation.

In a special study in 1970, the National Transportation Safety Board found that no safety conditions were being attached to Urban Mass Transportation Administration grants for rapid Tail transit systems. In support of the Board's findings, **the Commission recommends that the Urban Mass Transportation Administration require explicit fire safety plans as a condition for all grants for rapid transit systems.**



13

RURAL FIRE PROTECTION

About a quarter of the American people, according to the 1970 census, live on the Nation's 420 million acres of rural land.[1] For many of these Americans, fire protection is woefully inadequate. The same is true of many suburban dwellers whose political institutions and community services have not kept pace with rapid population growth.

Rural areas and rapidly developing suburbs can be plagued with many problems: insufficient water supplies, lack of adequate building codes or too few inspectors to enforce them, insufficient funds to pay firefighters or replace antiquated equipment. Even where a strong volunteer fire department exists, inadequate alarm facilities and great distances to fires often result in response times of 15 to 30 minutes or more.

Because many volunteer departments keep scanty records or no records at all, the seriousness of the fire problem outside of metropolitan areas is difficult to gauge. According to the Department of Health, Education, and Welfare, the fire fatality rate for white Americans in non-metropolitan areas is half again as great as the rate for whites in metropolitan counties (4 per 100,000 versus 2.7 per 100,000). Among non-whites, the disparity is even greater: 15.3 per 100,000 in non-metropolitan counties, 8.1 per 100,000 in metropolitan counties. In New Hampshire, where 56 percent of the land is classified as urban, 29 out of the 32 deaths from fire in 1971 occurred in rural areas.

Fire officials in New Hampshire estimate that if all rural homes had early-warning detectors, rural fire deaths would decline by as much as 75 percent. In Chapter 11 we recommended that model building codes call for early-warning detectors and alarms in every dwelling unit; in Chapter 16, in addition to urging all Americans to install such devices, we recommend incentives to encourage their installation. Here it is appropriate to note the special plight of many of America's rural and suburban dwellers. As in urban areas, most rural fire deaths occur at night during sleeping hours. A few minutes' difference inawakening to a fire can be a matter of life or death. But what is especially critical for rural dwellers is that if they awake belatedly and are trapped, it may be many minutes before the fire department arrives to rescue them. In the event

[1] By including communities of up to 10,000, the congressional authors of the Rural Development Act of 1972 encompassed 37 percent of Americans within their definition of rural.

of a power or telephone failure, even notification of the fire department may come too late. With special urgency, **the Commission recommends that rural dwellers and others living at a distance from fire departments install early-warning detectors and alarms to protect sleeping areas.** Publishers of newspapers and magazines for farmers and country dwellers could perform a valuable public service by publicizing the importance of these devices.

The best fire equipment, properly located, cannot be effectively utilized without well-trained firefighters. While many rural volunteers receive excellent training, there are many who do not. The risks to these men can be reduced and their effectiveness improved by proper training. The Commission received many pleas for improved training in our survey of the Nation's fire departments. Unlike those in urban areas, one rural fire department usually cannot afford to support a fire school. The consolidation of fire departments into county-wide or regional jurisdictions, as we urged in Chapter 3, would permit better training programs at less cost to the individual volunteers or their sponsoring departments. Strengthening of training programs would also come about

A couple surveying their destroyed home typify the plight of rural citizens with inadequate fire protection.

through the activities of the proposed National Fire Academy and under Title IV of the Rural Development Act.

The Rural Development Act

In its provisions for revitalizing the economy of rural America, the Rural Development Act of 1972 recognizes that fire protection in rural areas must grow apace. One section provides loans for water supply systems for industrialized areas being constructed in rural communities. Title IV of the law, called Rural Community Fire Protection, provides for assistance in organizing, training, and equipping local fire protection forces. The assistance is both technical and financial, with the Federal Government assuming up to 50 percent of the costs. Full and continuing funding of the fire protection provisions of the Rural Development Act is, in the Commission's judgment, essential.

The Rural Development Act also specifies that all applications for proposed water systems and other essential community fire protection facilities must be submitted to the agency that has been designated by the State as the appropriate clearinghouse. **The Commission recommends that U.S. Department of Agriculture assistance to such projects be contingent upon an approved master plan for fire protection for local fire jurisdictions.** (The master plan concept is discused in detail in Chapter 4.) This recommendation is not meant to preclude Federal assistance, including financial assistance, to help local jurisdictions develop master plans for fire protection. Wherever possible, the master plan should be the product of county-wide or regional coordination.

There are several reasons why master plans for fire protection are vital for rural communities. The first shopping center or first factory in a rural area can represent a huge jump in the demands that could be placed on the fire department's suppression capabilities. It is especially important to plan the location of future fire stations to minimize the distances fire engines must travel and to provide for built-in protection. Since funds, whether tax-based or volunteer, are generally scarce in rural areas, coordinated planning is needed to maximize the payoff in fire protection.

There are special problems to which master plans for fire protection in rural areas should be addressed. One is transportation fires, as discussed in Chapter 12. Provisions should be made in the plan for training and for equipment adequate to handle these fires. The second special concern should be buildings that have outlived their usefulness. Rural areas abound with them: schools not needed because of consolidation, village stores closed by nearby shopping centers, and farm buildings now unused because a number of small farms have combined into a large one. These structures are enticing to mischievous arsonists and to property owners for whom burning down a building is convenient disposal or even a source of profit. The master plan for fire protection should specify the limits of fire department responsibility when such fires occur.

Only through planning for fire protection will the impact of new structures on insurance and fire service costs be controlled. Only in this way will the responsibility of the public and that of the private sector (for example, company-supported fire brigades in industrial plants, automatic extinguishing systems in larger buildings) be specified. Only in this way will a fire in a shopping center or other large complex no longer be the first time anyone realizes the water mains are too small and the fire companies too few to stop a controllable fire from becoming a major disaster.

14

FOREST AND GRASSLAND FIRE PROTECTION

Despite the urbanization of the United States, vast areas of the country still resemble the primeval wilderness. Of the two billion-plus acres that make up the Nation, more than half consist of forests and grasslands. (Cities, highways, and waterways constitute only 500 million acres, farmlands and small wooded lots roughly the same amount.)

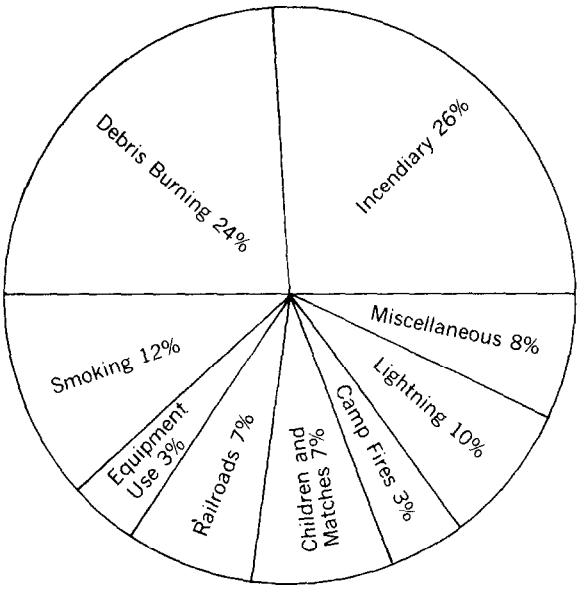
In recent years, forest and grass fires, ignited at the rate of about 300 a day, have been destroying an average of 4.7 million acres annually, In national forests alone, resources lost by fire amounted to more than $700 million in 1970. Fire destroys the prized hardwoods of the northcm forests, the pines that supply pulp mills in the South, the western species that go into plywood and other lumber supplies. The losses, already considerable, will grow critical as the Nation's consumption of industrial wood products rises. Presently that consumption amounts to 10.7 billion cubic feet of timber annually. By the year 2000, that consumption will nearly double to 20.8 billion cubic feet.

Grassland fires destroy valuable range land, robbing domestic animals and wildlife of their food supply. Not only is vegetation removed, but heat from range fires often dries out root systems and lays the soil bare. In turn the barren soil, eroded by wind and water, pollutes the air and streams, Erosion delays natural regeneration, sometimes stopping it altogether, leaving the soil sterile.

As urban sprawl encroaches on wildland areas, forest and grassland fires can pose a direct threat to man. In southern California during a l-month period of critical fire weather in 1970, 1,260 fires burned more than 600,000 acres, killed 14 people, destroyed more than 900 houses and other structures, and generated the potential for an aftermath of erosion, floods, and mudslides. That same year, the Laguna Hills fire in San Diego County burned 225,000 acres and caused an estimated $100 million damage to dwellings, other buildings, field crops, utilities, bridges, and other facilities.

As with other kinds of fires, man is the chief culprit. Nine out of ten forest and grassland fires are caused by human action (Figure 14-l). About a fourth of these man-caused fires are set by arsonists; a slightly smaller fraction results from people burning debris. Those fires not caused by man are usually caused by lightning-l0,000 such fires a year, resulting in about $100 million losses annually. In the West, in fact, lightning is the leading cause of forest fires.

Figure **14-1.** Percent of Fire Starts by Cause in 1971*



*Source: Forest Service, USDA.

Lightning-caused forest fires were a natural and frequent occurrence in North America over the millenia prior to the arrival of the first ocean-crossing settlers. But European civilization brought with it a propensity for making this natural phenomenon a problem: Over the years, debris from logging and land-clearing-treetops, limbs, and chips-multiplied the accumulation of "dead fuel" waiting to be ignited and to rage with great intensity, The encroachment of home-sites on wildlands and the use of forests for recreation have continued, and they have magnified the threat of devastating fires.

Ironically, our Nation's efforts in the twentieth century to save our forests has contributed to the problem also. For the longer a forest remains protected from fire, the more dead fuel accumulates on the forest floor, thereby increasing the hazard of a major blaze. The chaparral forests of southern California, for example, deposit as much as 1.3 tons of litter per acre every year. Other species in the Sierra Nevada deposit twice that amount of litter. In recent years, the practice of "prescribed burning"-to make forests more productive as well as to dispose of dead fuel-has won more and more adherents.

With forestlands in such abundance, the prevailing view in nineteenth century America was that forests could be harvested without replacing trees and that forest fires posed no serious problem. That view now threatens to be replaced by an equally erroneous notion: the romantic idea that the best management of nature is no management at all.

In a year's time, an acre of forest can convert solar energy into vegetable matter equivalent to as much as 300 gallons of gasoline in potential energy. Like a helium balloon being inflated, a forest accumulates an ever-greater fuel load with each passing year. To leave forest preservation to the whims of nature, or to depend solely on campers being careful in forests, simply courts disaster. Man must intervene directly with forest and grassland environments to preserve these important resources.

Accumulated residue, as we have mentioned, can be burned off-through prescribed burning or piling-and-burning. Both require skilled operators, careful control, and favorable environmental conditions. Another approach is to replace vegetation that is highly flammable with low-lying plants of low flammability. In addition to reducing fire hazards, such conversion projects can improve soil stability, increase water yield, improve the habitat for wildlife, and increase the production of forage.

Still another method of intervention is to clear strips of forestland of all vegetation to create firebreaks. A modification of this is the fuel break : strips of land in which only plants of low flammability are allowed to thrive.

A very different approach to discourage forest and grassland fires lies in weather modification-specifically, in inducing rain to counter the hazards pf a dry season or in suppressing lightning. But the approach is controversial: first, because effects are unpredictable; second, because efforts that have good effects in one place may have bad effects elsewhere. In Colorado, for example, potato growers have taken barley growers to court, claiming that the latter's efforts to suppress hail storms reduced precipitation so drastically that potato crops were ruined.

The Bureau of Land Management, an arm of the Department of Interior, has launched an effort to abate lightning and to increase precipitation in Alaska. (Tests in the mid- 1960's showed that seeding clouds with silver iodide nuclei could reduce cloud-to-ground lightning strikes by as much as 60 percent.) These efforts will have to

be carefully monitored to determine whether they have any undesirable effects.

The Agencies that Protect Wildlands

Responsibility for fire protection on Federal land lies, primarily, within the Departments of Agriculture and Interior. Other agencies, such as the Department of Defense and the Tennessee Valley Authority, are involved to a lesser extent. Each of the 50 States also has an agency responsible for fire protection of wildlands.

The Forest Service, a division of the U.S. Department of Agriculture, protects 203 million acres in 154 national forests and 3.8 million acres in 19 national grasslands. The Forest Service has a Congressional mandate to seek a balance among competing needs, such as timber, watershed management, protection of wildlife, and recreation. To provide fire protection, the Forest Service does not hesitate to alter the natural environment. For example, in fiscal year 1970, it converted 34,941 acres of highly flammable brush to perennial grasses. At the end of that year, the Forest Service reported that the national forests contained 3,882 miles of fuel and firebreaks. Government experts, however, estimate that an additional 22,000 miles of fuel breaks are needed to prevent decimation of our forests.

The Forest Service also has cooperative agreements with each of the 50 States to provide fire protection for lands in all major watersheds-575 million acres, all told. Federal support to the States takes the form of financial assistance (on a cost-sharing basis), training, inspection, implementation of research results, and the development and procurement of fire equipment.

Also in cooperation with the States, the Forest Service conducts the Smokey Bear educational program, which has been credited with saving $17 billion in fire losses,

Further, the Forest Service has a Fire and Atmospheric Sciences Research and Development Program. It supports basic and applied research on a broad range of subjects, from fire prevention to forest surveillance, and from hazard reduction to suppression methods. In addition to research in its three major laboratories, the program supports work by university scholars, industrial research groups, and fire control agencies.

A total of 545 million acres comes under the jurisdiction of the Department of the Interior. Its Bureau of Land Management provides fire protection for 455 million acres, and its Bureau of Indian Affairs protects 48 million acres. Through contracts, these two Bureaus protect an additional 110 million acres of State and private lands. Finally, the National Park Service and the Bureau of Sport Fisheries and Wildlife provide protection to 14 million and 30 million acres respectively.

As Table 14-1 indicates, the protection record of the 50 State fire agencies and the two major Federal agencies-the Forest Service and the Bureau of Land Management-has been improving significantly.

The improvements over the past two decades would be even more impressive were it not for a number of very large fires in 1968 and 1969. Indeed, it is the occasional fire that "gets away" which presents the greatest problem in wildland management. An accumulation of highly flammable vegetation or a long dry season are open invitations to such fires. While large fires-over 300 acres-account for less than 1 percent of total fires, they account for 60 percent of the acres burned and a high percentage of the total loss of

Table 14-1 Effect of Fire Protection in Forests and Wildlands

Period	Average number of man-caused fires per million acres protected	Average number of acres burned per year-all causes		
		National forest	State and private	Bureau of Land Management
1950-59	139	261,264	8,074,797	1,235,996
1960-69	99	196,000	3,704,871	874,342

Source: Forest Service, U.S.D.A.

life and resources. Firefighters also have their hands full when there are multiple ignitions-as, for example, when lightning strikes in several places or when sparks from damaged train wheels set fires along a railroad right of way.

Nearly every wildland fire is a candidate for status as a major fire if the conditions are right. Against that possibility measures must be taken. First in order of priority is *fire prevention-re*ducing the number of starts. Second is *prepared*ness; this includes intervening in the environment so that, if a fire starts, it will not rage out of control ; it also includes early detection and response. Third in order of priority is *initial* attack-that is, stopping fires while they are small with adequately trained and equipped forces. The fourth measure is *suppression* of major fires.

Fire Prevention

Smokey Bear is a great success story in the field of wildland fire protection. Yet the average of 300 forest and grassland fires a day shows that the message is not getting through to everyone. While much information has been gathered concerning the effectiveness of Smokey Bear, the audience reached is not precisely known. This audience must be identified and a program devised to extend the coverage to other groups who cause forest and grassland fires. In support of such an effort, the Forest Service has conducted studies concerning the personalities and background of those persons known to have caused wildland fires. The results of these efforts must find a way into all school courses that deal with the ecology, and into other appropriate educational media. Hence, **the Commission recommends that the proposed United States Fire Administration join with the Forest Service, U.S.D.A., in exploring means to make fire safety education for forest and grassland protection more effective.**

The effectiveness of fire prevention on non-Federal wildlands, in fact, depends heavily on the adequacy and enforcement of State fire laws. At present, several States-California, Florida, Georgia, and Oregon among them-have excellent fire laws. Other States lag far behind. **The Commission recommends that the Council of State Governments undertake to develop model state laws relating to fire protection in forests and grasslands.**

Prescribed burning is one way of reducing the accumulation of needles, branches, and other dead fuel from forests.

Air tankers, dropping water or chemical retardents, have proved especially valuable in limiting the spread of fire.

These laws should require, as a minimum: permits for debris burning, the use of fire safety devices for mechanical equipment operating in wildlands, strict zoning and building regulations, the construction and maintenance of firebreaks, and the establishment of access and escape routes. Provision should be made for such emergency measures as shutting down logging operations or rescheduling the hunting season during times of severe fire danger.

Once these laws are enacted, they will only be as effective as the enforcement. Several have testified to this Commission that, in many high-hazard areas, enforcement and court cooperation are inadequate.' **The Commission urges interested citizens and conservation groups to examine fire laws and their enforcement in their respective States and to press for strict compliance.**

If fire prevention efforts are to be effective, they must be aimed at the real, rather than imagined, causes of fire. This, in turn, means that accurate and detailed reports of forest and grassland fires must be gathered and analyzed. The national data collection system, recommended in Chapter 1, applies to wildland fires no less than to other kinds of fires.

Preparedness

The rate at which natural fuels build up depends, in part, on the type of vegetation, its growth rate, and its rate of decay. It also depends on climate. Rainfall and temperatures obviously influence growth rates. What is not so obvious is the fact that decay is faster in warm-moist than in warm-dry or cold-moist weather. Were it possible, on the basis of a few indicators, to predict far in advance which wildlands are building up fuel to hazardous levels, then it could be determined which wildlands should get first priority for modification-whether prescribed burning, fuel breaks, or other appropriate means. Educated guesswork for such predictions already exists; what is needed is firmer grounding in science. **The Commission recommends that the Forest Service, U.S.D.A., develop the methodology to make possible nationwide forecasting of fuel buildup as a guide to priorities in wildland management.**

One element important to the success of such forecasting is long-range weather prediction. That elusive goal is the subject of numerous Federal research projects. In the meantime, the National Oceanic and Atmospheric Administration is devising a National Fire Weather Service to

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aid fire control agencies. The forecast and advisory field services portion of the program is lagging and another portion that should be pushed is a research and development program to apply improvements in weather technology to fire weather forecasting. **The Commission supports the development of a National Fire Weather Service in NOAA and urges its acceleration.**

Preparedness also depends upon adequate surveillance of fire-prone lands. Increasingly, lookout towers are being supplemented by aircraft surveillance, including planes equipped with infrared sensors. The feasibility of using satellites for infrared detection of fires merits exploration.

Over the years, the Forest Service has given increased emphasis to preparedness. In general, larger investments in pre-suppression efforts should be matched with a downward trend in the cost of emergency suppression of large-scale fires. Evidence of the value of preparedness comes from a long-term look at the record of the Forest Serv-

A forest fire out of control, like this one near Los Angeles, can become a direct threat to whole communities.

ice (Table 14-2). If 1971 fires had burned at the 1951 average acreage per fire rate, 172,000 acres would have been lost, instead of the 36,266 acres actually burned over. At the 1956 average acreage per fire rate, 102,000 acres would have been lost.

Initial Attack and Suppression

Under conditions of drought or high winds, forest and grassland fires can move with unbelievable speed. Winds have been known to carry fire along treetops more than a mile from where the fire is burning at ground level. Fires have leapt 300 yards across freeways. A vital ingredient in effective suppression, therefore, is early detection, followed by swift initial attack with sufficient firefighting forces.

In addition to well-trained firefighters, effective initial attack depends on access by road or trail, plus the equipment that can be deployed-tractors, plows, and aircraft, for example. Air tankers and helicopters, dropping water or chemical retardants, have proved especially valuable in limiting the spread of fire. The efficiency and effiectiveness of amphibious air tankers have been increased in many areas through the use of water-scooping capabilities. Helicopters have also proved valuable for rescue operations and transport of firefighters.

Recognizing the important role of these aircraft, the Forest Service and cooperating agencies have begun a program to upgrade aircraft, provide more landing strips, and improve the effectiveness of retardants. In addition, some Air Force planes are being equipped with modular tank equipment to supplement strike forces for severe emergencies.

The Ecology-Minded Public

More than for most kinds of fires, there are grounds for optimism about the efforts against forest and grassland fires. The capabilities of Federal, State, and local control agencies are excellent. More heartening still, Americans have taken a new interest in the preservation of the Nation's unspoiled wildlands.

They are visiting State and national parks as never before, thus straining the parks' capacities and leaving them a little worse for wear. As the Nation's population grows, pressures will grow to give over wildlands to human settlement. Yet it is clear that future generations will need more unspoiled recreation lands, not less.

Americans know their obligations to others. They know that litter left behind today will be an annoyance to park visitors tomorrow. They know that a carelessly tossed cigarette or a campfire not adequately doused can turn a rich natural environment into a black wasteland. Care with fire is more than a moral imperative. It is a sound principle of ecological management.

Table 14-2. National Forest Fire Record

	January 1-July 31		
	1951	1956	1971
Number of fires	1,263	1,765	2,319
Acres burned	94,011	77,679	36,266
Average acreage per fire	74	44	16

A carelessly tossed cigarette or a campfire not adequately doused can turn a rich natural environment into a black wasteland.

POW!
ZAP!
SPARKY
BIFF!
HELP SPARKY
FIGHT FIRE

15

FIRE SAFETY EDUCATION

Among the many measures that can be taken to reduce fire losses, perhaps none is more important than educating people about fire. Americans must be made aware of the magnitude of fire's toll and its threat to them personally. They must know how to minimize the risk of fire in their daily surroundings. They must know how to cope with fire, quickly and effectively, once it has started. Public education about fire has been cited by many Commission witnesses and others as the single activity with the greatest potential for reducing losses.

In the Commission's poll of those who live daily with destructive fire-fire service personnel-98 percent of those who replied agreed that there is a need for greater education of the public in fire safety. Two-thirds agreed that most fires occur because of public apathy toward good fire prevention practices. (The larger the population served, the stronger was the tendency to be in agreement with this view.) To what extent apathy would be better labeled "ignorance" or merely "low priority concern" can only be guessed,

In the Commission's estimate, about 70 percent of the fires that occur in buildings can be attributed to the careless acts of people,' and together these fires caused by human action account for more than $800 million in property losses (Table 15-l). It is these fires that should be the special target of educational efforts designed to prevent them from happening.

The prevention of fires due to human carelessness is not all that fire safety education can hope to accomplish. Many fires caused by faulty equip ment rather than carelessness could be prevented if people were training to recognize hazards. And many injuries and deaths could be prevented if people knew how to react to a fire, whatever its cause.

As one writer has summed up the problem, "A significant factor contributing to the cause and spread of fire is human failure-failure to recognize hazards and take adequate preventive measures, failure to act intelligently at the outbreak of the fire, failure to take action which would limit damage."[2] These failures cannot be

[1] The Commission's estimate is at variance with other estimates, but all such efforts involve approximations, if only because a large number of building fires are reported in which the cause is unknown.

[2] Deuel Richardson, "The Public and Fire Protection," ***NFPA*** Quarterly, July 1962, p. 4.

Table **15-I.** Estimated Percentage of Building Fires and Losses Attributable to Human Action

Cause	(1) Percent attributed to human action	(2) Number of fires [1]	(3) Number of fires attributed to human action (Col. 1X2)	(4) Property loss [1]	(5) Property loss attributed to human action (Cal. 1X4)
Heating and cooking equipment	75	157,700	118,275	$172,895,030	$129,671,250
Smoking and matches	100	118,400	118,400	98,344,OOO	98,344,OOO
Electrical	50	160,900	80,450	271,269,OOO	135,634,500
Rubbish, ignition source unknown	75	34,400	25,800	21,754,OOO	16,315,500
Flammable liquid fires	75	64,900	48,675	53,931,000	40,448,250
Open flames and sparks	75	74,100	55,575	100,156,OOO	75,117,000
Lightning	0	22,200	—	40,335,000	—
Children and matches	100	70,400	70,400	72,285,OOO	72,285,OOO
Exposure (to another fire)	0	23,200	—	42,148,OOO	—
Incendiary (suspicious)	100	72,100	72,100	232,947,000	232,947,000
Spontaneous ignition	33	15,700	5,233	25,606,OOO	8,535,OOO
Gas fires and explosions (not reported elsewhere)	50	8,200	4,100	21,074,OOO	10,537,000
Explosions (miscellaneous and unclassified)	50	4,400	2,200	5,212,000	2,606,OOO
Totals		826,600	601,208[2]	$1,158,046,000	$822,440,500[3]

[1] Loss data from "Fires and Fire Losses Classified," *Fire Journal,* September, 1972 (pp. 65-69). Data in this table exclude two categories where human action cannot be estimated (i.e.: "Unknown or Unidentified" and "Miscellaneous Known"). -

2 72.8 percent.

[3] 71.2 percent.

legislated out of existence; they must be dealt with through education.

Day in and day out, firefighters see the evidence of human failure. They see pennies in fuse boxes and 30-ampere fuses where 15-ampere fuses ought to be. They see the tragic consequences of trash or flammable liquids stored near furnaces, overloaded electrical circuits, gas heaters improperly vented. They find the victims of fire who have died in their sleep because they failed to take the routine precaution of always sleeping with bedroom doors closed. And when they can get to them, they find the charred bodies of those who took a fatal gamble with fire: who opened a hot door, who dashed through smoke instead of crawling along the floor, who might have survived the gauntlet if they had held a wet cloth over nose and mouth. Organizations like the National Fire Protection Association and the National Safety Council have based their fire safety messages on these common failings (see box, page 115). Firefighters and others have brought these messages into the homes and classrooms of America. And still, thousands of Americans die needlessly every year.

Public Education Reduces Deaths and Injuries

A cynic might remark that this widespread ignorance shows that Fire Prevention Week, school programs in fire safety, and all the posters and pamphlets on fire prevention are wasted efforts. Yet we do not know how much worse the Nation's fire record would be if there were no educational efforts. Moreover, we do know that public education programs can dramatically reduce fire losses. Two studies supported by the Bureau of Community Environmental Management, an arm of the Department of Health, Education, and Welfare, provide evidence of this. Though small in scope, the studies are among the few in which results of fire prevention efforts have been measured.

Between 1966 and 1969, an intensive fire safety education program was directed at an area of southeast Missouri where the fire death rate was far higher than the national average. The

first step was to study the pattern of fires and burn injuries and their causes. Then a field staff was trained to administer the program, Civic groups, fire departments, local officials, and the mass media cooperated with the program. The public got fire safety messages every way they turned-from audiovisual demonstrations, educational programs, and media broadcasts. The result: The fire death rate dropped 43 percent in 3 years-from 12.9 to 7.4 per 100,000 population. For each dollar invested in the program, 20 dollars were saved in anticipated property losses, medical expenses, and earning losses. Two years after the pilot program was terminated, the death rate was still falling-five times faster than that of the rest of the State.

A similar study had been carried out 8 years earlier in Mississippi County, Arkansas. There, studies showed that misuse of electrical wiring systems and petroleum products, plus use and storage of flammable products near heating units, led other causes of fire. The public education program emphasized these problems. Following the first year of the education program, there were only half as many burn injuries requiring medical treatment as the year before. This favorable trend continued during ensuing years.

A number of incidents in recent years have demonstrated that when people have fire safety on their minds, fires decrease in number. In each incident, people were fire-conscious because they knew normal fire protection was not available to them. It happened in a midwestern city when a severe snowstorm immobilized all traffic, including fire trucks. It happened in several American cities in the late 1960's when fire departments were tied up in riot-torn areas. It has happened when fire departments have been battling landslides or coping with floods. In each case, the number of fires dwindled to a fraction of the normal.

A striking example of long-term success in fire safety education is the Smokey Bear campaign. That effort, supported by Federal and State forest agencies, has been described as the country's most successful program of environmental protection.

For 30 years public service advertising has urged Americans to prevent forest fires. During these years man-caused forest fires have been reduced from about 200,000 annually to about 105,000 in 1971. This reduction was achieved even though the land area for which statistics are kept has doubled and the number of days of recreation use has increased about tenfold. A doubling of the acreage alone would be expected to have resulted in 400,000 fires annually, but, as indicated, only 105,000 occurred. This overall reduction by 75 percent in the number of fires which would otherwise be expected to occur (assuming that the increased exposure to people leads in equal measure to chance of fire and the chance of early detection) has helped save $17 billion in natural resources over the 30-year period. The cost of this program to Federal and State agencies is about $488,000 per year, with approximately $40 million in service donated by the Nation's radio and television stations, newspapers, magazines, and the Advertising Council,

Current Efforts to Reach the Public

Though we as a Nation have not made the commitment to fire safety education that we ought, a number of efforts-by professional societies, the insurance industry, fire departments and other governmental agencies-are reaching some portion of the American people effectively.

Private organizations. Through posters and pamphlets (17 million distributed last year), the National Fire Protection Association brings a fire safety message to millions of Americans every year. The National Fire Protection Association is instrumental in promoting the annual Fire Prevention Week campaign, the Sparky the Fire Dog campaign in schools, and seasonal fire prevention campaigns in the spring and at Christmas.

The American Insurance Association annually distributes more than 26 million pamphlets to schools, hospitals, and other organizations. Its films reach an audience of more than two million people each year. Through the special training it provides to thousands of fire inspectors working for insurance companies, the American Insurance Association has an indirect but considerable effect on public education.

Insurers in the industrial and commercial sectors, notably the Factory Mutual System and the Factory Insurance Association, affect the safety of millions of Americans at their places of work, through counsel on fire prevention engineering,

Sparky the Fire Dog, a creation of the National Fire Protection Association, teaches fire safety to children.

inspections, and distribution of publications, films, and posters.

In addition, a number of insurance companies reach the public with fire safety messages. Pilot efforts have been made to teach fire safety in deteriorated neighborhoods where the Fair Access to Insurance Requirements (FAIR) plan is in operation. (Under the FAIR plan, subject to the Federal Insurance Administration, companies agree to insure properties that would not qualify under ordinary requirements.) Limited experience has shown that the efforts work only if support is won from local community leaders.

Lastly, the Fire Equipment Manufacturers Association distributes about 200,000 fire extinguisher selection charts and several million extinguisher operation manuals every year.

The Federal Government. With the very contrasting exception of the Forest Service's Smokey Bear program, the Federal Government is involved in only a limited way in fire safety education-except as it affects Government installations. Each Federal agency has responsibility for internal fire prevention. There is a Federal Fire Council that pulls together Federal fire-loss statistics, serves as a clearinghouse and central library of fire literature for the Federal agencies, and sponsors a limited program of fire safety training for Government personnel. Unfortunately, the activities of the Federal Fire Council have been extremely limited in recent years. There is no program in the Federal Government directed toward the public at large to prevent fire losses.

Fire departments. Local fire departments make significant contributions to public education--through inspections of dwellings and commercial establishments, through distribution of reading material on fire safety, and through cooperation with schools.

In sum, a variety of ways are being tried to heighten public consciousness of fire safety. The very fact that the educational efforts come from a

multiplicity of sources in a variety of ways probably serves to heighten public awareness of fire safety. Yet it is safe to assume, given the sheer number of efforts, that some programs are far less effective than others. What is needed is a mechanism for evaluating these programs so that weak efforts can be replaced by coordinated support of efforts of proven effectiveness.

Fire Safety Education in the Schools

Habits of fire safety are best instilled during the years of childhood, especially since youngsters are particularly prone to fire accidents, That fire safety education in schools can be effective is illustrated by a pilot study supported by the Bureau of Community Environmental Management of HEW.

In 1971, a demonstration project was begun in Memphis, Tenn., to determine the effectiveness of teaching safety concepts to young school children. Forty-three elementary school teachers attended a 22-hour series of workshops on an injury control curriculum. Emphasis was placed on teaching burn prevention concepts. The teachers returned to their classes and taught what they had learned to 1,016 children, ranging from kindergarten to the third grade. In the study area, burn injuries have decreased by 17 percent, while in a control area with similar population, burn injuries have increased by 100 percent. Because of the success of the pilot project, safety education is now being taught to all elementary school children in the Memphis school system.

How do other schools measure up? In an attempt to learn how much fire safety education in schools is required throughout the Nation, we wrote to the board of education in each of the 50 States, asking about programs in fire safety. Forty-two States replied to our request. Of these, seven reported that they have no State program of fire education. Four of these-Arkansas, Kansas, Tennessee, and Alaska (which has the highest fire fatality and personal loss record in the Nation) --expressed interest in starting a fire education program and asked the Commission's help. It seems safe to assume that the eight that did not reply have no program.

Among the States requiring fire safety education, Iowa, Minnesota, and New York appear to have the most complete curricula in the field. New York law calls for 15 minutes of fire education a week in all grades, kindergarten through ninth grade (over and above time spent on fire drills), while Minnesota requires 60 minutes a week of health and fire education. While some States do have legal requirements and well developed curricula, conversations with State officials reveal that implementation of these programs is not well enforced or programs are non-existent in many schools. One State teaches the dangers of ammunition, homemade bombs, and fireworks in the second grade but does not get around to the subject of matches until the third grade.

We need to point out that the absence of a statewide fire education program does not necessarily mean that there is no fire education in the State. Local school boards, fire departments, or other groups may be filling the void-at least in part. Some communities have exemplary programs. In Santa Ana, Calif., a city of 165,000 people, an imaginative program in the classrooms is supplemented by demonstrations by the fire department, a parade at the end of Fire Prevention Week, a poster contest, and a carnival for schoolchildren in May. Civic groups are as deeply involved in the program as the schools and the fire department.

But the Santa Anas are the exception, not the rule. The Nation's widespread ignorance about fire safety and the failure of many States to provide even minimal education in the subject underscore the need for Federal intervention. **The Commission recommends that the Department of Health, Education, and Welfare include in accreditation standards fire safety education in the schools throughout the school year. Only schools presenting an effective fire safety education program should be eligible for any Federal financial assistance.**

Because fire safety has been ignored in the education of teachers, there are few educators with the knowledge or qualifications to teach it. **The Commission recommends that the proposed United States Fire Administration sponsor fire safety education courses for educators to provide a teaching cadre for fire safety education.**

The Commission recommends to the States the inclusion of fire safety education in programs educating future teachers and the requirement of

As a prelude to teaching fire safety to children, many fire departments demonstrate their apparatus for them.

knowledge of fire safety as a prerequisite for teaching certification.

Our concern over the lack of public education, and particularly education of the young, is by no means new. In fact, it was expressed a quarter of a century ago by the 1947 President's Conference on Fire Prevention, many of whose recommendations, unfortunately, remain to be implemented.

That the Federal Government shows more interest in protecting its trees than its citizens from fire merely reflects the long-standing indifference of Americans to the problem of fire losses. But the imbalance deserves to be rectified. While the National Fire Protection Association and others are doing significant work in fire safety education, the Nation is not realizing anywhere near the benefit of the potential loss reduction possible through fire safety education. The Commision believes that a significant increase in effort is necessary and that this will only come about by the involvement of the Federal Government.

The Commission recommends that the proposed U.S. Fire Administration develop a program, with adequate funding, to assist, augment, and evaluate existing public and private fire safety education efforts. The program should be directed, first of all, toward encouraging local governments and the private sector to do more, reinforcing efforts with incentives when necessary. Secondly, it should seek effective ways to reach critical target areas where special educational efforts are warranted, such as young children and the vast numbers of the poor whose education is limited. Thirdly, it should develop model programs and guide local governments in their adaptation to local circumstances.

Further, **the Commission recommends that the proposed U.S. Fire Administration, in conjunction with the Advertising Council and the National Fire Protection Association, sponsor an all-media campaign of public service advertising designed to promote public awareness of fire safety.** In developing this campaign, the U.S. Fire Administration should provide for test marketing, evaluation, and periodic revision of the messages. Major emphasis should be placed on fire prevention in the home. This campaign should include national and regional efforts by all communications media directed toward specific fire-prone groups, such as the young and the elderly. The campaign should cover seasonal fire hazards, and should be geared through language, background, and program timing to the important recipients. Mass media education should not only create an awareness of fire hazards and fire safety, but should provide specific instruction on what to do and what not to do and motivate changes in attitudes and behavior.

Evaluation is an especially important phase of the recommended programs. Effectiveness of fire safety messages is best not left to guesswork. The best techniques of persuasion (admittedly, a field undeveloped as a science) must go into the message; the most exacting standards of testing must go into the evaluation of results. The latter is true whether results are being measured in terms of attitude changes, elimination of hazards, or decline in fire accidents. In all such testing, results should be compared with a control group, consisting of a similar population, that has not received the fire safety message. It would be appropriate for the U.S. Fire Administration to assist non-profit organizations, such as the National Fire Protection Association, in evaluating their efforts in fire safety education, It would also be appropriate for the US. Fire Administration to underwrite basic studies of techniques for motivating target audiences.

Special Opportunities

While it is premature to say what techniques work best, two pilot projects sponsored by the Department of Health, Education, and Welfare suggest approaches that could be adopted on a much wider scale. The first of these was tried in Norfolk, Va., in 1969. Specially trained paraprofessionals, called Injury Control Technicians, went from house to house in the target area in the company of housing-hygiene inspectors. The technicians acted as home environment counselors to help residents of the area identify injury hazards and, where possible, eliminate them. (All kinds of hazards were pertinent, but fire hazards were a major consideration.) The advice of the technicians was welcomed by the residents and, as a result, an average of five important hazards per household were eliminated.

In the second project, now in its fifth year, 500 specially trained paraprofessionals, called Health Educator Aides, are working in 36 cities. Re-

cruited mostly from the poor neighborhoods they serve, they have proven effective in reaching the poor and altering their behavior for their own good. While most of their work has been in rodent control, HEW's Bureau of Community Environmental Management is confident H.E.A.'s could be used to improve fire safety in poor neighborhoods. If H.E.A.'s spent 10 percent of their time on fire safety, as the Bureau recommends, it would cost $14.6 million to bring fire safety education to the Nation's 15 million disadvantaged families. The Bureau estimates that if the program reduced fire losses among this population by only 2.6 percent, the expenditure would be economically justified, but that a reduction of 10 percent is easily attainable.

In addition to health aides, there are a number of other Americans in occupations where, if they had special training in fire safety, they could favorably influence the safety of others:

- *Attendants in nursing homes, hospitals, and institutions* for *the handicapped* should have special training to handle their difficult responsibilities during fire emergencies. Evacuation is usually a slow process and, with certain patients, sometimes impossible ; and emergencies can be compounded by irrational behavior of patients.
- *Employees* of *restaurants, hotels, and places of public assembly* should be trained to lead patrons to exits, to extinguish small fires, and to render first aid.
- *Physicians* are valued counselors on a host of subjects ranging from nutrition to behavioral problems. Their advice on fire safety could be especially important to families with young children or elderly relatives in their care.
- Millions of preschool children spend part of their time under the care of *teachers and workers* in nursery *schools, day care centers, and Head Start programs,* In these contacts lie valuable opportunities for lessons in fire safety appropriate to the preschool age group.
- There are approximately 20,000 *resident managers* of major (150-330 units) federally assisted housing facilities for low-income families. Currently these managers are being offered training opportunities in such subjects as administration, management of physical facilities, and human and family relations by the federally funded National Center for Housing Management. If these resident managers had special training in fire safety, they could affect the well-being of 10 million Americans who live in these federally assisted housing projects.

These special situations merit special attention. **The Commission recommends that the proposed U.S. Fire Administration develop packets of educational materials appropriate to each occupational category that has special needs or op portunities in promoting fire safety.** In many instances, these packets could be distributed by professional organizations in the private sector on a shared-cost basis.

While Health Educator Aides and other paraprofessionals can supplement the residential inspection programs of fire departments by calling citizens' attention to hazards and sound practices of fire safety, they in no way diminish the need for thorough inspection programs by fire departments. Trained firefighters can bring to residential inspections an expertise exceeding that of paraprofessionals for whom fire safety is a part-time concern.

A National Program for Fire Safety Education

The Commission believes that an overall reduction of at least 2 percent per year in life loss, property loss, and injuries is a realistic and conservative goal for a national fire safety education program. We believe that the three-part program outlined in Table 15-2 will reach that goal in the early years of implementation, based on current fire loss statistics. We emphasize that parts of the program must be designed to provide feedback information on program effectiveness-information which is essential to achieving optimum benefit, yet is usually not collected.

Multimedia public service education. This nationwide program should be directed to the public at large through all forms possible, with an approach similar to the Smokey Bear campaign. The $1.5 million annual cost is a realistic estimate, based on previous public service campaigns.

Intensive local education. This part of the program should be aimed at that 5 percent of the Nation's population in areas suffering the highest loss of life from fire: Alaska, several Southern States, and the poor sections of large

Table 1-52. Estimated Annual Savings and Costs of a Fire Safety Education Program

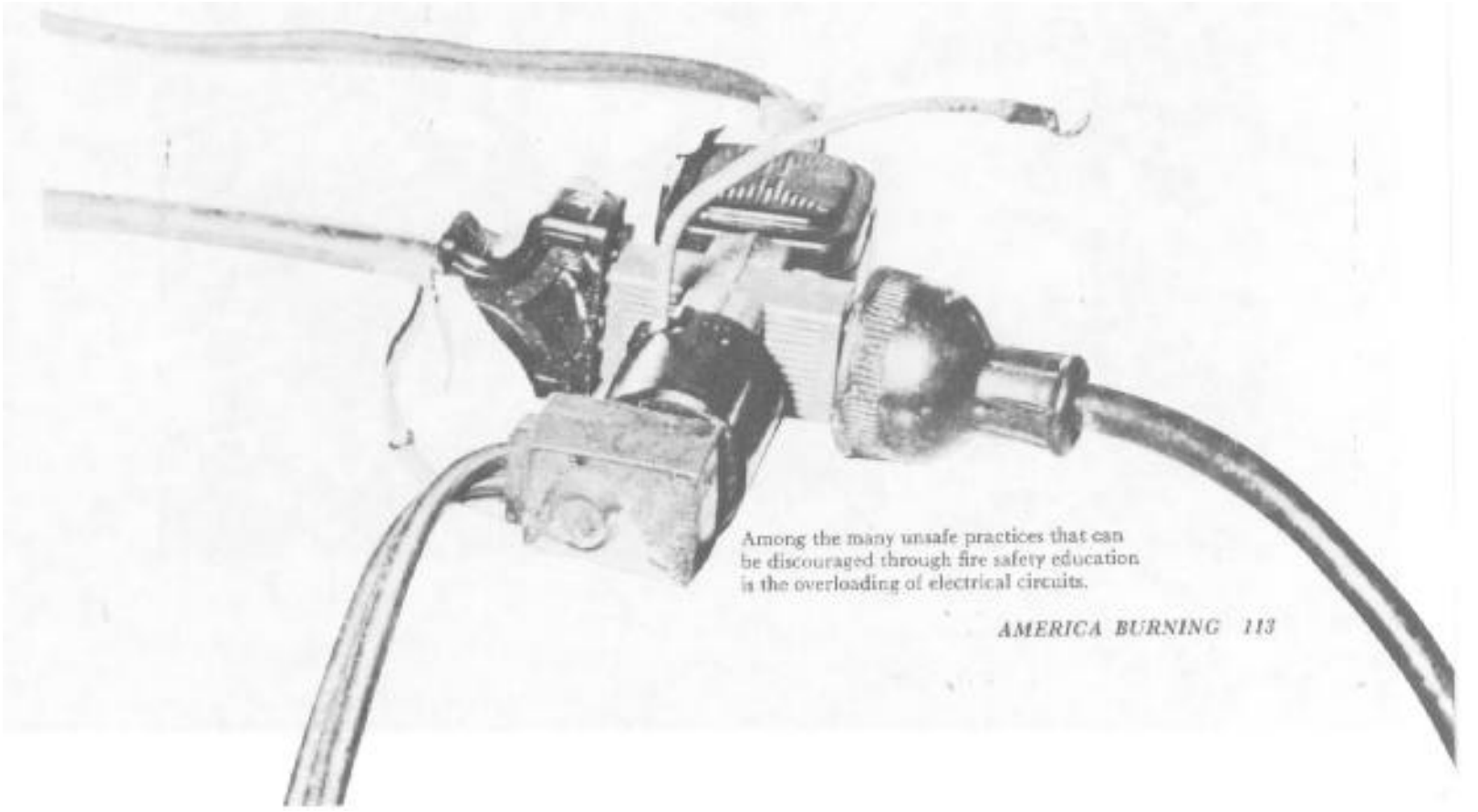
Program	Estimated savings			Estimated Federal cost
	Lives	Injuries	Property	
Nationwide multimedia public service education program	120	3,000	$27,000,000	$1,500,000
Intensive local education programs (directed to 5 percent of Nation's population with highest life loss risks)	76	1,900	4,300,000	2,100,000
Nationwide elementary schoolchild education	66	1,600	8,700,OOO	6,000,OOO
Total	262	6,500	$40,000,000	$9,600,000

cities. Various pilot projects have achieved significant reductions of fire incidence and burn injuries and deaths. The Arkansas pilot project mentioned earlier achieved a 50 percent reduction in burn injuries, while the one in Missouri resulted in a 14 percent reduction per year in fire deaths. The volunteer fire department of East Aurora, N.Y., reported a 28 percent reduction in the number of fires and a 52 percent reduction in dollar losses, achieved through a public education campaign. In Rochester, N.Y., spot announcements on television during station breaks contributed to a 15 percent annual reduction in smoking-related fires and an 18 percent annual reduction in fires caused by children and matches,

Cost-effectiveness as high as 20 to l-that is, $20 saved in losses prevented for every dollar spent on education-has been reported. Where volunteers are used or the media donate space or time, cost-benefit ratios can be even higher.

Past experience shows that the 760 lives lost in the high risk 5 percent of our population could be reduced by 10 percent year year. An investment of $2.1 million each year to reach this segment of the population could be expected to reduce fire injuries by 1,900 and property losses by $4.3 million annually.

Education of children in schools. Continuous education of children of elementary school age can, we believe, result in an annual 10 percent reduction in deaths and injuries within that group and an equal reduction in child-caused fires, especially those involving children and matches. We have estimated that for an annual cost of $6 million, specialized training can be provided for a corps of fire safety educators, including both

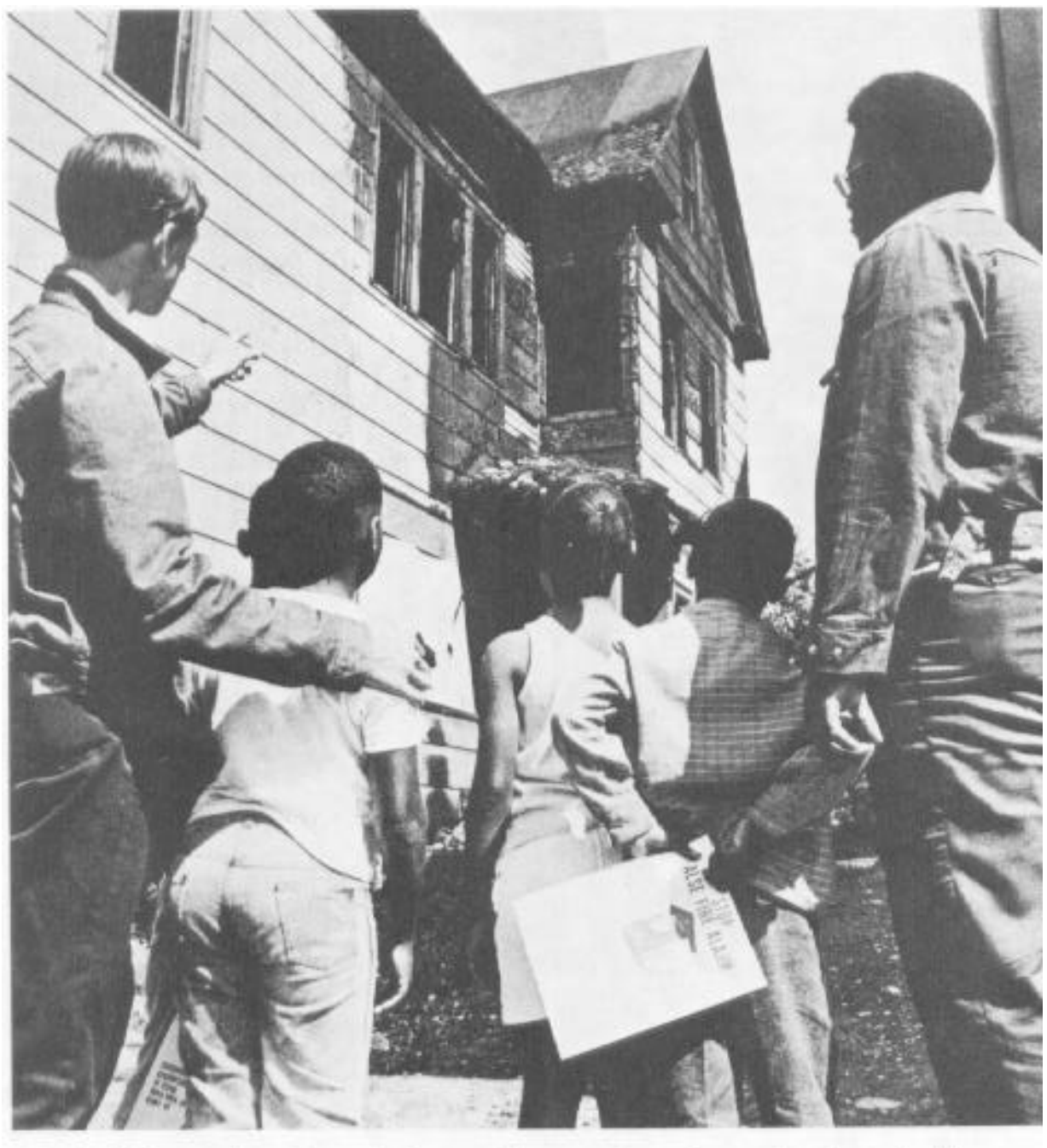


Among the many unsafe practices that can be discouraged through fire safety education is the overloading of electrical circuits.

teachers and firefighters. While the payoffs from these expenditures will not be especially high in t.he beginning, the attitudes and habits instilled should last a lifetime, thus having a cumulatively greater effect in future years,

The projected program should result in an annual saving of at least 260 lives, 6,500 injuries, and $40 million in property at an annual cost of $9.6 million: a cost-benefit ratio for property of four dollars return for every dollar invested, not to mention the incalculable savings in lives and injuries.

We recognize that not everyone will respond to or even be reached by public education, but we firmly believe that it can contribute significantly to reduction of fire losses.



Educational efforts must be made to reach those especially prone to fire accidents, such as the poor in cities

FIRE'S DO'S AND DON'T'S

Educational materials distributed by the National Fire Protection Association, the National Safety Council, the American Insurance Association, and others emphasize the major gaps in everyday knowledge and practice:

Before the Fire Starts

- Remove trash and stored items of outlived usefulness, particularly from the vicinity of furnaces and heaters and from hallways and exit areas.
- Exercise care in the use of electricity. Do not overload electrical outlets with many appliances, use only appropriate fuses, and do not hang electrical cords over nails or run under carpets, Have cords replaced when they begin to fray or crack, and have electrical work done by competent electricians.
- Do not store gasoline or flammable cleaners in glass containers, which can break, and avoid storing them inside the home. Do not keep more flammable liquids on hand than you really need.
- To avoid the danger of spontaneous ignition, dispose of rags wet with oil, polishes, or other flammable liquids in outdoor garbage cans.
- Inspect your home and workplace often for these and other hazards.
- Plan for escape from every area of the home, discuss escape routes with your family, and actually rehearse escape. Look for exits upon entering restaurants, theaters, and other public buildings. You might have to find your way out in thick smoke or darkness.
- Sleep with bedroom doors closed. In the event of a fire, you will gain precious minutes to escape.
- Learn how to extinguish common fires in early stages the best way. Roll a person whose clothing is on fire; use a proper portable extinguisher or even a handful of baking soda to extinguish a fire on your stove.
- Clothing afire is a prelude to tragedy. Buy garments, such as children's sleepwear, that meet Federal flammability standards as they become available, Do not wear (or permit children to wear) loose, frilly garments if there is any chance at all of accidental contact with a stove burner or other source of fire.
- Exercise extreme care with smoking materials and matches, major causes of destructive fire. Do not leave these where children can reach them.
- Invest in fire extinguishers, escape ladders, and-most important-early warning (smoke or products-of-combustion) fire detector and alarm devices.

After a Fire Starts

- If you see, smell, or hear any hint of fire, evacuate the family immediately, but don't compound tragedy by attempting a rescue through a gauntlet of flames or thick smoke. Call the fire department as soon as possible. Don't attempt to extinguish a fire unless it is confined to a small area and your extinguishing equipment is equal to the task.
- If your clothing ignites, roll over and over on the ground or the floor. Running will just fan the flames. Teach the proper procedure to your children.
- Before opening your door when you suspect fire in another part of the building-as in a hotel, for example-feel the inside of the door with the palm of your hand. If it's hot, don't open it. Summon aid, if possible, and go to a window and await rescue. If smoke is pouring 'into the room under the door, stuff bedding or clothing into the crack.
- In smoke, keep low. Gases, smoke, and air heated by fire rise, and the safest area is at the floor. Cover mouth and nose with a damp cloth, if possible. Don't assume that clear air in a fire situation is safe. It could contain carbon monoxide, which, before it kills you, affects judgment, hampering escape.

16

FIRE SAFETY FOR THE HOME

Of the 8,000 Americans who die in building fires every year, nine out of ten die at home. Firefighters find their bodies beyond the wall of fire or smoke that blocks escape, sometimes only a few feet from a window or door. But often, too, they are found where they slept: Smoke and toxic gases never gave them a chance.

The nearly 700,000 fires that occur in American homes annually produce losses exceeding $874 million. That figure tells only part of the story. In addition to structural damage, the losses include personal possessions-often acquired after years of work and saving, often objects of sentimental attachment whose value cannot be described in dollar figures.

The losses will grow. Presently there are about 68 million occupied dwelling units in the United States, and new units are being added at the rate of 2 million a year. Considering this growth and taking into account the demolition of old units, we can project annual property losses from residence fires approaching $1 billion by 1980-unless major steps are taken to combat the problem.

Residence fires are not a simple problem but a welter of interacting factors. Combustible interior finishes and furnishings, flammable clothing, and poor interior design from the standpoint of fire safety contribute to the heavy toll. The ignorance, confusion, or panic in people's response to fire helps to account for the fatalities. So does the lack of even elementary precautions, such as never smoking in bed and never leaving children home alone. So, too, does the lack of positive steps, such as installing early-warning fire detectors or extinguishing devices and rehearsing with the family various escape plans.

Fire Awareness in the Home

In Chapter 15 we recommended a concerted national effort in fire safety education, including a multiple-media public service advertising campaign. Obviously a major emphasis in this broad-based effort should be fire safety in the home. Americans must be educated to sound practices in the home to prevent fires from starting, and they must also be educated to react properly when a fire is discovered to save their lives and those of their families.

Thousands of Americans die needlessly because they react counterproductively when they discover a fire. Many waste precious minutes trying to put out a fire before awakening the family or calling the fire department. Others open hot doors, attempt a dash through thick smoke, or,

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in confusion (or under the influence of a toxic gas), fail to think of the most obvious measures for escape.

The National Fire Protection Association and the Fire Marshals Association of North America have devised a program called Operation EDITH (Exit Drills In The Home). In a community that adopts Operation EDITH, well-publicized efforts are made to encourage families to devise-and rehearse-plans for getting the family out of the house in the event of a fire. The publicity often includes demonstration of such steps as installing escape ladders and, when a fire happens, covering the nose and mouth with a wet cloth and crawling along the floor to avoid smoke. **The Commission supports the Operation EDITH plan and recommends its acceptance and implementation both individually and community-wide.**

Dwelling Inspections by Fire Departments

Though regrettably few fire departments conduct adequate evaluations of their programs, some have reported as much as 15 to 30 percent reduction in dwelling fires or life loss as a result of undertaking a program of home inspections. In 1972, Baltimore reported a 47 percent decrease in dwelling fires and a 38 percent reduction in lives lost from the year before, and attributed a significant portion of these reductions to the city's dwelling inspection program, Not surprisingly, inspection programs appear to be most effective in neighborhoods where losses are ordinarily high.

Only a portion of the Nation's 27,500 fire departments conduct residential inspections. In the Commission's survey of fire departments, only 20 percent of the 10,000 respondents reported inspecting more than 10 percent of the residences in their community each year.

In addition to locating fire hazards in the home, residential inspections can serve to heighten citizens' awareness of fire's threat and to teach them life-saving precautions and emergency procedures. Inspections can promote respect for the fire department and underscore its interest in saving lives and minimizing losses. In addition, inspections can serve to attract new members to the fire service.

Most important, residential inspections-used as educational opportunities as well as for identifying hazards-could save thousands of lives a year. **The Commission recommends that annual home inspections be undertaken by every fire department in the Nation. Further, Federal financial assistance to fire jurisdictions should be contingent upon their implementation of effective home fire inspection programs.** This recommendation is not meant to preclude Federal planning and implementation assistance to help fire jurisdictions undertake a program of residential inspections.

Small and volunteer fire departments that have manning problems, particularly during daytime hours, should be encouraged to use women volunteers as residential fire prevention inspectors. Cities that have health educator aides or other community workers in low-income neighborhoods (as described in Chapter 15) could utilize these workers to supplement the fire department's residential inspection program,

It is important that inspectors be carefully selected and trained, They must be able, not only to spot hazards, but to deal graciously and effectively with the public. In this regard, it would be appropriate for the proposed National Fire Academy to develop model curricula for the training of residential inspectors, Care must also be taken to assure citizens that the inspections are advisory only and limited to matters of fire safety. (Inspectors will not be welcomed into homes when they are suspected of searching for unlicensed dogs or housing code violations.)

To be successful, inspection programs must be evaluated. It is important for the Nation to know what kinds of inspection programs work and what kinds don't. At the very least, comparisons should be made between the 12 months' preceding a new inspection program and the first 12 months following, as well as between the last year of a program and the year after it is dropped.

Home Fire Detection

Most Americans who die in home fires die during the nighttime hours. Usually it is smoke, toxic gases, or lack of oxygen-not fire itself--that kills them.

In countless instances these lives would be saved if the victims were awakened to the presence of a fire in its early stages. There are on the market approved devices designed to detect smoke

or other products of combustion-not heat alone, which can be detected only in a fire's advanced stage-and sound an alarm. In a Canadian study,' the investigators concluded that 41 percent of recent fire victims in Ontario could have been saved if their dwellings had been equipped with early-warning detectors. Extrapolated to the United States, this would be a saving of 2,600 lives every year.

[1] J. H. McGuire and B. E. Ruscoe, "The Value of a Fire Detector in the Home," Fire Study No. 9 of the ***Division of Building Research, National Research Council,*** Ottawa, December 1962.

In addition to locating fire hazards in the home, residential inspections can serve to heighten citizens' awareness of fire's threat.

The National Fire Protection Association, the Department of Housing and Urban Development, and the International Association of Fire Chiefs, among others, support the use of early-warning detectors in homes. Those who testified to this Commission on fire safety in the home were unanimous in favoring widespread use of early-warning detectors. At a minimum, most advocates feel, there should be an early-warning detector on the ceiling near each sleeping area in the house. Some believe a system of heat detectors is an adequate substitute, but only if there are many more of them located throughout the house. There is a consensus that only devices approved by nationally recognized testing laboratories, such as Underwriters' Laboratories or Factory Mutual Research Corporation, should be used. **The Commission urges Americans to protect themselves and their families by installing approved early-warning fire detectors and alarms in their homes.**

Fire departments should encourage the installation of approved early-warning fire detectors in the course of their residential inspections. In the course of subsequent inspections, they should then check to see that the devices are in working order.

Representatives of numerous insurance companies have expressed to the Commission the desire to increase their efforts to reduce life and property losses and injuries by fire. Encouraging Americans to provide fire protection in their homes would be a major contribution, and **the Commission recommends that the insurance industry develop incentives for policyholders to install approved early-warning fire detectors in their residences.**

There could also be tax incentives. **The Commission urges Congress to consider amending the Internal Revenue Code to permit reasonable deductions from income tax for the cost of installing approved detection and alarm systems in homes.** Such a provision would not only offer a financial incentive but would serve to draw public attention to the importance of fire safety in the home.

Public awareness of the value of early-warning fire detectors would be enhanced if, as we recommended in Chapter 11, all of the Nation's model codes would specify at least a single-station early-

warning detector outside sleeping areas in every dwelling unit.

Here and there fire detection systems have become legal requirements for residences. Since 1958, Quincy, Mass., has required fire detection and alarm devices in all new single-family dwellings. The Village of Bayside, Wis., has a similar ordinance, and also requires that occupants perform maintenance checks on the detection systems and report on a standard form to the chief of public safety annually or face a $200 fine. In Ohio, the State fire code now requires a single-station fire detector in all new one-, two-, and three-family dwellings. At the Federal level, the Department of Housing and Urban Development requires early-warning fire detectors in multiple-family dwellings and care facilities, such as hospitals and nursing homes, insured or assisted by the Department. HUD recently extended the requirement to insured or assisted one- and two-family dwellings.

The 18,000 mobile homes that HUD provided to Pennsylvania's victims of Hurricane Agnes in 1972 were equipped with early-warning detectors and are serving as a testing ground for the devices. The National Bureau of Standards is collecting data on the experience with these detectors to evaluate their performance (including any tendency of causes other than fire to activate the alarm) and to aid in the development of installation and maintenance requirements.

Certainly the technology of early-warning detectors can be improved, and with a substantial market assured, the costs of these devices can be brought within the reach of low-income families. Manufacturers are working toward improvements in both directions, and their efforts are likely to accelerate when the devices "catch on." The National Aeronautics and Space Administration, the National Science Foundation, and the National Bureau of Standards are supporting work to improve the detectors. All of these efforts deserve coordination, and **the Commission recommends that the proposed United States Fire Administration monitor the progress of research and development on early-warning detection systems in both industry and Government and provide additional support for research and development where it is needed.** Long-term studies might investigate the possibility of coupling early-warning detection with household commodities, such as electrical wiring or telephones, or with such commonly used objects as lamps or light bulbs.

In addition to on-premises detectors and alarms, another avenue of exploration is the coupling of fire detection with cable television. The Federal Communications Commission requires commercial suppliers of cable TV to provide the capability to transmit a signal "upstream" from the subscriber as well as "downstream" from the transmitter. Several cities, including Pensacola (Florida), Atlanta, and a suburb of Chicago, are experimenting with means of transmitting fire alarms automatically by cable to summon aid.

Automatic Fire Extinguishing Systems

Where early-warning detectors and automatic extinguishing systems are used in combination, the protection to lives and property is enhanced greatly over that afforded by detectors alone. Automatic sprinklers are expensive; while they are feasible for high-rise and other large buildings, they are too costly for installation in the average home. Research and development are needed toward automatic extinguishing systems that will be cheap, aesthetically acceptable, and adaptable to existing homes as well as new construction. **The Commission recommends that the Proposed U.S. Fire Administration support the development of the necessary technology for improved automatic extinguishing systems that would find ready acceptance by Americans in all kinds of dwelling units.**

Automatic extinguishing systems in residences would not only save lives and reduce direct losses from fire, but would also reduce other expenses to the Nation, such as the costs of treating burn and smoke injuries, insurance costs (both premiums and payouts), and the costs of maintaining fire departments. The developers of Disney World in Florida, who have installed sprinkler systems in residential buildings such as hotels and apartments (and smoke detectors in single-family dwellings), report that there have been savings in insurance rates and, just as important, savings in the costs of maintaining fire departments.

Protection of Mobile Homes

Mobile homes possess some special fire danger

EARLY-WARNING (SMOKE) AND HEAT DETECTORS

"Three types of fire detectors are most commonly used in this country. These are known by the generic terms as heat detectors, smoke detectors, and flame detectors. Only heat and smoke detectors appear to have application to the household fire detection system. Heat detectors may be of the type that sense temperature of the environment, rate of rise of the environment temperature, or combinations of these. Smoke detectors of two different types are available. Optical detectors are designed to sense the scattering of a light beam by smoke particles; combustion products detectors are designed to detect the presence of particulate products of combustion by electrical means., Each detector type has advantages and disadvantages associated with any particular application. .

"In the late 1950's, self-contained non-electrical fire alarm units were being sold door-to-door. A unit of this type consisted of a heat detector.... a horn or bell to sound the alarm, and a source of stored energy.... Because these units respond only to a temperature rise, they are intended for use in areas where a fire producing a great deal of heat is likely to occur, such as near a furnace, but they have also been employed throughout other rooms in a home. Hard sell techniques were employed in marketing these units. . . .

"In order to be of value in providing life safety, a fire detection system must make provision for detecting a small smoldering fire soon enough that alarm can be given and the building evacuated before untenable smoke conditions are reached. In addition, but of less relative importance, the fire detection system ought to be capable of early detection of rapidly developing hot fires.

"Smoke detectors of the photoelectric and ionization types provide means for detecting smoke from either type of fire; and the most critical factor in determining the speed of response is the location of the detector. Heat detectors, on the other hand, provide early warning of hot fires in their immediate area only. . .

"The most favorable locations for smoke detectors which protect the bedroom area, either alone or in conjunction with detectors located throughout the house, depend of course on the building configuration. In general, the smoke detectors should be located so that smoke from any fire which originates outside of the bedroom area must pass over the smoke detector before entering the bedrooms."

----From testimony to the Commission (Oct. 4, 1972) of William J. Christian, consulting engineer, Underwriters' Laboratories, Inc.

characteristics. Among these are their small size, close proximity of heaters and kitchens to sleeping areas, the concentration of combustible materials, lack of adequate escape doors in many cases, and a higher combustibility of interior finishes than in most site-built homes. Mobile homes are the fastest-burning of all homes.

More than seven million Americans live in mobile homes, and mobile homes currently account for 95 percent of homes sold for under $15,000. Mobile homes presently are being manufactured at a rate well exceeding 500,000 per year.

While the incidence of fire in mobile homes is about the same or less than in conventional homes, data indicate, results are often more serious when a fire occurs. The office of the State Fire Marshal of Oregon has compiled some of the most complete records available on fire losses in mobile homes. They have reported, from data covering the period 1965 through 1971:

- The ratio of fatalities per fire in mobile homes is 2.74 times greater than for standard dwellings;
- The loss-to-value ratio per fire in mobile homes is 3.84 times greater than standard dwellings;
- Average mobile home fire losses are greater than average losses in standard dwellings by a ratio of 1.62 to 1 ($1,477 per fire average to $909 average for standard dwellings).

A number of individuals and organizations have pursued improvements in mobile home safety. Congressman Lou Frey, Jr., of Florida, introduced in 1972 the first national mobile home safety act. Federal action to protect owners of mobile homes is justified, since the Federal Government buys mobile homes for disaster victims and other uses and, through the Federal Housing Administration, provides mortgage insurance for a limited but growing number of mobile homes.

In addition, the National Fire Protection Association has devised a standard, NFPA 501B, which has been approved by the American National Standards Institute for the design and construction of mobile homes to provide fire safety. This standard has been criticized as not stringent enough; for example, there are no interior finish requirements for molding, doors, trim, cabinets, and splash panels, all of which can contribute to the rapid spread of fire. Nor are early-warning fire detectors required. **The Commission recommends that the National Fire Protection Asso-**

Many deaths from fires in the home can be attributed to ignorance of how to react and escape when a fire happens.

One important measure for averting tragedy is to rehearse, with all members of the family, plans for escaping various kinds of fires.

ciation and the American National Standards Institute jointly review the Standard for Mobile Homes and seek to strengthen it, particularly in such areas as interior finish materials and fire detection.

The NFPA/ANSI standard is advisory only, and many State and local jurisdictions have failed to enact a code for mobile homes equivalent to that standard. **The Commission recommends that all political jurisdictions require compliance with NFPA/ANSI standard for mobile homes together with additional requirements for early-warning fire detectors and improved fire resistance of materials.** These requirements will be effective only if they are enforced adequately-through inspection both at the point of manufacture and the final site of each mobile home.

Because of zoning requirements, mobile home parks are frequently located outside of cities and, hence, far from fire departments and adequate water supplies. This means that the parks themselves must provide safeguards against destructive fire, as the National Fire Protection Association has recognized in its Standard on Mobile Home Parks (NFPA 501A). **The Commission recommends that State and local jurisdictions adopt the NFPA Standard on Mobile Home Parks as a minimum mode of protection** for **the residents of these parks.**

Citizens' Responsibilities

There are millions of Americans who invest heavily in chain locks and burglar alarms, who keep guns in their homes and under store counters to supplement the protection they get from police departments. Very few of these Americans have paused to consider the wisdom of providing their own fire protection.

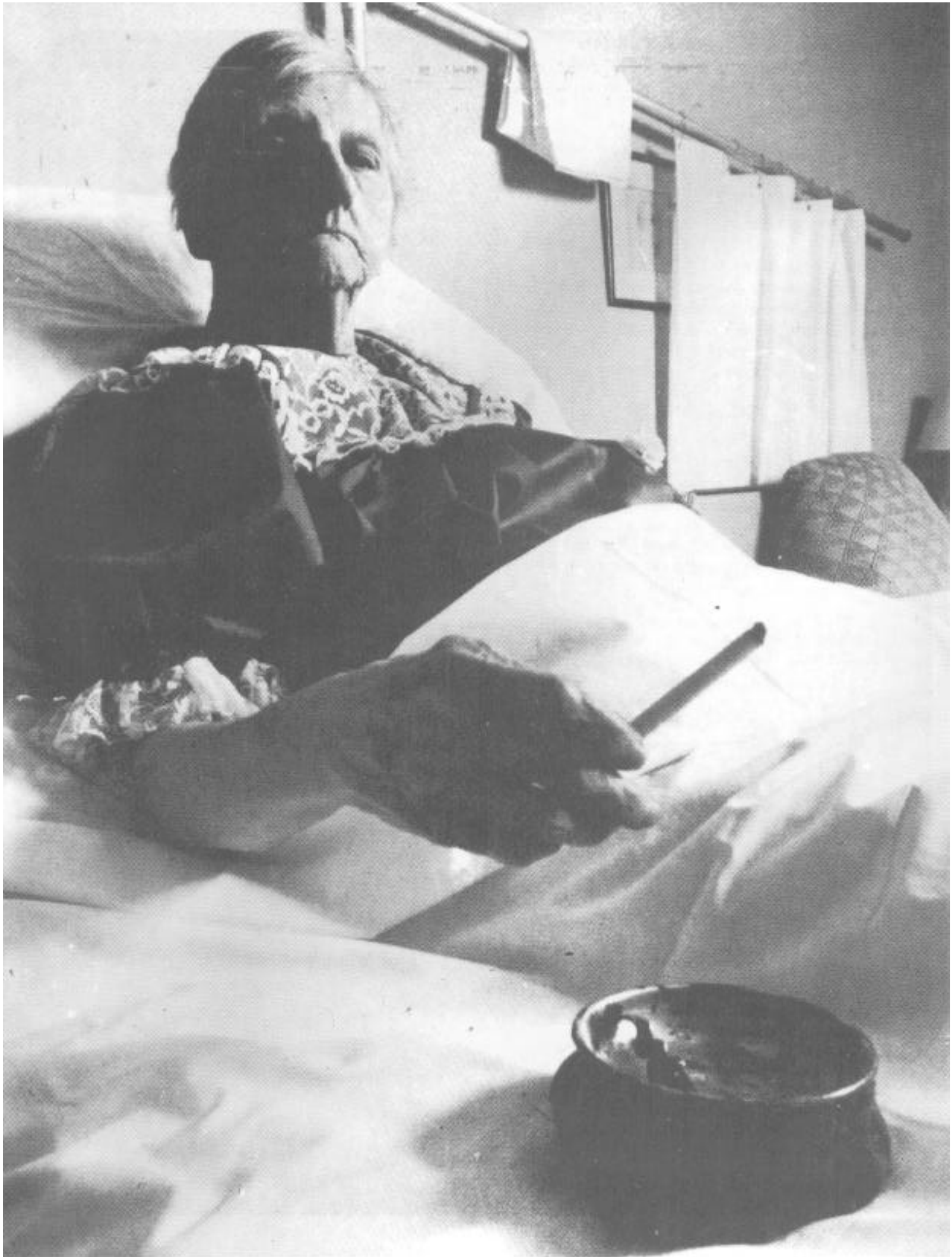
Consistent with the prevailing American attitude toward fire protection in the home, the burden of protecting lives and property in residential fires is borne overwhelmingly by the public, in the form of fire departments. The inadequacy of this reliance is conveyed by a single word: time. It takes time to discover a fire, time to notify the fire department, time for the fire department to reach the scene, and time for firefighters to bring the fire under control. Every passing second weighs the odds more heavily in favor of the fire and against the victims.

The attitude of the Japanese, who for centuries built their homes of very flammable materials, contrasts sharply. There, a destructive fire disgraces the person who allows it to happen; once upon a time, it was sufficient cause for crucifixion. A Japanese proverb translates: "There is no one who fails to get excited when the neighbor's house is on fire." That is, distant troubles do not interest people; it is only when a problem comes close to home that they are willing to do something.

Before Americans will take the steps to protect themselves and their families, the threat of fire must be brought "close to home." Thus, a need underlying many others is to educate Americans to recognize the dangerous enemy they have in destructive fire.

If fire consciousness could be instilled in Americans, then one could envision the day when every American home will have its own automatic fire department: an alarm that rescues the family and automatically activates the extinguishers that put out the fire. Then thousands of lives would be saved every year, millions of dollars of the Nation's resources would be saved from ruin, hospitals could be emptied of beds for burn and smoke injury patients, fire departments could be pared to a fraction of their present size, and fire insurance might he as cheap as dog licenses.

Other measures for averting tragedy include using and storing flammable liquids away from potential sources of ignition.



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FIRE SAFETY FOR THE YOUNG, OLD, AND INFIRM

There are millions of Americans against whom fire holds heavy odds. These are people with limited capacities-the very young, the old, the physically and mentally handicapped. Lacking the ability to cope adequately with fire accidents, these Americans deserve protective watchfulness from their families-that is, when they are with their families. When they congregate with peers of similar disabilities, a fire accident can threaten many lives. The situation is ripe for major tragedies in nursery schools, day care centers, homes for the physically or mentally retarded, and homes for the elderly.

In many such institutions, a combination of built-in fire protection and attentive staff has kept fire accidents under control, But there are poignant exceptions. In February of 1972, six children died in an apartment in Chicago that had been licensed by the State of Illinois as a day care center. At the time of the fire, the operators of the day care center had won two delays of a court case involving code violations found by the Chicago building department. Many such programs for preschool children are not subject to strict building code requirements because they are located in private homes, churches, or other buildings not designed for the purpose of child care.

The National Fire Protection Association has amended its Life Safety Code (NFPA 101) to govern construction, exit facilities, and fire detection systems in facilities for groups of preschool children in day care centers, group day care homes, and family day care homes. Included are provisions for early-warning fire detection devices where children sleep. The Department of Health, Education, and Welfare has urged the States to adopt these provisions as licensing requirements for these facilities. **The Commission strongly endorses these new provisions of the Life Safety Code for child day care centers and recommends that they be adopted and enforced immediately by all the States as a minimum requirement for licensing of such facilities.**

Among fire's victims, one large group stands out as a special and growing concern: the occupants of nursing homes and homes for the elderly. Annually, 3,500 to 4,000 fires break out in these facilities. During the 20 years from 1951 to 1970, 496 residents of facilities for the aged died in multiple-death fires (those killing three

or more). No one keeps a national record of single-fatality fires in nursing homes, but by conservative estimate the toll is 500 persons a year.

According to Government and industry estimates, about one million older Americans live in 23,000 nursing homes and other care facilities across the Nation. Most of these facilities are licensed by their respective States and hence may be regulated, to some degree, concerning fire safety. About 14,000 of these are subject to Federal certification (under Medicare and Medicaid programs) and must comply with the 1967 edition of the Life Safety Code of the National Fire Protection Association.

Perhaps another million elderly Americans live in "housing for the elderly" insured or assisted by the Department of Housing and Urban Development and thus subject to some fire safety requirements, though not as stringent as they could be.

Untold hundreds of thousands of older Americans live in nursing homes that are not State-regulated (usually because they dispense no nursing services) and in unregulated boarding houses, hotels, and other room-and-board facilities that cater mostly to the elderly.

Thus, fire protection for the elderly ranges from excellent to totally inadequate and, on balance, is far less than senior citizens deserve. It is a blemish on the American conscience that those who contributed to our prosperity are allowed to live their retiring years where even minimal fire safeguards are absent. The problem of fire safety in special housing for the elderly deserves attention, with growing urgency each passing day. The elderly population is expanding, as is the portion of Americans living out their years in nursing homes and housing for the elderly.' A stronger Federal role in attacking the problem is justified, since many homes for the elderly receive assistance from HUD or old age assistance payments.

Fire-resistive building construction, we should add, is not a panacea. In November of 1972, 10 people died of smoke inhalation in an Atlanta fire in a new 1l-story apartment house that cost $3.5 million to build. It appeared, in general, to meet the appropriate provisions of Atlanta's building code, the NFPA Life Safety Code, and the standards of the Department of Housing and Urban Development for housing for the elderly.

Moreover, many safeguards meant to avert multiple-death fires by limiting the spread of fire and smoke do not prevent the accidents that cause single deaths. Safeguard which only prevent multiple deaths cannot be considered adequate to the needs of the elderly.

It is not difficult to see why the elderly are especially prone to tragic fire accidents. Many lack the physical coordination to handle matches, cigarettes, or hot appliances safely. Others, mentally impaired or despondent, set fires deliberately. When a fire occurs, physical or mental impairment can hamper the chances of escape. As firefighters have discovered over and over, many elderly patients are reluctant to leave the room that houses their few worldly possessions. Compounding the problem of fires in nursing homes is the fact that many homes are sparsely staffed, especially during the nighttime hours.

Better Protection is Needed

The National Fire Protection Association recently revised the Life Safety Code and, in so doing, gave added attention to the problem of single-death fires. Stricter flammability requirements have been imposed on gowns, bedding, cubicle curtains, and draperies. Early-warning detectors arc recommended requirements for all new nursing homes, hospitals, and ocher care facilities. In recognition that building alterations and extinguishing systems are expensive, the fire protection standard is flexible, permitting reduction in compartmentation requirements if automatic sprinklers are installed or deleting the sprinkler requirements where compartmentation standards are met in fire-resistive and protected non-combustible buildings.

The Department of Housing and Urban Development, too, has revised its standards for institutional and residential occupancies for the elderly, to require more extensive, yet not complete, coverage by automatic sprinklers and early-warning detectors.

State requirements vary widely. Since 1967, Massachusetts, which has some of the most stringent standards, has required that all new and

'The over-65 group is expected to increase 30 percent by 1985, while the total population will grow by only 18 percent. In the 6 years from 1963 to 1969, while the elderly population grew by 21 percent, the number in nursing homes increased by two-thirds.

existing facilities for the aged (except those strictly providing housing for the elderly) be equipped with automatic sprinklers if they have three or more residents. On the other hand, there are seven States with no sprinkler requirements of any kind.

Reliable estimates place the cost of automatic sprinkler systems between $0.65 and $1.25 per square foot, depending on the difficulty of installation. While this is roughly similar to the cost of carpeting, we recognize that the cost could be burdensome to many owners of facilities for the aged, particularly if the owners must also invest in early-warning detectors. Such facilities are an expanding need in our society, hence any increase in financial burdens must be carefully weighed against its possible effect of discouraging private enterprise to provide these facilities, Yet the fire safety of the elderly should

Lack of mobility or physical coordination compounds the problem of rescuing nursing home patients from a fire.

yield to no compromise. **The Commission recommends that early-warning detectors and total automatic sprinkler protection or other suitable automatic extinguishing systems be required in all facilities for the care and housing of the elderly.**

The recommendation applies to residences for the elderly as well as to care facilities. Some financial incentives may be necessary. Federally guaranteed low-interest loans, tax incentives such as accelerated depreciation and exclusion of fire extinguishing systems from tax assessments, reduced fire insurance premiums, and concessions in structural fire protection requirements would offer desirable inducements to builders and owners.

In putting forth this recommendation, the Commission recognizes that it exceeds standards of the NFPA Life Safety Code at a time when Federal agencies and many States still lag behind current provisions of the code. We believe the Federal agencies and States should be making every effort to keep up with changes in the NFPA standards. **The Commission recommends to the Federal agencies and the States that they establish mechanisms for annual review and rapid upgrading of their fire safety requirements for facilities for the aged and infirm, to a level no less stringent than the current NFPA Life Safety Code.**

It is appropriate to pause and note here that the recommendations we have thus far put forth in this chapter, and the ones that are to follow, could apply equally well to other kinds of facilities for the infirm and handicapped in our society. We have focused on nursing homes and housing for the elderly because these have been a major source of tragic fires. But other kinds of institutions, such as homes for the physically or mentally handicapped, have conditions very similar to those of facilities for the aged. Thus, it would be appropriate for Federal and State authorities also to review periodically the extent of coverage provided by their fire safety regulations-that is, to include various kinds of institutions for the handicapped as well as facilities for the elderly.

The limited capabilities of the physically handicapped and the elderly to escape from fire in institutions and public buildings need special attention. A deaf person cannot hear a fire alarm bell. A blind person cannot see an exit sign. The crippled person in a wheelchair needs ready access to a safe refuge from fire that does not require the USC of stairs or elevators. Audible and visual fire alarms, wide doorways, and ramps are some of the needs. **The Commission recommends that the special needs of the physically handicapped and elderly in institutions, special housing, and public buildings be incorporated into all fire safetey standards and codes.**

No standards are useful, of course, if they are not enforced. **The Commission recommends that the States provide for periodic inspection of facilities for the aged and infirm, either by the State's fire marshal's office or by local fire departments, and also require approval of plans for new facilities and inspection by a designated authority during and after construction.**

Lowering the amount of combustibles in nursing homes-including interior finishes, furnishings, and fabrics-is a matter of utmost priority. Here the experience of the Veterans Administra-

Though set afire simultaneously, the flame-resistant pajamas burn far more slowly than standard cotton pajamas.

tion is instructive. The VA is furnishing every one of the 80,000 patients in its hospitals with pajamas made of a flame-resistant cloth. Eventually all bath robes will be of this material, and the VA is evaluating the material for possible use in bedding. While the fire-resistant material used is four times as expensive as cotton, it lasts 10 to 15 times longer. The garments have been readily accepted by patients; while the 1 percent of patients who are risks to themselves (most because of their smoking habits) are required to wear fire-resistant clothing, few of the others reject the garments.

Among the elderly in nursing homes, acceptance of uniform garments is less likely. Many have developed sentimental attachment to their own clothing and to the individuality it gives them. It would still be appropriate, however, to require fire-resistant clothing on patients prone to fire accidents. Other fabrics in nursing homes, such as bedding and draperies, should meet high standards of non-flammability, as should furnishings and interior finishes. **The Commission recommends that the National Bureau of Standards develop standards for the flammability of fabric materials commonly used in nursing homes with a view to providing the highest level of fire resistance compatible with the state-of-the-art and reasonable costs.**

Other measures can be taken to reduce the life losses from fires in nursing homes. Specially protected, supervised areas can be set aside for smokers. Smoking can be prohibited in bedrooms unless an attendant is present.

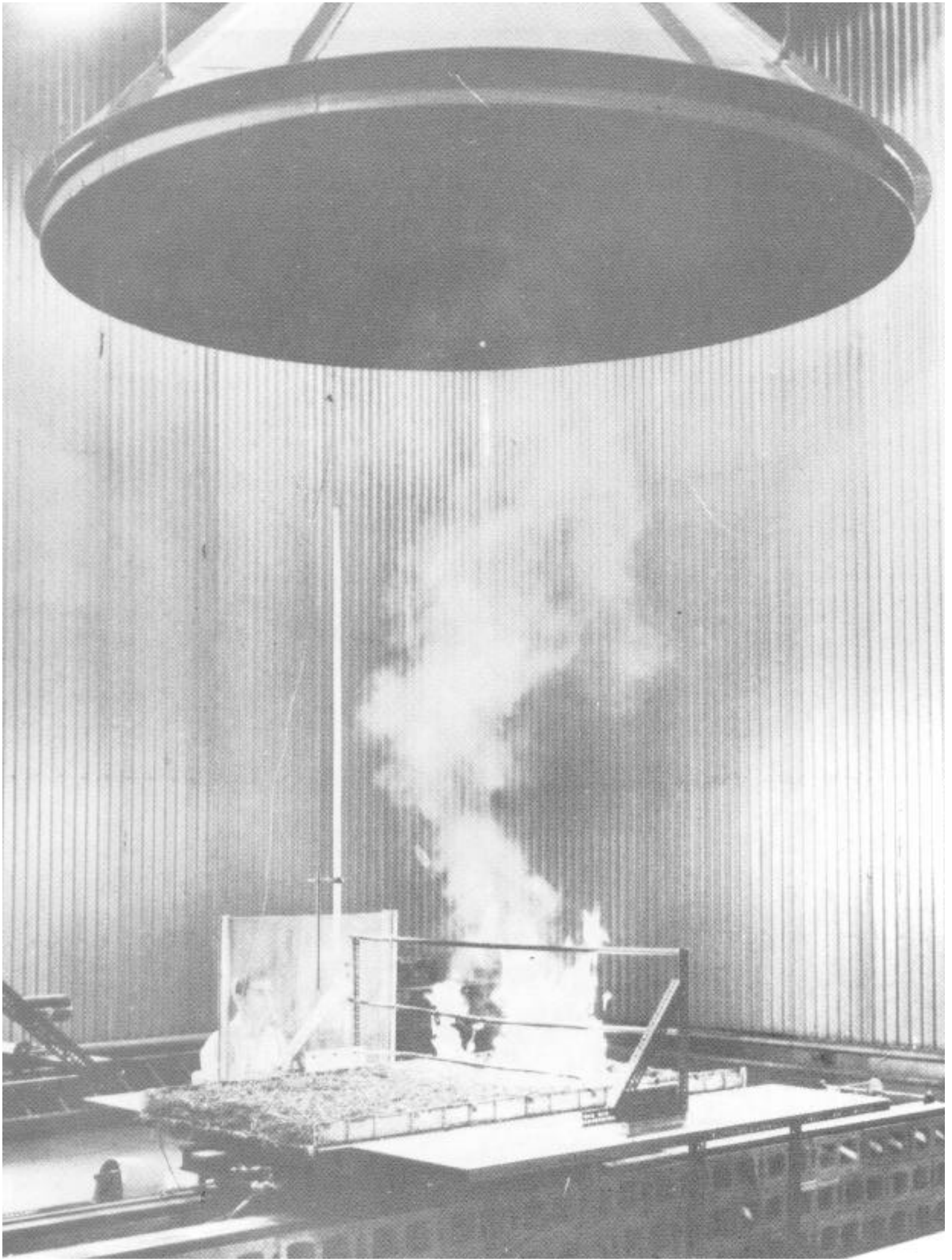
State and local governments can regulate the location of nursing homes-prohibiting them at great distances from fire departments. They can require that alarm systems be tied directly and automatically to the local fire departments. **The Commission recommends that political subdivisions regulate the location of nursing homes and housing for the elderly and require that fire alarm systems be tied directly and automatically to the local fire department.**

The Department of Health, Education, and Welfare, and other governmental bodies which inspect Medicare and Medicaid institutions, can aid local fire departments by transmitting their findings relating to fire and life safety to the departments.

Finally, loss of life can be reduced through the education of staff, residents, and families of residents on fire safety. It is particularly important to train staff how to handle a fire emergency, and in Chapter 15 we recommended that the proposed United States Fire Administration develop training aids for just this purpose.

An incident that happened in Virginia several years ago underscores the importance of education for all who enter nursing home doors. After returning home from visiting an elderly relative, a man called the nursing home to confess that he had given forbidden matches to the relative. The call was too late. The patient had already burned to death.

Multiple-death tragedies could be averted if all nursing homes were required to have built-in fire protection.



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RESEARCH FOR TOMORROW'S FIRE PROBLEM

In both the public and private sectors, the Nation spends about $105 million annually on research and development related to fire (see Appendix VII). It would be difficult to define an adequate level of investment against which this figure could be compared. But evidence marshaled earlier in this report of laggard progress in the technology of firefighting, the treatment of burn and smoke victims, and fire protection of the built environment suggests that the Nation is seriously under-investing in fire-related research.

Much of the research is devoted to narrow- and short-term goals. Industrial research and development, for example, is largely devoted to ensuring that materials and products meet existing codes rather than more ambitious standards of fire safety. Of the $27 million spent on fire research and development by the Federal Government, about $18 million is directed to the specific missions of the sponsoring agencies-for example, in the Atomic Energy Commission, to the prevention and control of fires in nuclear reactor facilities.

Comparatively little has been done in the realm of basic research and other research in which, if a technological improvement is a possibility, it is a long-term payoff. As far back as 1959, the Committee on Fire Research of the National Research Council noted a dearth of basic research directed toward a fundamental understanding of the phenomena of ignition, fire growth, and fire spread. The Committee recommended a "national program emphasizing those areas not adequately covered by current efforts of military and civil agencies." During the 1960's, most of the basic research on fire pertained to forest fires, since the forest environment was easier to deal with and properly preceded attention to the more complex environment of urban fires. By 1969, the Committee on Fire Research was able to report "small but significant" progress in basic fire research.

In the mid-1960's, research interest in the built environment was spurred by new Federal laws dealing with fire safety, in particular with certain fabrics and the materials in aircraft interiors. An expanding role for the Federal Government was defined when the Fire Research and Safety Act of 1968 authorized the National Bureau of Standards to undertake a more comprehensive research program. When the National Science Foundation established its Research Applied to National Needs program in 1971, it opened the way to more extensive fire research.

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Some notable achievements have been made. For example, some of the reactions that take place in a flame are now understood, which opens the way to understanding how the addition of chemicals might inhibit flames. The basic mechanisms of heat radiation are understood almost to the point where the distances at which other fuels in a room will ignite by the radiative energy from a fire can be predicted. In the realm of technological improvements, additives for water have been developed which reduce friction in a hose. Other additives make water "light" so that it floats on top of liquid fuels and smothers flames.

Some Areas for Exploration

There is much to be done in the broad field of fire research. We have indicated important areas for specific research throughout the report.

One basic need is to strengthen this grounding of knowledge about fire in a body of scientific and engineering theory, so that real-world problems can be dealt with through predictive analyses. The development and testing of new materials and assemblies, the teaching of fire protection, the creation of new architectural designs, the engineering design of more effective fire control systems, and the development of fire prevention programs could be greatly expanded and improved if more fundamental understanding of fire behavior were available.

Human Behavior. Because so many fires are due to human carelessness, and because so many people react counterproductively when a fire occurs, the Commission has placed great emphasis on education as a means of reducing the Nation's fire losses. But "carelessness" blankets a range of behavior from relative innocence and helplessness to subconscious attention-getting or self-destructiveness. Effective educational efforts will depend on a much firmer knowledge of why people cause fires than now exists. Moreover, those efforts will require studies of what kinds of fire safety messages work--that is, which kinds of presentations alter human behavior to reduce fire accidents and their consequences-rather than cause citizens to "tune out" (as can happen if the messages are too scary), or blunt their sensitivity through too much repetition.

Likewise, "arson" covers behavior from pyromania to fire-setting motivated by greed. Better understanding of this range of behavior would greatly aid the apprehension of arsonists, the search for safeguards against arson, and the search for alternatives-that is, less destructive outlets for the mentally sick arsonist, and attractive economic alternatives for those who deliberately set fire to their own property.

Fire dynamics. To the extent that materials in the built environment are controlled at all, they are controlled by voluntary standards and building codes, each of which can be no better than the test methods specified for measuring fire performance. Unfortunately, present test methods often yield numbers that tell little more than how materials or structures behave in idealized test configurations. Actual fire performance in a building depends critically on such factors as physical layout, interactions between walls, floors, and ceilings, fuel loads, and the presence of complicating components such as air conditioning ducts. Thus there is a need for research toward the development of test methods that more accurately predict real-world fire performance.

Smoke and *toxic* gases. The physiological effects of smoke inhalation and tolerance limits are not known adequately. Neither is much known about the chemical nature of combustion products, nor how smoke and gases are influenced by combustion conditions, such as temperature and turbulence. Smoke and toxic gases are important hazards, and a better understanding **of** their chemical and physical nature, how they are generated, how they move with lethal effect for great distances through a building, and their physiological effects would provide a foundation of knowledge needed for the development of test methods, standards, and countermeasures.

Automatic detection. Of basic importance is finding the best harbinger of fire. Three considerations enter in: reliable early warning, low cost, and a triggering mechanism that will not be activated by causes other than fire. The best early-warning detectors now on the market use optical detectors to sense smoke or electrical means to detect the particulate products of combustion. Largely as a result of contracts from the National Aeronautics and Space Administration, a number of industrial and Government laboratories are investigating carbon monoxide detection by spectroscopic techniques. Another possible ap-

proach is detection of microscopic particulates, called aerosols, which are known to be produced in copious quantities by combustion, but which themselves are little understood.

Additional basic knowledge is needed on how fast detectors must react, what they must be sensitive to, and how they should be placed to be maximally effective.

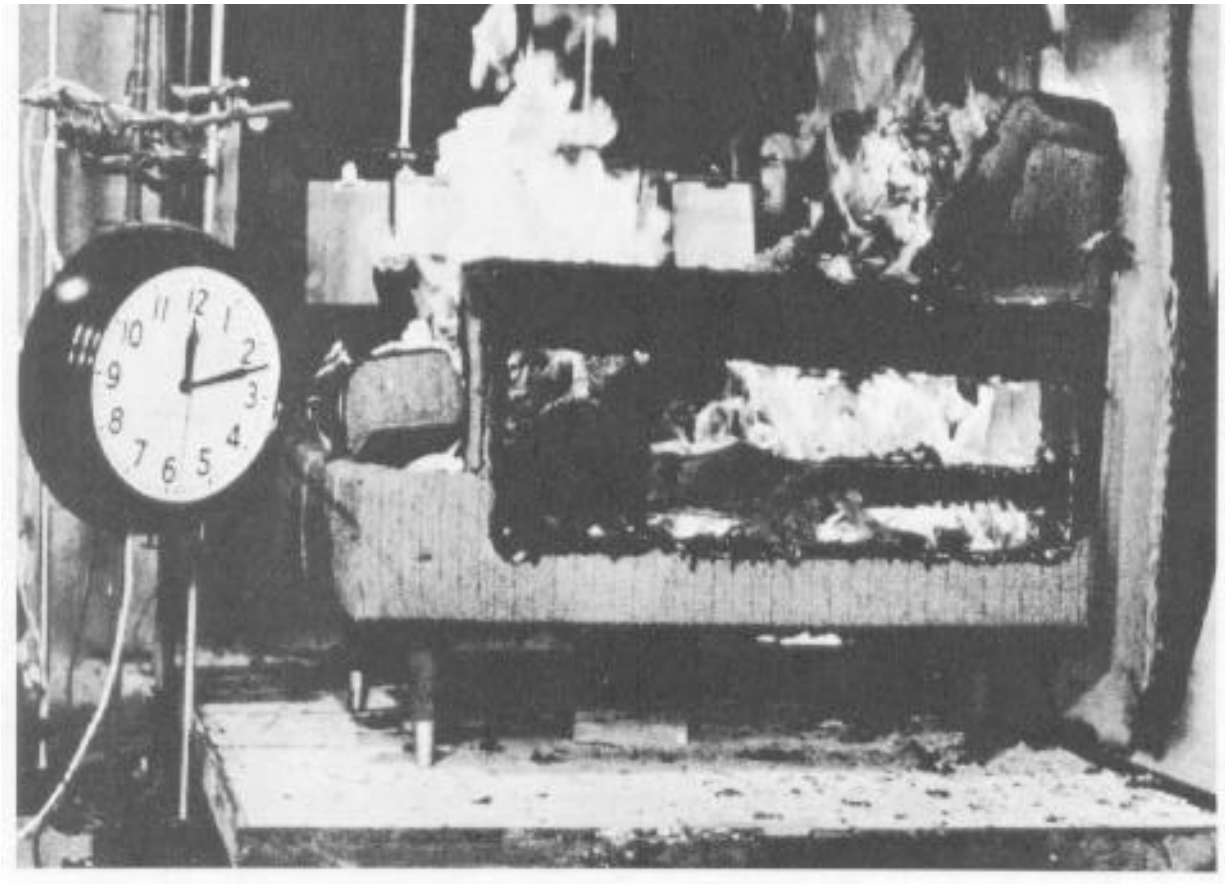
Fire services. As we discussed in detail in Chapter 7, there is room for improvement in the technology of every aspect of firefighting: in the means by which fire departments are notified of fires, in the ways in which men and equipment are dispatched, in firefighters' personal equipment, in the trucks and hoses and suppression agents used to put out fires.

State and local pilot programs. To ensure the prompt introduction of research results, a major effort in translating research into operational practice is essential. We envision pilot programs at the State and local level providing the opportunity for field testing of new research ideas in the real world, serving as a mechanism for demonstrating the practicality of technological innovations to the fire services, and providing training to assist the fire services in their use.

Goals for Research

Most discussions about fire research focus ***on*** particular research problems, rather than on larger questions of what the research can accomplish. Yet for new initiatives in fire research to be justified, the *potentials* of fire research ought to be clearly stated.

One need only consider the chief causes of fire losses-carelessness and shortcomings of design-to realize that losses could be significantly reduced through research. The National Bureau of Standards has suggested that a 50 percent reduction in all categories of losses is possible. A more detailed and ambitious set of goals for research would include the following:



When their products can cause fire to spread rapidly, manufacturers should conduct research to make them safer.

- Reduce fires clue to human behavior by 80 percent;
- Increase in-hospital survival of burn patients by 50 percent through improved burn care;
- Decrease firefighter injuries by 50 percent through better personal protective equipment;
- Eliminate 90 percent of all large property losses through improvements in building design;
- Reduce fire injuries and fatalities at the accident site by 80 percent through safe fabrics, design of products, detection devices, and on-the-scene care;
- Increase the fire control capability of fire departments by 50 percent by faster response and more effective extinguishing methods.

These are long-term goals which, in the absence of major breakthroughs or absence of implementation, might never be attained. But they are guideposts for action. It is relevant to note that if the United States had undertaken its space program with the idea "We might get to the moon" instead of "We *will* land men on the moon," that event would probably still lie far in the future.

The Federal Role in Research

With annual allocations of about $27 million, the Federal Government accounts for one-fourth of the Nation's expenditures on research related to fire. There are kinds of research it would be inappropriate for the Federal Government to undertake. The development of specific products should remain in the private sector, as should fire endurance testing of materials and products.

It is appropriate for the Federal Government to undertake research that could lead to new products in the long run, especially when industry can only afford modest research for gradual refinement of its products. Studies on incentives and harriers to innovation, now under way in the National Science Foundation and the National Bureau of Standards, may lead to strategies of government-industry cooperation that could shift to industry a greater share of the research toward long-term improvements. How to encourage innovation among the manufacturers of firefighting and related equipment would be one of the major concerns of the proposed 'United States Fire Administration.

Many areas of research will continue to lie beyond the interest of profit-seeking organizations and, hence, more likely sponsored by nonprofit foundations, universities, or the Federal Government. This includes exploratory research into highly unconventional solutions for which the risks of arriving at a dead end are too great for industry to undertake. It includes basic medical research several steps removed from any new pharmaceutical or other therapeutic development. It includes research to serve the Government's own nonprofit ends, such as the pilot studies that should accompany the development of new programs in fire safety education.

The Federal Government has developed strong programs in basic and highly exploratory research concerning fire, notably in the National Bureau of Standards, the National Science Foundation, and the National Institutes of Health. Their programs fill important voids left by research in the private sector. Desirable as it might be from the standpoint of economizing, it is not likely that the private sector could fill the gaps if the programs were diminished in any way. **The Commission recommends that the Federal Government retain and strengthen its programs of fire research for which no nongovernmental alternatives exist.** This is not to say that all federally sponsored research should be done "in-house." Throughout the academic and technological communities there are excellent research resources, and the turning away of research from defense and aerospace programs provides a great source of expertise to be tapped.

There ought to be a clear set of priorities in federally sponsored research. Presently there is no group in the Federal Government looking at the total picture of fire research needs-including the physics and chemistry of fire, as well as medical, behavioral, and technological problems-and advising the budgetmakers on what programs deserve what level of support. This is an important function which the proposed U.S. Fire Administration would perform. As it is now, every agency's research program is, in effect, competing for dollars with every other fire research program.

Details of how the U.S. Fire Administration would carry out this function are discussed in the next chapter. Certain important aspects deserve mention here. First, the U.S. Fire Administration would have a system of data-collecting which would serve to guide research priorities. The de-

tailed information it gathered on firefighter injuries, for example, would indicate which injuries happen most often and deserve the most attention, as it would also indicate what must be changed to reduce those injuries.

Second, the U.S. Fire Administration would be an important clearinghouse of information, for both the public and private sectors. Thus it would know what research industry was pursuing, and it would also know what research problems are not being pursued and possibly deserve Federal attention. It would have the important function of disseminating research information to fire researchers everywhere, so that investigators could benefit quickly from the accomplishments of their colleagues and avoid duplicating each other's work. In these ways would the entire Nation's efforts in fire research be strengthened.

In the next chapter we also discuss the allocation of Federal resources for various purposes, including research. That analysis calls for a near-doubling of the Federal research effort; specifically, **the Commission recommends that the Federal budget for research connected with fire be increased by $26 million.** Our recommendation is based not solely on what federally sponsored research could accomplish in the reduction of fire losses, but also on the importance of research relative to other kinds of efforts to reduce losses.

Not a Federal Responsibility Alone

As important as Federal research is for combating the Nation's fire problems, the responsibility is not solely the Government's

Social and legal responsibilities are borne by the private sector as well. For example, car manufacturers are held responsible for defects in design or assembly that can lead to accidents. They are not held accountable, of course, for the stupid or careless actions of drivers. By the same token, the manufacturers of materials that go into the built environment are not responsible for the careless actions that lead to fire accidents. But what happens to those materials as a fire progresses can make the difference between a small loss and a huge one, indeed between life and death. To that extent do manufacturers share in the obligation to make the built environment fire-safe.

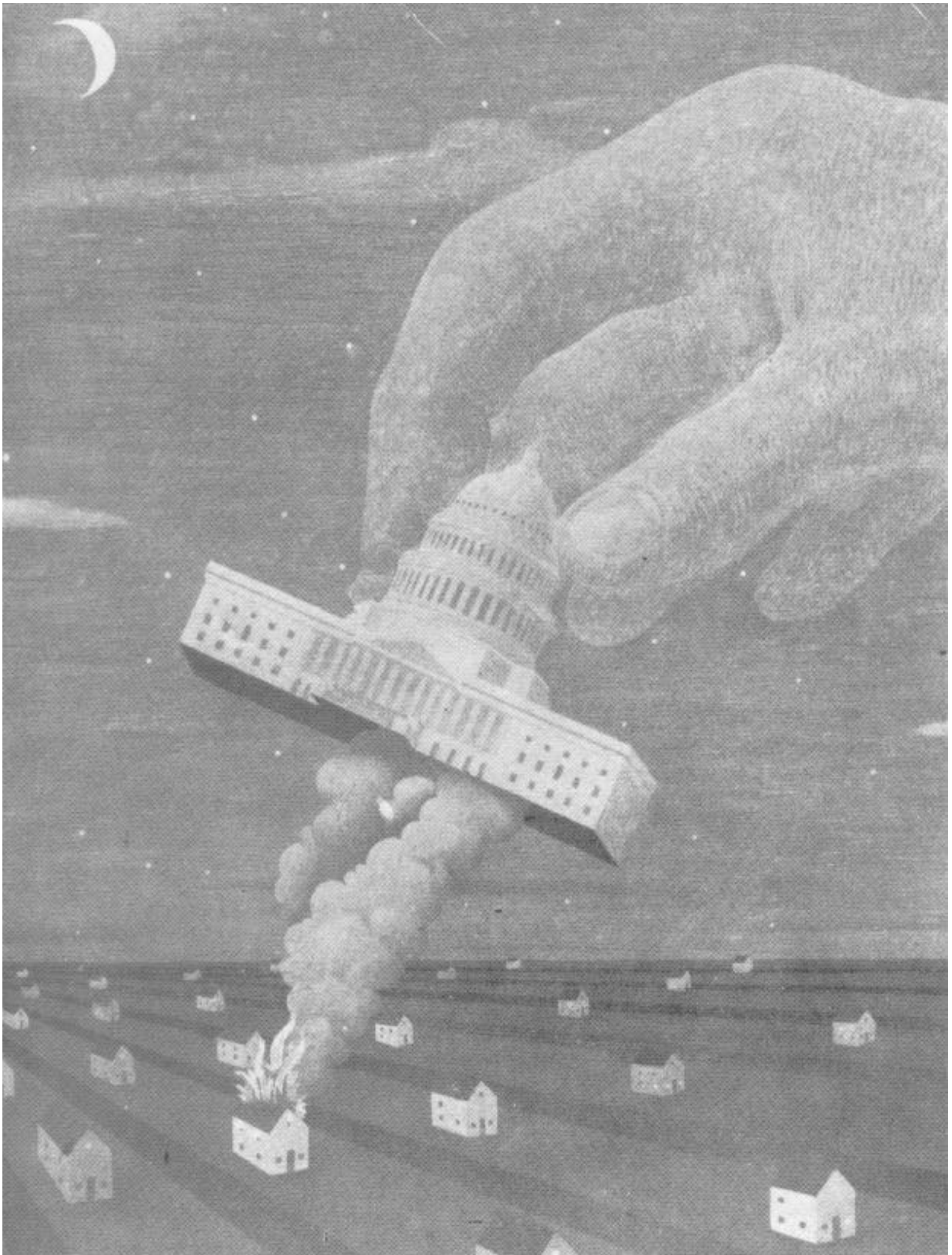
The Government can require that manufacturers make materials fire-safe, as it has done with certain fabrics and as we have recommended that the Consumer Product Safety Commission do for a whole range of materials and products. But industry should accept its responsibilities in the absence of coercion. Accordingly, **the Commission recommends that associations of material and product manufacturers encourage their member companies to sponsor research directed toward improving the fire safety of the built environment.**

People tend to think of research as an expendable luxury, an activity that can be cut off when today's problems, rather than tomorrow's, cry out for solution and total consumption of monetary resources. Behind this view there sometimes lies resentment that, in supporting research, society pays well-educated men and women to do what they enjoy doing, purely for their own satisfaction.

The view is extremely shortsighted. Many of today's problems could be quickly solved-or averted altogether-if yesterday there had been an adequate investment in research. For many years there was an under-investment in research to develop pollution-free automobile engines, and now the Nation is forced to a headlong rush, expensive and laden with problems, to develop those engines in time to meet Federal deadlines.

Likewise, problems for tomorrow can be staved off through adequate investments in research today. There is hope of arresting the so-called energy crisis through research on alternative, untapped sources of energy.

Through progress in medicine, automobile design, and pollution control, Americans are fighting against their destroyers. Some day they will awaken to the realization that they need not accept destructive fire passively. Research must go forward now so that, when that day arrives, effective countermeasures against fire will be ready. Indeed, there are already many Americans who do not accept destructive fire passively. They would have welcomed tomorrow's research accomplishments many years ago.



19
FEDERAL INVOLVEMENT

Time and again this report has made evident the need for Federal initiatives to help combat the Nation's fire problem, and also for coordination to strengthen programs now scattered among Federal agencies. These considerations point to an overriding need : *a permanent Federal agency specifically concerned with fire.*

Emphatically, what is not needed is a Federal bureaucracy assuming responsibilities that should be retained by State and local jurisdictions. Fire prevention, fire suppression, and public education on fire safety should remain primarily responsibilities of local governments, where familiarity exists with local conditions and the people being served. Communities have already invested heavily in manpower and equipment for fire protection, in recognition that it is a local responsibility. Likewise, regulatory responsibilities for fire prevention and code enforcement should remain at State and local levels. Codes and regulations must respond to changes in the built environment, and past experience illustrates that State and local governments are likely to be more dynamic and responsive to changing needs for different jurisdictions than a single Federal regulatory agency.

The Federal Government can help, however, in being a national advocate of fire protection and in providing better training and financial assistance-so that State and local governments and private enterprise can more effectively reduce deaths, injuries, and property losses from fire. Paramount among the objectives is to assist local fire services to improve their effectiveness and broaden their responsibilities from primarily fire suppression to a "fire loss management" orientation designed to prevent fires from happening and reducing their consequences when they occur.

The United States Fire Administration, as we have proposed to call the Federal instrumentality, would have other important functions as well:

- To evaluate the Nation's fire problem, through data collection and analysis, research, and conferences, and to keep the public and all branches and levels of government informed on current matters concerning destructive fire;
- To analyze and report on programs related to fire in other Federal agencies and recommend changes that would strengthen the Federal effort;
- Through the creation of a National Fire Academy, to provide improved training and education for fire service personnel, building designers, code officials, and others;
- To strengthen public awareness of fire's threat;
- To provide bloc grants to State government units for disbursement to local governments.

(These grants should not be overburdened with Federal criteria but contain simple guidelines for each State fire agency to administer.)

Parallels to the intergovernmental relations envisioned for the U.S. Fire Administration exist in the field of criminal justice. The Law Enforcement Assistance Administration awards grants for the strengthening of local law enforcement. LEAA gathers crime data, keeps criminal records and statistics for use by local law enforcement agencies, lends advice to those agencies, and, through the Law Enforcement Education Program, trains local law enforcement officers. Counterparts are needed in the field of fire protection.

Having given considerable thought to the objectives of the U.S. Fire Administration, the Commission has concluded that the Administration would best be placed in a Federal department that has a primary responsibility for urban affairs, urban planning, local government assistance, and housing, as well as knowledge of building requirements. Hence, **the Commission recommends that the proposed U.S. Fire Administration be located in the Department of Housing and Urban Development.** Under the President's Departmental Reorganization Program, the proposed successor to HUD, which would be known as the Department of Community Development, would also retain the urban affairs responsibilities.

Attachment to a Cabinet-level department is preferable to an independent commission. There is considerable feeling in the Executive branch that the growth of independent commissions ought to be arrested and reversed. Moreover, independent commissions, as a rule, have a history of early attention to their needs and later consolidation into departments to achieve support from the Executive branch. With a Cabinet-level spokesman for its programs, the U.S. Fire Administration would, over future years, have a better chance of continuing support.

At the same time, the U.S. Fire Administration would suffer inattention if buried many organizational levels down in its sponsoring department. The Fire Technology Division of the Institute for Applied Technology under the National Bureau of Standards within the Department of Commerce is an example of good intentions and inadequate support. [1]

TO provide effective advocacy of fire prevention and control, and firm executive control, responsibility, and accountability, the U.S. Fire Administration ought to be an Administrator-headed agency. Figure 1991 proposes an organizational scheme for the agency. Functions to be provided, as discussed in previous chapters :

Planning and Evaluation. To provide effective management, the organization must have a regular process for evaluating the success of its programs. It is from these evaluations that future priorities in the allocation of resources are derived.

General Counsel and Administrative Process. General Counsel provides the legal counsel for the agency, while Administrative Process handles the budget, accounting, and personnel, as well as the technical review of local and State assistance programs.

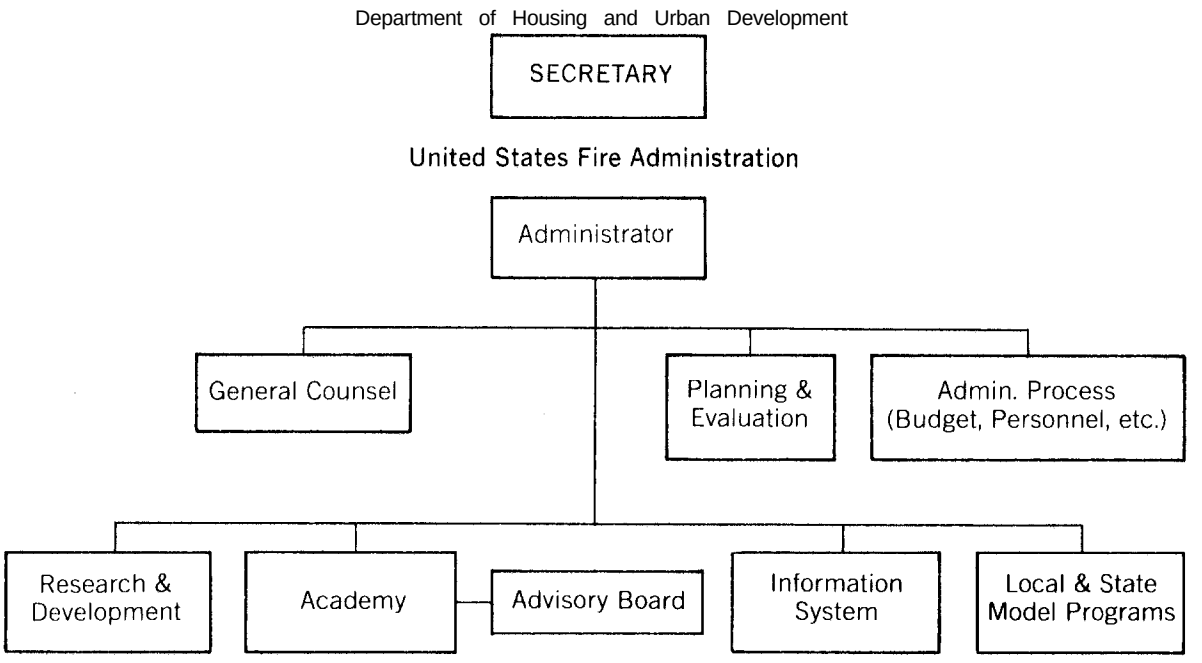
National Fire Academy. The Academy, discussed in Chapter 6, has an important function as a conduit of Federal assistance to local communities. Its educational programs could have a pronounced effect on fire prevention, fire safety in buildings, and the performance of local fire departments. All segments of the field of fire protection, both public and private, will benefit from the Academy, and all should have a part in its development.

Research and Development. This division sponsors and encourages research in the behavioral, physical sciences, and engineering areas, which have the greatest potential for reducing future fire losses. It works in cooperation with the technically oriented research programs at the National Bureau of Standards and the National Science Foundation, and with private groups. By also ensuring the flow of information among investigators in fire research, in both government and private laboratories, the division can hasten progress in research and discourage waste and duplication. A close interface with local, State, and Federal programs, the Academy, and information functions is essential.

Information System. Before effective management of a fire loss reduction program can be accomplished, good information is vital. Local and State feedback is essential to program evaluation. The fire data base for the Nation's fire

[1] See Minority Report of Commissioner Phillips.

Figure 19-1. Proposed Organization of the U.S. Fire Administration



services and the Federal and State governments should reside in the U.S. Fire Administration. This function will provide for a nationwide exchange of information pertaining to fire and life safety and have data collection, storage, retrieval, and dissemination capability. A uniform reporting system should be required for all' fire jurisdictions and would provide the first comprehensive fire data base in the Nation. **The Commission recommends that Federal assistance in support of State and local fire service programs bc limited to those jurisdictions complying with the National Fire Data System reporting requirements.** The development of this program could be contracted to a private organization skilled in information systems. The National Bureau of Standards will continue to have a role in data collection to support its research and engineering-based technology.

Local and State Model Programs. This division will have the primary responsibility for acting as liaison with local and State model programs developed through the Academy or the research division. Programs that provide assistance to school fire prevention education, community college fire science, fire service master plan programs, and public media education would fall into this division. Federal assistance is envisioned here in the form of education, information, and program grants. Assistance to public fire education, local master plan development, and statewide information systems are examples. A bloc grant system administered by each State fire agent is anticipated. A State fire agency may be a State fire commission or the office of the State fire marshal.

Present Federal Roles

The Federal Government is concerned with destructive fire in numerous ways. Research and development activities are scattered among many different agencies: fire suppression (mostly to protect Federal property), laws affecting the sale and shipment of hazardous materials, and testing flammability of materials for the purpose of setting standards are examples of Federal involvement.

Fire prevention and control. Fire prevention is oriented toward protecting Federal buildings and installations. In addition, the Forest Service of the U.S. Department of Agriculture maintains fire control capabilities to protect the Nation's forests and sponsors educational efforts to reduce forest fires. The Department of Defense is concerned not only with the, protection of military equipment and bases, but with the use and

control of fire in warfare. The fire activities within some departments are complex and not always easily identified. For example, the National Aeronautics and Space Administration does not have a fire program per se, but undertakes work related to fire problems as part of mission projects at a number of different research centers.

The Federal Fire Council was originally established as an interagency advisory group on matters relating to fire safety. It formed a medium for pooling talent from agencies for mutual aid in solving fire problems unique to the Federal Government, In reality, it has operated at a marginal level for several years. The U.S. Fire Administration will assume this responsibility and perform this important function for the agencies.

Research. In the realm of fire research, the Federal Government is a dominant force. In Chapter 18, we estimated that the fire-oriented research, development, testing, and evaluation activities in the Federal Government for fiscal year 1972 amounted to nearly $27 million. Most of the research is oriented to hardware solutions; there is comparatively little work on such behavioral questions as why people ignore fire safety, why they start tires, or how hardware systems could be used more efficiently.

Both the National Bureau of Standards and the National Science Foundation (under its Research Applied to National Needs program) have small but significant fundamental research programs in combustion and on test methods. The Forest Service has a major research program in forest fire prevention and control.

Data and Information. Fire information relating to burns and deaths is collected by the Center for Vital Statistics in the Department of Health, Education, and Welfare, and by the Forest Service relating to fire experience in forests and wildlands. The Occupational Safety and Health Administration collects information on work-related fire injuries. The Consumer Product Safety Commission collects information and conducts investigations on fire accidents involving products and flammable fabrics. Lastly, the National Bureau of Standards analyzes data relating to flammable fabrics and also operates a partly automated Fire Information Reference Service for use within the Federal Government. Additionally, NBS is developing a conceptual design for a Fire Loss Data System.

Federal efforts in this area have, however, been fragmentary-each division collecting only that information it has use for. No national, uniform, comprehensive data collection and analysis system exists.

Advisory Panels. Generally, each agency with an extensive research and development program (of which fire research may be a part) has advisory panels composed of experts from outside the Government. They advise on the nature and direction of the agency's programs. There also exists the National Research Council's Committee on Fire Research, which is specifically concerned with promoting and coordinating fire research.

The U.S. Fire Administration and Existing Programs

The Commission does not propose that all Federal fire roles transfer to the US. Fire Administration. Certainly the U.S. Forest Service has conducted an excellent fire program and should continue to do so. The Department of Health, Education, and Welfare has an excellent medical research and public education capability; this should be supported and augmented. The research and engineering-based technology programs presently underway at the National Bureau of Standards should continue to provide the base needed for improved fire safety. The research program of the National Science Foundation is making a significant contribution to needed fundamental scientific knowledge, and should continue. The Department of Housing and Urban Development should continue to encourage fire safety through the standards it has developed for its housing programs. The proposed U.S. Fire Administration would complement and help coordinate these many activities; it would provide the comprehensive evaluation and guidance necessary to determine areas of greatest need and then mobilize efforts in that direction; it would act as the central point in a program of information exchange that would strengthen all the Federal programs having to do with fire. And it would fill the voids, providing Federal help where it does not presently exist-such as providing assistance to local fire services. The recommended responsibilities of Federal agencies, and of the private sector, are shown in Table 19-1, on pages 144 and 145.

Implementing the U.S. Fire Administration

New legislation will be required to create the U.S. Fire Administration. Federal involvement will have to be phased, initially attacking the high priority problems where there is agreement on solutions. Establishment of the Administration will be a giant first step in the right direction.

The programs of the U.S. Fire Administration will also be subject to evolution and changing priorities. It is important, and should be a matter of continuing policy, that vitally affected groups, both in and out of government, participate in the planning of the agency's programs; that includes fire service organizations, the insurance industry, fire equipment manufacturers, codes and standards organizations, and especially the National Fire Protection Association. For the agency as a whole, this participation can be informal; but for the National Fire Academy, a formal advisory board should be established.

The projected costs in Table 19-2 can serve as an indication of minimum operating program needs and as a starting point for discussion.

Some of the amounts in the table should be thought of as "seed" monies-that is, funds to aid and encourage State and local governments to improve their programs and to sponsor research and information exchange. The funds in the Federal portion are also intended to overcome present barriers to innovation by creating the climate that provides the incentives to private enterprise to turn their attention to neglected needs in fire protection, For example, paid fire departments typically spend less than 1 percent of their budgets on capital and equipment investments. By encouraging them to spend 2 percent, the proposed program should enlarge the market for new equipment to the point where industry can afford major investments in improving firefighting equipment.

The most important aim of the proposed expenditures is to reduce the Nation's tragic losses from fire. The Commission believes that a reduction of 5 percent a year in deaths, injuries, and property losses is an attainable goal. That rate of reduction cannot be sustained indefinitely, and might be expected to level off as losses approach half of what they are today, It would take about 14 years to reach that plateau, (Bear in mind that the goal is a 5 percent reduction from the totals of the year preceding, which is a slower attrition than 5 percent this year, 10 percent next year, 15 percent the year thereafter.) In the first year, about 600 lives would be saved; at the end of 5 years, a cumulative total of 8,300 lives would be saved; at the end of 10 years, a total of 28,000 lives would be saved. During that lo-year period, 119,000 Americans would be spared the trauma of serious burn injury. Of importance from the standpoint of cost-effectiveness is that fact that a 5 percent reduction in dollar losses due to property destruction, personal earnings losses, and burn treatment costs would be $350 million the first *year-which is considerably more than we have projected for the annual costs of a Federal program for each of its first 5 full years.*

Table 19-2. Annual Program Operating Budgets

U.S. Fire Administration	$124,840,000
Local fire master plan development	30,000,000[1]
State and local training assistance	30,000,000[1]
Research	26,000,000[2]
Equipment upgrading assistance	15,000,000[1]
Public education	9,600,000
Firefighter personal protective equipment	4,000,000[1]
National fire data system	3,740,000[1]
National Fire Academy	4,000,000
Administration	2,500,000
Other programs	28,250,000
Burn treatment center, unit and program development (HEW)	5,000,000
National Institutes of Health program (burn and smoke research) (HEW)	3,250,000
Rural fire protection (USDA, Title IV of Public Law 92-419)	7,000,000[3]
Detection and alarm systems and built-in protection loan insurance (HUD)	10,000,000
Research and engineering-based technology program (NBS)	3,000,000
Total	$153,090,000[4]

[1] These Federal programs require State and local governments to provide matching participation.

[2] The $26 million does not include the current fire research budgets of Federal agencies. Funds shown here would be used to contract with public and private agencies where appropriate.

[3] This was the recommended annual funding level for a 3-year conservative rural fire protection program. Funds have not, as yet, been appropriated and the Commission feels that funding is more than justified by the losses in the areas covered.

[4] This budget is an estimate of the average annual expenditure for the first 5 years. The mix of expenditures will vary as staffs are recruited and trained.

Table 19-1 • Major Federal and Private Responsibility by Proposed U.S. Fire Administration Divisions

Agency	Academy	Information systems
Department of Housing and Urban Development, (Department of Community Development) Establish U.S. Fire Administration	Establish Academy Academy functions: (1) Fire service leadership education and training (2) Develop curricula and model programs for: • training fire service instructors • training fire management • fire suppression • fire prevention • master plan program • information systems • entrance and promotional examinations • paramedics and emergency medical services • arson investigation • fire safety design for engineers and architects • standardize firefighting termi- (3) Advocate for fire services	Develop National Fire Data System • tied in with State and local systems. develop uniform systems of reporting • research information collection • investigatory responsibilities for information gathering • disseminate information • publish report to President and Congress yearly on fire prevention and control status • review all Federal or federally sponsored fire programs annually and report to OMB • public education
Department of Commerce (Department of Economic Affairs)	Act as technical support arm for the Academy	Research and engineering based technology fire information system Report status of programs and fire budgets to USFA Investigatory responsibilities to gather information to support program
Department of Health, Education, and Welfare (Department of Human Resources)	Coordinate fire prevention programs with Academy	Burn and smoke injury and death information system Report status of programs and fire budgets to USFA Fire facts
Department of Agriculture (Department of Natural Resources)	Coordinate rural and wildlands fire training with Academy	Report status of programs and fire budgets to USFA
General Services Administration	Participate with Academy	Federal building fire experience information Report findings of merit to USFA
PRIVATE	Participate with Academy	Contract for development and implementation of information system; commercially distribute information (NFPA)
National Science Foundation (RANN)	Participate with Academy	
National Academy of Sciences	Participate with Academy	
Department of Defense	Act as disaster research arm for Academy	
Consumer Product Safety Commission	Participate with Academy	National Electronic Injury Surveillance System
Department of Transportation	Participate with Academy in fire protection and safety activities for all transportation modes	Provide transportation fire data

Local and State model programs	Research and development
Urban fire protection and education program Implement at State and local level: • information systems grants • state fire training grants • master plan for fire protection • local code enforcement programs • fire euipment grants • fire safety systems analysis and impact statements • home fire alarm systems • improved fire protection standards in focal and State codes • information systems (UFIRS)	Sponsor research in urban fire (1) Fire prevention and education: • fire caused by people (arson negligence) • effective fire prevention practices • public education (with HEW) (2) Fire services: • fire equipment • fire management • firefighter injuries • fire suppression. (3) fire safety design. Develop residential fire protection code for minimum property stand.
Assist State and local building and fire code groups in the development of standards	Conduct research and development • systems approach to fire safety • principles of fire detection and alarm systems • principles of fire retardants • fire behavior models • principles of built-in protection systems • new test methods • nature of basic flammability • fire equipment standards • building fire safety Evaluate and classify: • building materials • fire hazard properties Standardize: • fire research physical Science terminology
Sponsor special education for teachers Assist local fire departments and code enforcement agencies through notification of hazard Implement health department fire prevention programs at local levels Improve quality and availability of fire injury medical care	Sponsor research in: • burn and smoke treatment • public education for fire Safety (with USFA)
Rural fire protection and fire ed. ucation program • develop water systems, fi. nance fire equipment, fire prevention planning, advocate for the rural environment Forestand wildlands fire protection program	Conduct research in forest fire behavior and control weather forecast and early-warning systems
Implement Federal building fire safety design	Sponsor research in Federal building fire safety design
Model code groups implement improved fire protection standards	Sponsor and conduct research in all fire areas including: • Proprietary interests • Materials testing • Product development
.....	Sponsor research in fire technology application and basic fire research
.....	Serve as a review committee on fire needs
Model program for disaster pre. paredness	Research for disaster preparedness
.....	Flammable fabric and test method development
.....	Conduct research for transportation fire safety

20

WHAT CITIZENS CAN DO

It is an accepted principle of our society that government ought to intervene to protect citizens when voluntary safeguards are inadequate. As long as there are drivers who drink, there will be a need for government efforts to keep them off the highways. As long as there are unscrupulous merchants, there will be a need for laws and court procedures to protect consumers. As long as food processors use additives of unknown hazards to health, there will be a need for government to test these chemicals and ban them when appropriate.

And yet, two themes in American thinking about government run counter to acceptance of this principle. First, we as a people do not want government regulating every aspect of our lives. Second, we regard government regulation as a last resort, a morally inferior solution to voluntary safeguards. We would prefer, in other words, that in our society merchants and manufacturers *want* to protect the public rather than be required to do so. In brief, we want government that is not paternalistic and all-encompassing,

A balance must be struck. As President Nixon pointed out in his Second Inaugural, there is no "purely government solution for every problem" and individuals must be encouraged "to do more for themselves and decide more for themselves." Where the Government should act, he also pledged, it "will act boldly and lead boldly."

Consider the relevance of *public concern* to these observations. First, history has demonstrated over and over that the pressure of public concern lies behind voluntary self-regulation. The rating code of the movie industry is a convenient example. Second, government regulation has wide acceptability only when it is backed by considerable public concern. It is public concern that encourages voluntary regulation and legitimates government regulations.

This Commission harbors no illusions about the amount of public concern over the deaths, injuries, and property losses from the Nation's destructive fires. That concern is minuscule when compared with the magnitude of the problem. We hope, of course, that this report will serve to broaden and invigorate public concern over fire safety. The task to educate and sensitize Americans to the problems of fire safety, both by government and by private groups, must begin now.

To make a difference, public concern must be channeled toward specific objectives. Any number of this Commission's recommendations might serve as focal points for public pressure. At the

Federal level, for example, proposed new actions that could be hastened through "grassroots" sup port include :

- Extension of flammability standards or labeling requirements beyond rugs, mattresses, and children's sleepwear to other kinds of fabrics and to other classes of materials, such as those that go into home furnishings;
- Undertaking of a long-term, multiple-media, public service advertising campaign to make Americans more conscious of fire safety;
- Establishment of a United States Fire Administration to improve the fire services and of a National Fire Academy to upgrade their training, together with programs of financial assistance to local fire departments;
- Extension of the number of hospital facilities providing burn treatment and support of research to improve the treatment of burn and smoke inhalation injuries.

Citizens can also press for improvements at the State and local levels:

- Strengthening of the fire safety provisions of building codes;
- Shifting of fire department priorities toward fire prevention, with emphasis on inspection and educational programs;
- Encouragement of regional cooperative arrangements among fire departments;
- Providing adequate fire safety education in the schools and to preschool youngsters in nursery schools and day care centers.

Americans can take action to protect themselves from fire.

The Commission is confident that every concerned citizen who has access to pen and paper can find an appropriate avenue of expression, whether it is a letter to an editor or a letter to a public official elected to serve him. Arousing the interest of the press is important for two reasons: The press has the investigative tools to explore the adequacy of fire protection, particularly at the local level; it also has considerable power to mold public opinion.

Where Fire Safety Begins

In this report we have tried to make clear that fire is a potential threat to the life and well-being of every American, that while it has victimized the poor disproportionately no one is immune to harm from fire.

But prudence in daily living can minimize the chance of fire and make the difference between life and death if fire strikes. The minimal precautions in the home are well-established, if seldom observed: a well-maintained heating system, no overloaded electrical circuits, flammable liquids stored in tightly fitting containers and away from heaters and furnaces, absence of rubbish, unobstructed stairways, matches out of reach of children. Beyond these minimal precautions lie positive steps: the installation of fire extinguishers, fire escapes, or escape ladders, and-most important-early-warning detectors. Another measure, costing not a cent, is a family discussion-and rehearsal-of steps to be taken during various kinds of fire emergencies.

Prudence must be exercised outside the home as well. If there appear to be dangerous conditions at the place of work, these should be reported to the Occupational Safety and Health Administration. A conscious effort to note the location of fire exits when entering a building or a restaurant will likely become, in time, an ingrained habit.

Lastly, acquainting friends with the subject of fire safety may help to save a life or two some day.

America's Future

Twenty-five hundred years ago, the philosopher Heraclitus observed : "All things are exchanged for fire, and fire for all things-as wares are exchanged for gold and gold for wares."

Today we would put it differently: that heat energy is involved in the processes of creation and transformation, as it is involved as well in destruction and decay. Heat is both friend and foe. Lumber, petroleum and its distillates, electrical energy : Name any major source of destructive fire, and one realizes at once that we cannot get along without them. But we live in a tenuous relationship with them.

Through most of American history, resources were so abundant that we were blind to that tenuous relationship. What fire consumed could easily be replaced. Coincidentally, this Nation grew to maturity during a century and a half when death was accepted stoically. Whether by diphtheria, typhoid, or fire, death was entitled to its toll, even among young children. Advances in medical science changed American hopes and expectations, though fire never received the attention that went into the major diseases. As for material resources, only recently has the United States been converted to the view forced on other nations long ago: that resources are limited and need to be carefully managed.

During the years of America's development, one noble view has prevailed: that a citizen is entitled to any behavior that is not injurious to his neighbors. What has changed over the years is the concept of what is injurious behavior, and it has been broadened as a result of attention to ecological considerations. A dramatic example of how that concept has widened is the restrictions impaced on major fuel users during the winter of 1972-73. What might come to prevail, in future years, is the view that a fire caused by one American is a danger and an unfair cost to his fellow citizens.

It is appropriate to close with a reminder of an observation made earlier in this report. Many Americans, referencing the Second Amendment, vehemently defend their right to possess guns as protection against intruders. Happily, it has not been a task of this Commission to debate gun control. What is worthy of remark is that Americans have a duty, much more than a right, to protect themselves and others from fire.

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MINORITY REPORT

Minority Report of Anne Wight Phillips, M.D., Harvard Medical School, Massachusetts General and Youville Hospitals.

TO KEEP THEM SAFE

A Tribute.-This minority of the National Commission on Fire Prevention and Control commends the President and the Congress for their concern for public safety and wishes to express her esteem for the dedicated majority of the Commission with some of whose recommendations she concurs although taking the liberty of disagreeing with others.

FIGURE 1

I am indebted to Patty and her parents for permission to present this series of pictures, which emphasize, more adequately than words can tell, the urgency of our fire problem. This picture was taken at age 8, before her burn injury.

Top photo by Frank Kelly, Boston Herald American

MINORITY REPORT OF COMMISSIONER ANNE W. PHILIPS, M.D.

Mr. President and Members of the Congress of the United States:

This minority, although endorsing many of the conclusions and recommendations of the majority of the Commission, cannot approve the following :

I, The magnitude of the projected budget for the majority's program ($153,090,000)

II. The location of responsibility for all of the nation's fire problems within a single agency and department

III. The proposed paramount objective for the new U.S. Fire Administration and the resulting distribution of resources recommended

IV. The proposed interim budget for the National Bureau of Standards

I. The Minority Opposes the Projected Budget

The saving of a single life is not justified, if for the same expenditure of funds and effort, it is **pos**sible to save more than one. Neither in direction nor magnitude can I support the majority's projected budget, for I believe that the saving in lives, property, and human suffering, which would be achieved by the Commission majority's program, can be equalled or exceeded with a significantly smaller budget.

II. The Minority Opposes the U.S. Fire Administration

At the end of the first half year as a member of the Commission I was in favor of the creation of a single Federal agency to coordinate the activities of all agencies concerned with fire in the Federal *Gov*ernment. The need for careful planning for the Nation's *fire* programs and the prospect of economy through reduced duplication and administrative overhead seemed to justify it. Reluctantly, I have come to take the opposite position for the following reasons :

1. Likelihood of neglect of *important aspects of the fire problem*

In whatever department the proposed U.S. Fire Administration settles, it must, inevitably, (unless it is very large) lack expert knowledge and special interest in those fire problems, which are primarily concerned with the interests of other Federal departments. Even with the best of intentions, needed programs outside the major thrust of the Administration and the interests of the chosen department will be down-graded or neglected, receiving less attention and funding than they merit-in part because the department and the administration will

not have the background to see their importance and in part because the outside department will have less interest in pursuing fire programs, considering them Fire Administration matters.

Judging from the proposed budget, this downgrading process has already begun.

2. Limited national resources

At its first meeting, the National Commission on Fire Prevention and Control unanimously adopted as its objective the reduction of the losses of life and property from destructive fires. A glance at the majority's proposed budget will indicate that any prospects of financial savings, due to better administration or wasteful duplication, may be of fleeting benefit in the face of the high costs of the proposed programs, some of which may have little impact on the losses of life and property from destructive fires. In view of our limited resources it appears wise to spend such funds as can be made available on solutions to the fire problem, using existing agencies, rather than on creating a new administration and new demands for funds.

3. Existing agencies could make substantial *strides in fire prevention and control*

It is sound policy to give responsibility for any enterprise to those with special knowledge and ability in the field, but impossible in this case, since no single department has "expertise" in all aspects of the fire problem. There are many people with such specialized knowledge and ability in the various Federal departments and in the private sector, who are ready, willing, and able to go to work on reducing the Nation's fire losses. It seems the part of wisdom to use them.

4. Loss of *valuable volunteer effort*

It is apparent from the programs proposed for the U.S. Fire Administration that, if implemented as written, the Administration would take over many functions which are now carried out-without cost to the taxpayer-by private enterprise. This minority cannot contemplate with complacency the demise of the National Fire Protection Association, for example, which in the 78 years of its existence, has, through its fire prevention efforts, its educational programs and its life safety codes, become a world leader in the continuing war against fire. No one will ever know the number of lives, jobs, and millions of dollars worth of property saved by their endeavors.

If a U.S. Fire Administration is to be, let the enabling legislation be so drawn that maximum use is made of such private agencies. It would seem simpler and cheaper and quicker to call upon them for their expert assistance now, without the creation of a new Government agency.

5. White knight effect

The fire problem has wide ramifications-social, political, scientific, economic, and so on. The proposed multifaceted US. Fire Administration, by taking on all aspects of the fire problem, may, like the white knight, gallop off in all directions, spreading itself too thin to prove the master of any. It would seem that there is more to be gained by tackling smaller aspects of the problem and handling that little well.

6. *The* Commission recommendations run *roughshod over Title I*

Congress, by Title I of the Fire Research and Safety Act of 1968 (see App. I), authorized the Secretary of Commerce to conduct, directly, or through grants, fire research, educational programs, a fire information reference service, and so on. In that act Congress also assured the continuation of other existing Federal fire programs by stating that "nothing contained in this title shall be deemed to repeal, supersede, or diminish existing authority or responsibility of any agency or instrumentality of the Federal Government." Congress, therefore, after due deliberation, felt it unwise to remove all fire problems to a single department, although giving the Department of Commerce the lion's share of the responsibility. This Commission minority finds itself in agreement with them.

FIGURE 2

Patty's face on her first admission to the Shriners' Burns Institute in Galveston. She underwent more than 3 months of reconstructive surgery, costing approximately $27.000. (The darkening of her hair at this age is normal for her family coloring). Figure 3 shows her appearance after many operations.

7. Inevitable delay

Statistics tell us that 300,000 children are going to be seriously burned in this country in the next 2 years. Their suffering depends upon our speed (Figs. 1, 2, and 3). Admittedly, we are never going to prevent all fire accidents, but there is sound evidence that many of the victims can be spared if fire safety education programs are promptly initiated. With swift and adequate funding, the Department of Commerce might have the multimedia education campaign recommended by the Commission well underway before hearings on the proposed U.S. Fire Administration can begin.

8. Danger *of* pressure from special groups

Although in the majority of instances the interests of special groups in the fire field will run parallel with the interests of the Nation, the situation should not be created where the Nation's fire interests could be subordinated to those of any special group.

III-A. The Minority Questions the Direction of Emphasis for the U.S. Fire Administration

This Commissioner believes that, if there is to be an all-encompassing U.S. Fire Administration, its paramount objective should be the same as that adopted by the Commission: *the reduction of the losses of life and property from destructive fires.* Contributing to that objective should be programs such as firesafety education for the general public, applied research to produce a safer environment, basic research on the nature of fire and smoke, their behavior and control, improved education for members of the fire service, and so on,

FIGURE 3.

Results after extensive plastic reconstruction. Patty wishes no further surgery at this time.

The concept set forth in Chapter 19, that assistance to local fire services should be paramount among the objectives of the proposed US. Fire Administration I cannot accept.

Tremendous credit should be given to the fire service for its ready acceptance of the concept that firemen should serve primarily as "fire preventers", rather than "firefighters." They will need help in changing to this new position. Even before this shift, there was a need for better education of the fire officer-better training in command, management, educational and training techniques, fire suppression, community relations, arson, and so on, to which the new emphasis on fire prevention must be added.

I believe that creation of a National Fire Academy is needed, but not as an objective ranking higher than all others. If a secondary objective is to be assigned, let it be to knowledge-new knowledge through research and dissemination of existing knowledge. *Widespread public education in fire safety principles should be our first concern.*

There is an old saying in the fire service, cited in the Commission report, that "The three principal causes of fire are men, women, and children." Statistics bear this out, making it crystal clear that most deaths, most injuries, and most fires are caused by people. Since people are the cause of the overwhelming majority of fires, it is reasonable to believe that people must be included in the solution.

Much can be done by making clothing fire resistant and by installing automatic extinguishing systems and early detection systems-there have been no recorded instances of multiple deaths in buildings fully equipped with operational sprinklers, for example-but man can, and does, circumvent the devices installed for his protection, painting over sprinkler heads, propping open smoke and fire doors and putting a penny in the fuse box. There is no substitute for understanding how to prevent fires and what to do when fires occur.

What do Americans Know About Fire Safety?

In the first months of the Commission's existence, a search was made for data on the American pub. lic's knowledge of fire safety principles, Surprisingly, the only studies discovered were made after small fire education campaigns. No one had probed our citizens' basic fire knowledge.

Since an incredible delay is necessitated by Federal restrictions on questionnaires, a survey of our citizens' knowledge was undertaken independently of the Commission and without its financial sup-

port.' Initially several hundred adults and children around the Nation were interviewed. Then a questionnaire was devised and is now being used in schools, together with an answer sheet, so that students can learn, while correcting their own papers. A copy of the questions will be found in Figure 4, should the reader wish to sample his or her own firesafety knowledge before reading further, The answers appear at the end of this minority report.

Figure 4

FIRE SAFETY QUESTIONNAIRE

Student ☐ Fire Safety Teacher ☐ Age ——
Schooling: Public ☐
Private ☐
Teacher ☐ Previous Fire Training, ——————
Where (if any) school, Scouts, Army, industry, etc.
Address: —————— Sex: Male ☐ Female ☐
City State

1. If your house began to fill up with thick, black smoke, what would you do? (answer fully)
2. What would you do if you woke up at night, smelled, smoke, and found that your bedroom door was shut, but hot when you touched it?
3. Will the clothing you have on now burn?
4. What would you do right now if your clothing caught on fire?
5. If you were trapped in a bedroom on the fifth floor with flames outside in the hall and smoke pouring in under the door (with no telephone and no fire escape), what would you do?
6. (a) When you go to a strange place (movie house, friend's house for the night, hotel, restaurant, etc.), do you check to see where the exits or fire escapes are?
   (b) If the answer to 6(a) was "Yes," do you depend on being able to see the exit to find it, or do you figure out how to find it in the dark or in thick smoke?
7. Do you have a family escape plan, including ways of getting out of your house if the stairs or doors are blocked by fire, *and a meeting place* outside the house?
8. What should you do (or should your wife or mother do) if the frying pan catches on fire?
9. Carbon monoxide is produced by almost all fires. What effect does it have on you before it makes you sleepy and kills you?
10. Assume you plan to hang by your hands from a window ledge and then drop to the earth below. Estimate in feet the distance you could drop and still have a 50:50 chance of surviving without serious injury.
11. (a) What is the reason for having fuses in an electric circuit?
    (b) What strength fuse should be used in an ordinary lighting circuit?
12. What number should you dial to report a fire by telephone, and how should you report it?
13. When is an electric cord dangerous? (give at least two examples)
14. When is a double plug dangerous?
15. What should you do if you discover a large fire in your basement?
16. If you are trying to light a gas oven or burner and the first match goes out too soon, what should you do?
17. What is meant by "spontaneous combustion" or "spontaneous ignition"?
18. How should you store oily or greasy rags?
19. Why should gasoline be stored only in metal cans with self-closing caps?
20. Should you put out an electric fire with water?

Limited Survey Finds Alarming Voids in Public Fire Safety Knowledge

Data from 2,109 Americans of all ages from Maine to Florida and New York to California follows. [2] It would be presumptuous to generalize from this small sampling to the Nation as a whole, but thus far the findings have been surprisingly consistent from State to State and from one school district to another.

Less than 30, out of every 100 teenagers questioned, knew that in the presence of smoke they should stoop low or crawl out of the fire area.

Half of the youngsters from 7 to 18 questioned would do something dangerous if the frying pan caught fire, attempting to carry it or throw water on it. Teenagers were no more knowledgeable than children from 7 through 12.

Over 500 people questioned did not know that opening a hot door during a fire would almost certainly expose them to heat above human tolerance. This group included 44 out of 177 teachers.

Almost no children under seven knew that they should drop and roll if their clothing caught fire.

Very few families had a well thought out escape plan, including a predesignated meeting place outside the house.

Three-quarters of the adults questioned recommended the use of too strong a fuse for an ordinary lighting circuit.

Asked what they would do if trapped in a fifth floor room with flames outside in the hall and smoke pouring in under the door (with no telephone and no fire escape), only 3 out of 10, old or young, thought to stuff anything into the death-dealing crack. Some, of all ages, including teachers, said they would jump.

39, out of every 100 adults questioned, would react dangerously if their clothing ignited, many failing to comprehend the speed with which fire can spread to the neck and shoulders from the trouser cuff or hemline (Fig. 5) .

[1] This Commissioner has paid for all printing and most of the postage from her own limited resources. She is indebted to Harvard Medical School for a small supplementary outlay for postage.

[2] The author of this report wishes to express profound gratitude for assistance in this survey rendered by Chief Robert Fly of Kirkland, Wash., and Chief Merrill Hendricks of Dallas, Tex.

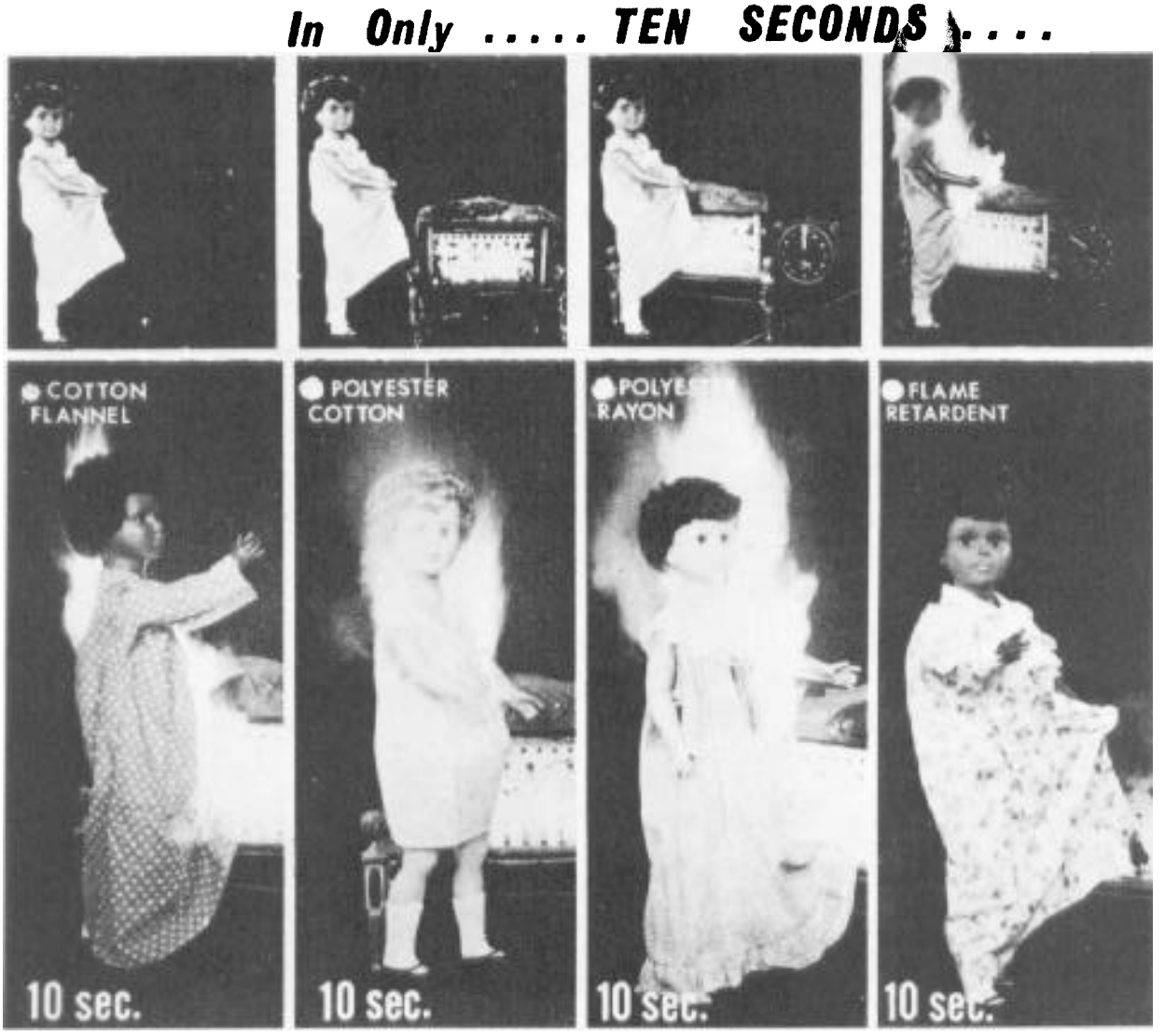


FIGURE 5

The need for public fire safety education is clear. That it can be effective is documented by the Commission in Chapter 15. Other evidence is available. Hopefully, my objection to the direction proposed for the U.S. Fire Administration now appears justified.

What of the budget?

III-B. The Minority Opposes the Budget Allocations

My main objections to the proposed budget are threefold :

1. Proposed budget is not responsive to the concerns of the Nation's fire chiefs.-In the early days of this Commission, a questionnaire was sent out to fire chiefs throughout the Nation. Replies from 10,000 chiefs have been tabulated, Under the heading "Evaluation of Fire Department Problems" the chiefs were asked to rank "in order from most serious to least serious" the problem areas of concern to them. Unselfishly, the chiefs gave top ranking to "lack of effective public education on fire safety." Inadequate training and education for fire service personnel was listed eighth and the need for improved fire department apparatus and personnel protective equipment ninth. The proposed budget fails to reflect their considered opinions.

2. Need for pilot projects.-The majority of the Commission has recommended that every local fire jurisdiction prepare a master plan designed to meet the community's present and future needs, and $30 million are budgeted for local master plan development. Similarly $15 million have been set aside for equipment upgrading and $10 million for detection and alarm systems and built-in protection loan insurance, We do not know whether these programs will reduce the losses of life and property from destructive property. These, and untried educational programs, should be tested on a local or regional basis through pilot projects, before investing large amounts of money on their implementation nationwide. Training of burn specialists should likewise, precede the development of burn centers.

3. Inadequate provisions for public education.-The budget allotment for public education will not produce the type of program the Commisison has envisioned in chapter 15. There are 25 million children in this Nation between kindergarten and sixth grade. The $6 million specified for elementary school education on chart 15.2 is estimated by both private and Government experts to be insufficient to put one piece of effective material in the hands **of** each school child. Ten million would be required to supply effective graded materials to each of the Nation's 1.3 million elementary school teachers. Other means, such as using existing films and visual aids, close-circuit TV, etc. should be explored, but it seems unlikely that the proposed budget will be adequate to achieve the desired results.

IV. Minority Finds Interim Budget Insufficient

The setting of the interim budget at $3 million **for** research and engineering programs fairly well precludes the National Bureau of Standards from acting in accordance with most of its mandate under Title I during the next year or two. Assigned an inadequate budget of $5 million at the outset and underfunded at that, it can be reasonably expected to continue to do only those things for which it has the greatest research and engineering ability. The NIFE program (National Inventory of Fire Experience) for cooperative effort between the Bureau of Standards and the National Fire Protection Association will probably be left in abeyance because of the uncertainty of its future. If a national fire data system is to be set up under the US. Fire Administration, and essentially independent of them both, there may be little initiative to go forward.

Almost certainly 2 years and more will pass before any real Federal fire safety education program is undertaken (whether through grants or otherwise), while week after week more Pattys are carried into the Nation's hospitals (Figs. 2 & 3).

DISCUSSION

I. Budget

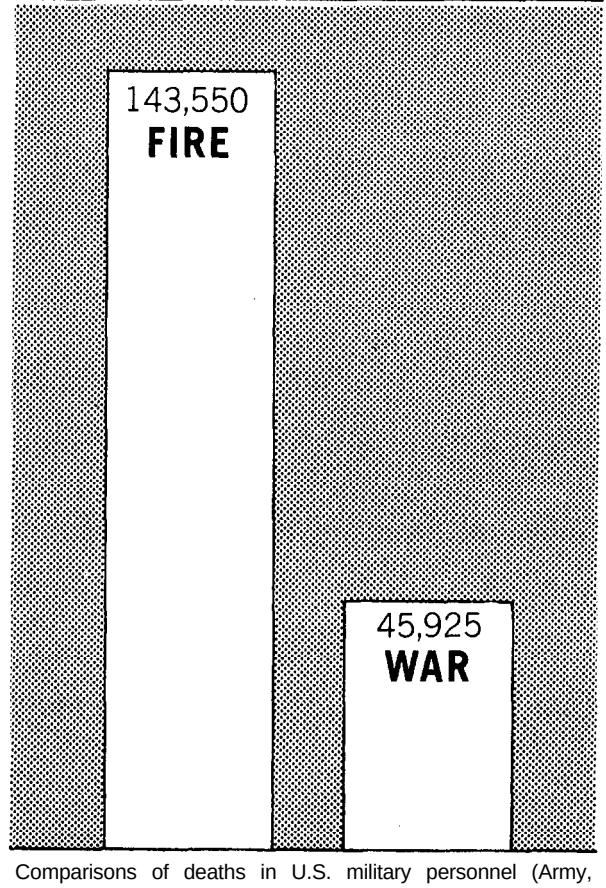
Although in my opinion the total budget proposed by the majority of the Commission is too big, yet what has been spent on fire prevention and control by the Federal Government in the past is too small.

II. Measures To Reduce Injuries and Loss of Life and Property From Destructive Fires

It is the conviction of this minority that *without* ***a continuing massive program to educate the public in simple fire safety measures, a substantial reduction*** *in* ***our tragic American fire toll cannot be expected.*** The principal measures recommended to save lives, suffering and property are:

1. A massive multimedia, recipient-oriented public education campaign.
2. Fire education in the schools.

FIGURE 6 Deaths – U.S. Fires vs. Vietnam War



Comparisons of deaths in U.S. military personnel (Army, Navy, Coast Guard, Marine Corps, and Air Force) resulting from actions by hostile forces in Vietnam, 1961 through 1972, and deaths from U.S. fires for the same period (Statistics from the Department of Defense and the National Fire Protection Association).

3. Fire department involvement in fire safety education of commercial, industrial, and institutional personnel and in an optional inspection program for dwellings.

4. Development of a reliable and inexpensive smoke and fire detection system for dwellings.

5. Reduction of the hazards of flammable wearing apparel.

6. Use of noncombustible interior finish materials in residences and places of business and assembly.

7. Complete automatic fire extinguishing systems for homes (and hospitals) for the incapacitated and for high-rise buildings.

8. A program of fire safety training for the health educator aides of the Department of Health, Education, and Welfare, who, because of their rapport with the residents of high-risk areas may be able to teach fire safety principles on a person to person basis.

9. Increased research on smoke and smoke inhalation injury which is responsible for more than half of the Nation's fire deaths.

III, Principal Measures To Improve the Fire Services

1. Establishment of a National Fire Academy.

2. Research on better engineering of breathing apparatus and protective clothing.

3. Federal support for State and local fire inspection programs.

Minority Recommendations

1. Continued support of existing fire programs in the Federal Government.

2. Reduction of the projected total additional fire budget by $100 million during the build-up years and $75 million during the operating years, subject to subsequent review.

3. Retention of the Department of Commerce as the principal focus for the Federal fire effort, in accordance with the provisions of Title I of the Fire Research and Safety Act of 1968.

4. Swift and adequate funding of the Department of Commerce to permit early institution of a massive. multimedia fire safety education campaign.

5. Enactment of new legislation to assign responsibility, for direct support to the fire services, to the Department of Housing and Urban Development, including the establishment of a national fire academy.

6. Creation of a new temporary Commission in 1983 to assess the effectiveness of the Federal fire programs and make recommendations to the President and the Congress for further steps to diminish the Nation's annual toll from fire.

7. Increased use of the oversight function of the appropriate committees to assure assessment of effectiveness and adequate planning by the departments during the interim.

This minority opposes the creation of a new Federal fire agency at this time. During the proposed review in 1983 it would be appropriate to consider whether the Nation's interests would be better served by the establishment of a Federal agency for fire research and education in the Department of Commerce.

This minority urges the President and the Congress in considering these recommendations and those of the majority of the Commission, to use as your yardstick, the probable reduction of life and property losses if the measures suggested are adopted.

In conclusion, I support the position of the majority of the Commission that expanded Federal action is needed in the fire field and that, properly directed, the investment will pay off handsomely, A few final words may emphasize the need:

As grim as were our losses due to enemy action in Vietnam, they were small compared with our Nation's fire casualties for the same period (Fig. 6). Smoke and fire seriously injure 300,000 Americans every year and kill nearly 12,000. How many are 12,000? How many people could you call by name if you met them on the street? 2,000? 4,000? In this Nation, fire and smoke kill more people each and every year than the average person knows and gravely injures more than he has ever met.

Respectfully submitted,

ANNE WIGHT PHILLIPS.

SELF-SCORING THE FIRE SAFETY QUESTIONNAIRE

Questions	*Safety score (points)*
Question 1. If your house began to fill up with thick, black smoke, what would you do? (answer fully)	
If your answer included getting beneath the smoke by crouching or crawling (to evade harmful combustion products), give yourself	3
If your answer included getting out of the house, give yourself	3
If your answer included rousing the rest of the household, give yourself	3
If your answer included calling the first department, give yourself	3
If your answer included opening windows without first closing doors (to keep the air from the fire) subtract 3 points	
Question 2. What would you do if you woke up at night, smelled smoke, and found that your bedroom door was shut, but hot when you touched it?	
If your answer did not include opening the hot door (which would expose you to killing heat), give yourself	4
If your answer included calling for help by phone or from a window, or finding an alternative way out, give yourself	3

Question 3. Will the clothing you have on now burn?

If your answer is yes, give yourself ---------- 3
(NOTE.—It is hoped that in the future this question will have to be deleted, as flame resistant materials become more available.)

Question 4. What would you do right now if your clothing caught on fire?

If your answer included dropping and rolling (to extinguish the flames by smothering them) give yourself ---------- 3
If your answer included running (which fans the flames) subtract 3 points.
If your answer included going to draw water (which takes too long) subtract 3 points.
If your answer included wrapping up in a blanket, coat, or rug, but remaining vertical (thus permitting continued inhalation of smoke), give yourself only ---------- 1

Question 5. If you were trapped in a bedroom on the fifth floor with flames outside in the hall and smoke pouring in under the door (with no telephone and no fire escape), what would you do?

If your answer included stuffing something into the offending crack to reduce the smoke entering the room, give yourself ---------- 3
If your answer included yelling from the window for help, or hanging something out the window to attract firefighters' attention, give yourself ---------- 3
If your answer included jumping, subtract 3 points.
If your answer included opening the window a crack, top and bottom to vent the smoke and you did not leave a door open, so air could reach and fan the fire, give yourself ---------- 2
If your answer included finding better air by keeping low or breathing air from outside the window, give yourself ---------- 2
If your answer included making a rope out of bedsheets, curtains, etc., give yourself ---------- 1
If you said you would make it, but not use it unless forced to, give yourself an additional ---------- 1

Question 6. (a) When you go to a strange place (movie house, friend's house for the night, hotel, restaurant, etc.), do you check to see where the exits or fire escapes are?

If you habitually check the exits when you stay at hotels, inns, motels, etc., give yourself ---------- 1
If you check to see where the exits are when at a restaurant or staying overnight at a friend's house, give yourself ---------- 1

(b) If the answer to 6(a) was yes, do you depend on being able to see the exit to find it, or do you figure out how to find it in the dark or thick smoke?

If your answer to 6(a) was no, give yourself no points for question 6(b).
If your answer to 6(a) was yes, and you do not rely on being able to see the exit signs, but figure out how to find an exit in the dark in thick smoke, give yourself ---------- 1

Question 7. Do you have a family escape plan (including ways of getting out of your house if the stairs or doors are blocked by fire), and a meeting place outside the house?

If you have a way out of your house if the stairs and doors are blocked by smoke, give yourself ---------- 2
If you have a planned place to meet outside the house which the whole family knows about, give yourself ---------- 2

Question 8. What should you do (or should your wife or mother do) if the frying pan catches on fire?

If your answer is to smother the fire with the lid or baking soda or to use a dry powder (all purpose) or CO_2 fire extinguisher,[1] give yourself ---------- 3
(Sand and dirt are acceptable answers if cooking outside).
If your answer is to smother the fire with salt or a wet towel, give yourself ---------- 2
If you threw water on the fire or used a soda-acid fire extinguisher or a water-pump tank type of extinguisher (water may spread the fire over the kitchen), subtract 3 points.
If you attempted to carry the flaming frying pan, which may ignite your clothing, spill, or become too hot to hold, subtract 3 points.
If you threw flour, which explodes, at the fire, subtract 3 points.

Question 9. Carbon monoxide is produced by almost all fires. What effect does it have on you before it makes you sleepy and kills you?

If your answer reported that carbon monoxide has no effect, or that it makes you cough, your eyes water, or smells badly, subtract 2 points. It has no color, taste, or smell and gives you no warning of its presence, but it is NOT harmless.
If your answer indicated that carbon monoxide distorts your judgment, give yourself ---------- 2
(Victims of carbon monoxide poisoning may make irrational attempts at escape, or may waste vital minutes saving items of little or no value. People who have been in a burning building for some minutes should be watched, to be sure they do not go back into the fire)
If your answer indicated that carbon monoxide disturbs your coordination (making simple escape efforts, such as unlocking a window difficult, or impossible), give yourself ---------- 2

Question 10. Assume you plan to hang by your hands from a window ledge and then drop to the earth below. Estimate in feet the distance you could drop and still have a 50:50 chance of surviving without serious injury.

Score yourself in accordance with the following table: If your answer was—

Less than 20 feet: score	3
More than 20 feet, but less than 25 feet: score	1
More than 25 feet, but less than 35 feet: score	0
More than 35 feet, but less than 50 feet: subtract	2
More than 50 feet: subtract	3

Add 1 point if you have had training as a parachute jumper.
Subtract 1 point if you are over 50 years of age, unless your answer was under 15 feet.

[1] The pressure on a CO, extinguisher is generally about 600 lbs.; Pressure on an all purpose extinguisher is generally about 300 lbs. Stand off from the fire 7 or 8 feet.

Question 11. (*a*) *What is the reason for having fuses in an electric circuit?*

If your answer indicates that the purpose of a fuse is to prevent a fire (by "blowing" before the wires can overheat when too much of a load is put on them), give yourself_____ 3

(*b*) *What strength fuse should be used in an ordinary lighting circuit?*

If your answer advised a 15 amp. fuse, give yourself _____ 3

If your answer advised a 30 amp. fuse, subtract 3 points.

Question 12. What number should you dial to report a fire by telephone, and how should you report it?

If your telephone area is on the 911 emergency system, and you wrote down 911, or

If you gave the correct number for your local fire department, give yourself_____ 1

If you said you would give the location of the fire slowly and clearly, give yourself_____ 1

If you said that you would stay on the line to give additional information requested by the fire department, if you could do so safely, give yourself _____ 1

If the number you called (police or "operator") would result in a delay in transmitting the message to the fire department, give yourself only__ 1

If you gave the wrong number, either for the fire department, or the police, or left the question unanswered, subtract 3 points.

Question 13. When is an electric cord dangerous? (*give at least two examples*)

If you listed any two of the following, give yourself _____ 3

When it is frayed;

When the insulation has worn off;

When it is wet;

When it is under a rug (where repeated walking on it may break the insulation);

When it is run over a nail (where the insulation may break at the bend);

When it is run through a doorway (where closing the door may cause a break in the insulation);

When it is pulled out of a wall socket by the wire, instead of by holding onto the plug, so there is danger of one of the wires coming loose and touching the other; and

When nails are driven into it.

Question 14. When is a double plug dangerous?

If your answer included: When it is broken or when it is wet, give yourself_____ 1

If it included when it is overloaded, (by having many appliances plugged into it or two heating appliances plugged into it), give yourself__ 3

Question 15. What should you do if you discover a large fire in your basement?

If your answer included:

Shutting the basement door, give yourself_____ 3

Calling the fire department, give yourself_____ 3

Getting everyone, including yourself, out of the house, give yourself_____ 3

If your answer included trying to fight a basement fire yourself, subtract 2 points. If it included fighting the fire yourself without having notified the fire department, subtract 3 points, instead of 2.

Question 16. If you are trying to light a gas oven or burner and the first match goes out too soon, what should you do?

If your answer included turning off the gas before lighting a second match (so that explosive quantities of gas would not accumulate in the oven or burner to be set off by the second match), give yourself_____ 3

If you made sure the first match was completely out, by breaking it or touching the tip, before discarding it, give yourself_____ 1

Question 17. What is meant by "spontaneous combustion" or "spontaneous ignition"?

If your answer described the ignition of substances (such as wet newspapers, oily rags, paint-covered wipe cloths, and damp hay), which generate their own heat and ignite without the application of an external heat source, give yourself_____ 2

Question 18. How should you store oily or greasy rags?

If you answered that they should not be kept or

If you said they should be kept in a closed metal container, give yourself_____ 3

Question 19. Why should gasoline be stored only in metal cans with self-closing caps?

If you answered:

To prevent fires, give yourself_____ 3

Because metal cans will not break readily, give yourself _____ 3

If you answered to prevent fumes from spreading across the floor (which may be ignited by a spark, cigarette, or hot furnace), give yourself__ 3

Question 20. Should you put out an electric fire with water?

If you answered no, give yourself_____ 3

Add up your points to determine your fire safety score. Maximum possible score=100 (101 for parachute jumper).

APPENDIX I

PUBLIC LAW 90-259

(90th Congress, S. 1124, Mar. 1, 1968)

AN ACT

To amend the Organic Act of the National Bureau of Standards to authorize a fire research and safety program, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Fire Research and Safety Act of 1968".

TITLE I-FIRE RESEARCH AND SAFETY PROGRAM

DECLARATION OF POLICY

SEC. 101. The Congress finds that a comprehensive fire research and safety program is needed in this country to provide more effective measures of protection against the hazards of death, injury, and damage to property. The Congress finds that it is desirable and necessary for the Federal Government, in carrying out the provisions of this title, to cooperate with and assist public and private agencies. The Congress declares that the purpose of this title is to amend the Act of March 3, 1901, as amended, to provide a national fire research and safety program including the gathering of comprehensive fire data; a comprehensive fire research program ; fire safety education and training programs; and demonstrations of new approaches and improvements in fire prevention and control, and reduction of death, personal injury, and property damage. Additionally, it is the sense of Congress that the Secretary should establish a fire research and safety center for administering this title and carrying out its purposes, including appropriate fire safety liaison and coordination.

AUTHORIZATION OF PROGRAM

SEC. 102. The Act entitled "An Act to establish the National Bureau of Standards", approved March 3, 1901, as amended (15 U.S.C. 271-278e), is further amended by adding the following sections:

"SEC. 16. The Secretary of Commerce (hereinafter referred to as the 'Secretary') is authorized to--

"(a) Conduct directly or through contracts or grants-

"(1) investigations of fires to determine their causes, frequency of occurrence, severity, and other pertinent factors;

"(2) research into the causes and nature of fires, and the development of improved methods and techniques for fire prevention, fire control, and reduction of death, personal injury, and property damage;

"(3) educational programs to-

"(A) inform the public of fire hazards and fire safety techniques, and

"(B) encourage avoidance of such hazards and use of such techniques;

"(4) fire information reference services, including the collection, analysis, and dissemination of data, research results, and other information, derived from this program or from other sources and related to fire protection, fire control, and reduction of death, personal injury, and property damage;

"(5) educational and training programs to improve, among other things-

"(A) the efficiency, operation, and organization of fire services, and

"(B) the capability of controlling unusual fire-related hazards and fire disasters; and

"(6) projects demonstrating-

"(A) improved or experimental programs of fire prevention, fire control, and reduction of death, personal injury, and property damage,

"(B) application of fire safety principles in construction, or

"(C) improvement of the efficiency, operation, or organization of the fire services.

"(b) Support by contracts or grants the development, for use by educational and other nonprofit institutions, of-

" (1) fire safety and fire protection engineering or science curriculums; and

"(2) fire safety courses, seminars, or other instructional materials and aids for the above curriculums or other appropriate curriculums or courses of instruction.

"SEC. 17. With respect to the functions authorized by section 16 of this Act-

"(a) Grants may be made only to States and local governments, other non-Federal public agencies, and nonprofit institutions. Such a grant may be up to 100 per centum of the total cost of the project for which such grant is made. The Secretary shall require, whenever feasible, as a condition of approval of a grant, that the recipient contribute money, facilities, or services to carry out the purpose for which the grant is sought. For, the purposes of this section, 'State' means any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, the Canal Zone, American Samoa, and the Trust Territory of the Pacific Islands; and 'public agencies' includes combinations or groups of States or local governments.

"(b) The Secretary may arrange with and reimburse the heads of other Federal departments and

agencies for the performance of any such functions, and, as necessary or appropriate, delegate any of his powers under this section or section 16 of this Act with respect to any part thereof, and authorize the redelegation of such powers.

"(c) The Secretary may perform such functions without regard to section 3648 of the Revised Statutes (31 U.S.C. 529).

"(d) The Secretary is authorized to request any Federal department or agency to supply such statistics, data, program reports, and other materials as he deems necessary to carry out such functions. Each such department or agency is authorized to cooperate with the Secretary and, to the extent permitted by law, to furnish such materials to the Secretary. The Secretary and the heads of other departments and agencies engaged in administering programs related to fire safety shall, to the maximum extent practicable, cooperate and consult in order to insure fully coordinated efforts.

"(e) The Secretary is authorized to establish such policies, standards, criteria, and procedures and to prescribe such rules and regulations as he may deem necessary or appropriate to the administration of such functions or this section, including rules and regulations which-

"(1) provide that a grantee will from time to time, but not less often than annually, submit a report evaluating accomplishments of activities funded under section 16, and

"(2) provide for fiscal control, sound accounting procedures, and periodic reports to the Secretary regarding the application of funds paid under section 16."

NONINTERFERENCE WITH EXISTING FEDERAL PROGRAMS

SEC. 103. Nothing contained in this title shall be deemed to repeal, supersede, or diminish existing authority or responsibility of any agency or instrumentality of the Federal Government.

AUTHORIZATION OF APPROPRIATIONS

SEC. 104. There are authorized to be appropriated, for the purposes of this Act, $5,000,000 for the period ending June 30, 1970.

TITLE II-NATIONAL COMMISSION ON FIRE PREVENTION AND CONTROL

FINDINGS AND PURPOSE

SEC. 201. The Congress finds and declares that the growing problem of the loss of life and property from fire is a matter of grave national concern; that this problem is particularly acute in the Nation's urban and suburban areas where an increasing proportion of the population resides but it is also of national concern in smaller communities and rural areas; that as population concentrates, the means for controlling and preventing destructive fires has become progressively more complex and frequently beyond purely local capabilities; and that there is a clear and present need to explore and develop more effective fire control and fire prevention measures throughout the country in the light of existing and foreseeable conditions. It is the purpose of this title to establish a commission to undertake a thorough study and investigation of this problem with a view to the formulation of recommendations whereby the Nation can reduce the destruction of life and property caused by fire in its cities, suburbs, communities, and elsewhere.

ESTABLISHMENT OF COMMISSION

SEC. 202. (a) There is hereby established the National Commission on Fire Prevention and Control (hereinafter referred to as the "Commission") which shall be composed of twenty members as follows: the Secretary of Commerce, the Secretary of Housing and Urban Development, and eighteen members appointed by the President. The individuals so appointed as members (1) shall be eminently well qualified by training or experience to carry out the functions of the Commission, and (2) shall be selected so as to provide representation of the views of individuals and organizations of all areas of the United States concerned with fire research, safety, control, or prevention, including representatives drawn from Federal, State, and local governments, industry, labor, universities, laboratories, trade associations, and other interested institutions or organizations. Not more than six members of the Commission shall be appointed from the Federal Government. The President shall designate the Chairman and Vice Chairman of the Commission.

(b) The Commission shall have four advisory members composed of-

(1) two Members of the House of Representatives who shall not be members of the same political party and who shall be appointed by the Speaker of the House of Representatives, and

(2) two Members of the Senate who shall not be members of the same political party and who shall be appointed by the President of the Senate.

The advisory members of the Commission shall not participate, except in an advisory capacity, in the formulation of the findings and recommendations of the Commission.

(c) Any vacancy in the Commission or in its advisory membership shall not affect the powers of the Commission, but shall be filled in the same manner as the original appointment.

DUTIES OF THE COMMISSION

SEC. 203. (a) The Commission shall undertake a comprehensive study and investigation to determine practicable and effective measures for reducing the destructive effects of fire throughout the country in addition to the steps taken under sections 16 and 17

of the Act of March 3, 1901 (as added by title I of this Act) . Such study and investigation shall include, without being limited to-

(1) a consideration of ways in which fires can be more effectively prevented through technological advances, construction techniques, and improved inspection procedures;

(2) an analysis of existing programs administered or supported by the departments and agencies of the Federal Government and of ways in which such programs could be strengthened so as to lessen the danger of destructive fires in Government-assisted housing and in the redevelopment of the Nation's cities and communities:

(3) an evaluation of existing fire suppression methods and of ways for improving the same. including procedures for recruiting and soliciting the necessary personnel ;

(4) An evaluation of present and future needs (including long-term needs) of training and education for fire-service personnel;

(5) a consideration of the adequacy of current tire communication techniques and suggestions for the standardization and improvement of the apparatus and equipment used in controlling fires ;

(6) an analysis of the administrative problems affecting the efficiency or capabilities of local fire departments or organizations: and

(7) an assessment of local, State, and Federal responsibilities in the development of practicable and effective solutions for reducing fire losses.

(b) In carrying out its duties under this section the Commission shall consider the results of the functions carried out by the Secretary of Commerce under sections 16 and 17 of the Act of March 3, 1901 (as added by title I of this Act), and consult regularly with the' Secretary in order' to coordinate the work of the Commission and the functions carried out under such sections 16 and 17.

(c) The Commisison shall submit to the President and to the Congress a report with respect to its findings and recommendations not later than two years after the Commission has been duly organized.

POWERS AND ADMINISTRATIVE PROVISIONS

SEC. 204. (a) The Commission or, on the authorization of the Commission, any subcommittee or member thereof, may, for the purpose of carrying out the provisions of this title, hold hearings, take testimony, and administer oaths or affirmations to witnesses appearing before the Commission or any subcommittee or member thereof.

(b) Each department, agency, and instrumentality of the executive branch of the Government, including an independent agency, is authorized to furnish to the Commission, upon request made by the Chairman or Vice Chairman, such information as the Commission deems necessary to carry out its functions under this title.

(c) Subject to such rules and regulations as may be adopted by the Commssion, the Chairman, without regard to the provisions of title 5, United States Code, governing appointments in the competitive service, and without regard to the provisions of chapter 51 and subchapter III of chapter 53 of such title relating to classification and General Schedule pay rates, shall have the power-

(1) to appoint and fix the compensation of such staff personnel as hc deems necessary, and

(2) to procure temporary and intermittent services to the same extent as is authorized by section 3109 of title 5, United States Code.

COMPENSATION OF MEMBERS

SEC. 205. (a) Any member of the Commission, including a member appointed under section 202 (b) who as a Member of Congress or in the executive branch of the Government shall serve without compensation in addition to that received in his regular employment, but shall be entitled to reimbursement for travel, subsistence, and other necessary expenses incurred by him in connection with the performance of duties vested in the Commission.

(b) Members of the Commission, other than those referred to in subsection (a), shall receive compensation at the rate of $100 per day for each day they are engaged in the performance of their duties as members of the Commission and shall be entitled to reimbursement for travel, subsistence, and other necessary expenses incurred by them in the performance of their duties as members of the Commission.

EXPENSES OF THE COMMISSION

SEC. 206. There are authorized to be appropriated, out of any money in the Treasury not otherwise appropriated, such sums as may be necessary to carry out this title.

EXPIRATION OF THE COMMISSION

SEC. 207. The Commission shall cease to exist thirty days after the submission of its report under section 203 (c)

Approved March 1, 1968.

Legislative history

HOUSE REPORT No. 522 accompanying H.R. 11284 (Comm. on Science and Astronautics).

SENATE REPORT No, 502 (Comm. on Commerce) .

CONGRESSIONAL RECORD: Vol. 113 (1967) : Aug. 16, considered and passed Senate. Vol. 114 (1968) : Feb. 8, considered and passed House, amended, in lieu of H.R. 11284. Feb. 16, Senate agreed to House amendment.

APPENDIX II

HEARING WITNESSES

Fire Issues

(Old Senate Office Building, Washington, D.C., February 15-17, 1972)

FEBRUARY 15, 1972

Hon. John J. Sparkman, Senator, Huntsville, Ala.
Capt. James Dalton, Arson Division, Newark Fire Department, Newark, N. J.
Hon. Robert H, Steele, Congressman, Vernon, Conn.
Mrs. Mary Fogarty, Mother of Burn Victim, Lowell, Mass.
Charles Morgan, President, National Fire Protection Association, Boston, Mass.
Curtis Volkamer, President, International Association of Fire Chiefs, Chicago Fire Department, Chicago, Ill.
Dr. Roswell Atwood, Director of Research and Education, International Association of Fire Fighters, Washington, D.C.
David N. Francis, President, Fire Equipment Manufacturers Association, Inc., Evanston, Ill.
Hon. Hugh Scott, Senator, Philadelphia, Pa.

FEBRUARY 16, 1972

Hon. George P. Miller, Congressman, Alameda, Calif.
James T. Lynn, Undersecretary of Commerce, Washington, D.C.
Herbert C. Yost, Director of Public Safety, Lancaster, Pa.
Raymond Hill, Chief, Los Angeles City Fire Department, Los Angeles, Calif.
Truman G. Blocker, M.D., Burn Specialist, Galveston, Tex.
Melvin Stark? Vice President for Government Affairs, American Insurance Association, New York, N.Y:
Terry B. Hayes, Assistant Executive Secretary, Fire Marshals Association of North America, Boston, Mass.
James R. Dowling, Director, Codes and Regulations Center, The American Institute of Architects.

(New Senate Office Building, Washington, D.C.)

FEBRUARY 17, 1972

Hon. J. Caleb Boggs, Senator, State of Delaware.
Dr. Carl Walter, Chairman of the Fire Committee of the National Academy of Sciences, Washington, D.C.
Hon. Jerry L. Pettis, Congressman, State of California.
Henri O'Bryant, Jr., Clothing Manufacturer, Los Angeles, Calif.
Joseph Galvin, Fire Chief of Battalion 12, New York City Fire Department, New York, N.Y.
Gerald Maatman, President, National Loss Control Services Corp., Long Grove, Ill.
Wilbur A. Sanders, Deputy Commissioner, Public Buildings Service, General Services Administraton, Washington, D.C.
Lt. David Echols, Baltimore Fire Department, Baltimore, Md.
Quinton Wells, Assistant Commissioner for Technical and Credit Standards, Department of Housing and Urban Development, Washington, D.C.
Martin M. Brown, President, Society of Fire Protection Engineers, Boston, Mass.
James Gaskill, Lawrence Radiation Laboratories, Livermore, Calif.

Fire Services

(Auditorium, Mercantile National Bank Building, Dallas, Tex., April 24-25, 1972)

APRIL 24, 1972

Hon. John G. Tower, Senator, Wichita Falls, Tex.
Merrcll 6. 1 lendrix, Chief, Dallas Fire Department, Dallas, Tex.
David Gratz, Chief, Silver Spring Fire Department, Silver Spring, Md.
Dennis Smith, Douglas Court, Washingtonville, N.Y.
Mike B. Perez, Jr., Fire Chief, Laredo, Tex.
Robert E. Smylie, Chief, Crew Systems Division, Manned Spacecraft Center, NASA, Houston, Tex.
Earle A. Phillips, Project Director, Tank Car Safety Project, Railway Progress Institute-Association of American Railroads, Chicago, 111.
Martin Grimes, Director, Fire Service Division, National Fire Protection Association, Boston, Mass.
Dennis Parker, Fire Chief, Collegeville, Pa.

APRIL 25, 1972

Edwin N. Searl, Vice President, Insurance Services Office, New York, N.Y.
C. J. Winquist, Vice President, Gage-Babcock & Associates, Inc., Westchester, 111.
John A. Rockett, Chief, Fire Services Section, Fire Technology Division, National Bureau of Standards, Washington. D.C.
Philip Stevens, Philip Stevens and Associates, Skaneateles, N.Y.
Matthew Jimenez, Chief, Hayward Fire Department, Hayward, Calif.
Henry Smith, Chief, Fireman Training School, Texas A. & M., College Station, Tex.
Harvey Ryland, General Research Corp., Santa Barbara, Calif.

Fire and the Built Environment

(International Hotel, Los Angeles, Calif., June 27-28, 1972)

JUNE 27, 1972

Richard Patton, President, Patton Fire Protection and Research, Inc., Phoenix, Ariz.
Dr. Thomas G. Bell, Executive Vice President, American Nursing Home Association, Washington, D.C.
Richard E. Stevens, Director, Engineering Services, National Fire Protection Association, Boston, Mass.
Irving Einhorn, Professor, Material Science Engineering, University of Utah, Salt Lake City, Utah.
John Ed Ryan, Engineer, National Forest Products Association, Washington, D.C.
G. R. Munger, General Manager, J. P. Carroll, Manager, and J, G. Degenkolb, Code Consultant, Society of the Plastics Industry, Inc., New York, N.Y.
Jasper Hawkins, Chairman of Codes and Standards Committee, American Institute of Architects, Los Angeles, Calif.

JUNE 28, 1972

Max L. Feldman, General Manager, and Jerry McLinn, Manager of Technical Services, The Sierra Group, Santa Barbara, Calif.
Merrill Butler, Member of Executive Committee, and Alan R. Trellis, Technical Services Division, National Association of Home Builders, Washington, D.C.
John Degenkolb, Code Consultant, Glendale, Calif.
T. II. Carter, Executive Director, International Conference of Building Officials, Pasadena, Calif.
Robert E. Novick, Director, Health Services and Mental Health Administration, Department of HEW, Washington, D.C.
Kenneth Chan, Disney Enterprises, Glendale, Calif.
Richard Houts, Chief Engineer, Los Angeles County Fire Department, Los Angeles, Calif.
Douglas R. Leisz and Richard Mylars, Forest Service, U.S.D.A., Washington, D.C.
Lewis A. Moran, State Forester, and John Hastings, California Division of Forestry, Sacramento, Calif.

(Fairmont Hotel, San Francisco, Calif.)

JUNE 30, 1972

Keith Calden, Chief, San Francisco Fire Department, San Francisco, Calif.
W. G. Kirkland, Building Research Advisory Board, National Academy of Sciences, National Research Council.
.4lfred Goldberg, Superintendent of Building Inspection, San Francisco, Calif.
John M. Rhodes, Factory Mutual Research Corp., Norwood, Mass.
Edward J. Reilly, Vice President, National Automatic Sprinkler and Fire Control Association, Inc., White Plains, N.Y.
Thomas R. Simonson, Consulting Engineer, San Francisco, Calif.
Jack A. Bono, Underwriters' Laboratories, Inc., Northbrook, Ill.
Robert E. Bishop, Assistant State Fire Marshal, State of California.
Dr. Robert Brady Williamson, Associate Professor of Engineering Science, University of California, Berkeley, Calif.
Richard G. Gewain, Chief Fire Protection Engineer, American Iron and Steel Institute, New York, N.Y.

Fire Prevention

(Palmer House, Chicago, Ill., October 3-5, 1972)

OCTOBER 3, 1972

Curtis Volkamer, Chief, Chicago Fire Department, Chicago, Ill.

Doug Wendt, Doug Wendt Foundation, Fargo, N. Dak.

Charles Cohn, Technical Processes Division, Colonial Alloys Co., Philadelphia, Pa.

James W. Kerr, Staff Director, Support Systems Research Division, Defense Civil Preparedness Agency, Washington, D.C.

Rolf Jensen, Professor and Chairman, Illinois Institute of Technology, Chicago, Ill.

Ambrose B. Kelly, Retired General Counsel, Factory Mutual Insurance System, Providence, R-1.

Robert E. May, Illinois State Fire Marshal, Division of Fire Prevention, Chicago, Ill.

OCTOBER 4, 1972

Professor Howard W. Emmons, Gordon McKay Professor of Mechanical Engineering, Harvard University, Cambridge, Mass.

John O'Hagan, Chief of the New York City Fire Department, New York, N.Y.

Leslie Fisher, Director, Burns Prevention Program, Burns Care Institute, Albany, N.Y.

Howard Boyd, Metropolitan Fire Marshal, Nashville, Tenn.

Barbara Hill, Teacher, Fremont Elementary School, Santa Ana, Calif.

Jack B. Haskins, Chairman, Graduate Studies and Research, College of Communications, The University of Tennessee, Knoxville, Tenn.

William Christian, Consulting Engineer, Underwriters' Laboratories, Inc., Northbrook, III.

Robert E. Duke, Chicago Chapter of the Society of Fire Protection Engineers.

OCTOBER 5, 1972

W. G. Schultz, CPCU, Vice President, Engineering Communications and Education, Lumberman's Mutual Insurance Co. of Mansfield, Mansfield, Ohio.

Ralf Hotchkiss, Center for Concerned Engineering, Washington, D.C.

James C. Robertson, State Fire Marshal, Department of Public Safety and Correctional Services, OEce of the Fire Marshal, Baltimore, Md.

Stanley Emery, Inspector, State Fire Marshal's Office, Concord, N.H.

Joseph N. Baker, City Manager, Burbank, Calif.

John R. Corcoran, President of the New York Society of Fire Technologists, Newhurg, N.Y.

Joseph A. O'Keefe, Director, Fire Science Programs, The Commomwealth of Massachusetts Board of Regional Community Colleges, Boston, hlass.

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APPENDIX III

ACKNOWLEDGMENTS

Contributing Agencies and Organizations

Office of Management and Budget
Department of Agriculture
Department of Commerce
Department of Health, Education, and Welfare
Department of Housing and Urban Development
Department of Transportation
General Services Administration
National Academy of Sciences

Boston, Massachusetts, Fire Department
Chicago, Illinois, Fire Department
Cincinnati, Ohio, Fire Department
Dallas, Texas, Fire Department
Denver, Colorado, Fire Department
Huntington Beach, California, Fire Department
Independence, Missouri, Fire Department
Los Angeles City, California, Fire Department
Los Angeles County, California, Fire Department
Metropolitan Dade County, Florida, Fire Department
Miami, Florida, Fire Department
Mountain View, California, Fire Department
New York City, New York, Fire Department
San Francisco, California, Fire Department
Santa Ana, California, Fire Department
Sarasota, Florida, Fire Department
Seattle, Washington, Fire Department
Silver Spring, Maryland, Fire Department
Washington, D.C., Fire Department

American Forestry Association
American Iron and Steel Institute
Factory Mutual System
Insurance Services Office
International Association of Black Professional Fire Fighters
International Association of Fire Chiefs
International Association of Fire Fighters
International City Management Association
Model Building Code Groups
- American Insurance Association
- Building Officials and Code Administrators International, Inc.
- International Conference of Building Officials
- Southern Buildings Code Congress

National Association of Mutual Insurance Companies
National League of Cities
New York City Rand Institute
Sierra Group
Society of the Plastics Industry, Inc.
Tall Timbers Research Station
Underwriters' Laboratories, Inc.
University of Maryland
University of Michigan Burn Center
Urban Institute

Consultants

Howery, Baker, Simon and Murchison, Attorneys At Law
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David B. Gratz, Fire Management Associates, Inc.
Gordon F. Vickery, Retired Chief, Seattle Fire Department
Gage-Babcock and Associates, Inc.
John Buck, editor
Judy Harkinson, photographs
Jerry Dadds, design
Centers for Study
Ambrose Kelly, Retired General Counsel, Factory Mutual System
Prof. Irving Einhorn, University of Utah
Dr. R. B. Williamson, University of California, Berkeley

Department Representatives

James Kerr-Department of Defense
Robert Novick-Department of Health, Education, and Welfare
Willard R. Tikkala-Department of Agriculture
Quinton Wells-Department of Housing and Urban Development
Dr. Karl Willenbrock-Department of Commerce

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APPENDIX IV

RECOMMENDATIONS OF THE NATIONAL COMMISSION ON FIRE PREVENTION AND CONTROL

CHAPTER 1

1. . . . the Commission recommends that Congress establish a U.S. Fire Administration to provide a national focus for the Nation's fire problem and to promote a comprehensive program with adequate funding to reduce life and property loss from fire.

2. . . * the Commission recommends that a national fire data system be established to provide a continuing review and analysis of the entire fire problem.

CHAPTER 2

3. The Commission recommends that Congress enact legislation to make possible the attainment of 25 burn units and centers and 90 burn programs within the next 10 years.

4. The Commission recommends that Congress, in providing for new burn treatment facilities, make adequate provision for the training and continuing support of the specialists to staff these facilities. Provision should also be made for special training of those who provide emergency care for burn victims in general hospitals.

5. The Commission recommends that the National Institutes of Health greatly augment their sponsorship of research on burns and burn treatment.

6. The Commission recommends that the National Institutes of Health administer and support a systematic program of research concerning smoke inhalation injuries.

CHAPTER 3

7. The Commission recommends that local governments make fire prevention at least equal to suppression in the planning of fire department priorities.

8. The Commission recommends that communities train and utilize women for fire service duties.

9. The Commission recommends that laws which hamper cooperative arrangements among local fire jurisdictions be changed to remove the restrictions.

10. The Commission recommends that every local fire jurisdiction prepare a master plan designed to meet the community's present and future needs in fire protection, to serve as a basis for program budgeting, and to identify and implement the optimum cost-benefit solutions in fire protection.

11. . . . the Commission recommends that Federal grants for equipment and training be available only to those fire jurisdictions that operate from a federally approved master plan for fire protection.

12. The Commission recommends that the proposed U.S. Fire Administration act as a coordinator of studies of fire protection methods and assist local jurisdictions in adapting findings to their fire protection planning.

CHAPTER 4

13. The Commission recommends that the proposed U.S. Fire Administration provide grants to local fire jurisdictions for developing master plans for fire protection. Further, the proposed U.S. Fire Administration should provide technical advice and qualified personnel to local fire jurisdictions to help them develop master plans.

CHAPTER 5

14 . . . the Commission recommends that the proposed U.S. Fire Administration sponsor research in the following areas: productivity measure of fire departments, lob analyses, firefighter injuries, and fire prevention efforts.

15. . . the Commission urges the Federal research agencies, such as the National Science Foundation and the National Bureau of Standards, to sponsor research appropriate to their respective missions within the areas of productivity of fire departments, causes of firefighter injuries, effectiveness of fire prevention efforts, and the skills required to perform various fire department functions.

16. The Commission recommends that the Nation's fire departments recognize advanced and specialized education and hire or promote persons with experience at levels commensurate with their skills.

17. The Commission recommends a program of Federal financial assistance to local fire servircs to upgrade their training.

18. In the administering of Federal funds for training or other assistance to local fire departments, the Commission recommends that eligibility be limited to those departments that have adopted an effective, affirmative action program related to the employment and promotion of members of minority groups.

19. The Commission recommends that fire departments, lacking emergency ambulance, paramedical. and rescue services consider providing them, especially if they are located in communities where these services are not adequately provided by other agencies.

CHAPTER 6

20. . . . the Commission recommends the establishment of a National Fire Academy to provide specialized training in areas important to the fire services and to assist State and local jurisdictions in their training programs.

21. The Commission recommends that the proposed National Fire Academy assume the role of developing, gathering, and disseminating, to State and local arson investigators, information on arson incidents and on advanced methods of arson investigations.

22. The Commission recommends that the National Fire Academy be organized as a division of the proposed US. Fire Admmistration, which would assume responsibility for deciding details of the Academy's structure and administration.

23. The Commission recommends that the full cost of operating the proposed National Fire Academy and subsidizing the attendance of fire service members be borne by the Federal Government.

CHAPTER 7

24. The Commission urges the National Science Foundation, in its Experimental Research and Development Incentives Program, and the National Bureau of Standards, in its Experimental Technology Incentives Program, to give high priority to the needs of the fire services.

25. The Commission recommends that the proposed U.S. Fire Administration review current practices in terminology, symbols, and equipment descriptions, and seek to introduce standardization where it is lacking.

26. The Commission urges rapid implementation of a program to improve breathing apparatus systems and expansion of the program's scope where appropriate.

27. The Commission recommends that the proposed U.S. Fire Administration undertake a continuing study of equipment needs of the fire services, monitor research and development in progress, encourage needed research and development, disseminate results, and provide grants to fire departments for equipment procurement to stimulate innovation in equipment desian.

28. . . . the Commission urges the Joint Council of National Fire Service Organizations to sponsor a study to identify shortcomings of firefighting equipment and the kinds of research, development, or technology transfer that can overcome the deficiencies.

CHAPTER 8

No recommendations.

CHAPTER 9

29. The Commission recommends that research in the basic processes of ignition and combustion be strongly increased to provide a foundation for developing improved test methods.

30. This Commission recommends that the new Consumer Product Safety Commission give a high priority to the combustion hazards of materials in their end use.

31. : . . the Commission recommends that the present fuel load study sponsored by the General Services Administration and conducted by the National Bureau of Standards be expanded to update the technical study of occupancy fire loads.

32. The Commission recommends that flammability standards for fabrics be given high priority by the Consumer Product Safety Commission,

33. The Commission recommends that all States adopt the Model State Fireworks Law of the National Fire Protection Association, thus prohibiting all fireworks except those for public displays.

34. The Commission recommends that the Department of Commerce be funded to provide grants for studies of combustion dynamics and the means of its control.

35. The Commission recommends that the National Bureau of Standards and the National Institutes of Health cooperatively devise and implement a set of research objectives designed to provide combustion standards for materials to protect human life.

CHAPTER 10

36. The Commission urges the National Bureau of Standards to assess current progress in fire research and define the areas in need of additional investigation. Further, the Bureau should recommend a program for translating research results into a systematic body of engineering principles and, ultimately, into guidelines useful to code writers and building designers.

37. The Commission recommends that the National Bureau of Standards, in cooperation with the National Fire Protection Association and other appropriate organizations, support research to develop guidelines for a systems approach to fire safety in all types of buildings.

38. . . . the Commission recommends that, in all construction involving Federal money, awarding of those funds be contingent upon the approval of a fire safety systems analysis and a fire safety effectiveness statement.

39. This Commission urges the Consumer Product Safety Commission to give high priority to matches, cigarettes, heating appliances, and other consumer products that are significant sources of burn injuries, particularly products for which industry standards fail to give adequate protection.

40. The Commission recommends to schools giving degrees in architecture and engineering that they include in their curricula at least one course in fire safety. Further, we urge the American Institute of Architects, professional engineering soci-

eties, and State registration boards to implement this recommendation.

41. The Commission urges the Society of Fire Protection Engineers to draft model courses for architects and engineers in the field of fire protection engineering.

42. The Commission recommends that the proposed National Fire Academy develop short courses to educate practicing designers in the basics of fire safety design.

CHAPTER 11

43. The Commission recommends that all local governmental units in the United States have in force an adequate building code and fire prevention code or adopt whichever they lack.

44. The Commission recommends that local governments provide the competent personnel, training programs for inspectors, and coordination among the various departments involved to enforce effectively the local building and fire prevention codes. Representatives from the fire department should participate in revielving the fire safety aspects of plans for new building construction and alterations to old buildings.

45. The Commission recommends that, as the model code of the International Conference of Building Officials has already done, all model codes specify at least a single-station early-warning detector oriented to protect sleeping areas in every dwelling unit. Further, the model codes should specify automatic fire extinguishing systems and early-warning detectors for high-rise buildings and for low-rise buildings in which many people congregate.

CHAPTER 12

46. The Commission recommends that the National Transportation Safety Board expand its efforts in issuance of reports on transportation accidents so that the information can be used to improve transportation fire safety.

47. The Commission recommends that the Department of Transportation work with interested parties to develop a marking system, to be adopted nationwide, for the purpose of identifying transportation hazards.

48. The Commission recommends that the proposed National Fire Academy disseminate to every fire jurisdiction appropriate educational materials on the problems of transporting hazardous materials.

49. The Commission recommends the extension of the Chem-Tree system to provide ready access by all fire departments and to include hazard control tactics.

50. . . . the Commission recommends that the Department of the Treasury establish adequate fire regulations, suitably enforced, for the transportation, storage, and transfer of hazardous materials in international commerce.

51. The Commission recommends that the Department of Transportation set mandatory standards that will provide fire safety in private automobiles.

52. The Commission recommends that airport authorities review their firefighting capabilities and, where necessary, formulate appropriate capital improvement budgets to meet current recommended aircraft rescue and firefighting practices.

53. The Commission recommends that the Department of Transportation undertake a detailed review of the Coast Guard's responsibilities, authority, and standards relating to marine fire safety.

54. The Commission recommends that the railroads begin a concerted effort to reduce rail-caused fires along the Nation's rail system.

55. . . . the Commission recommends that the Urban Mass Transportation Administration require explicit fire safety plans as a condition for all grants for rapid transit systems.

CHAPTER 13

56. . , . the Commission recommends that rural dwellers and others living at a distance from fire departments install early-warning detectors and alarms to protect sleeping areas.

57. The Commission recommends that U.S. Department of Agriculture assistance to [community fire protection facilities] projects be contingent upon an approved master plan for fire protection for local fire jurisdictions.

CHAPTER 14

58. . . . the Commission recommends that the proposed U.S. Fire Administration join with the Forest Service, U.S.D.A., in exploring means to make fire safety education for forest and grassland protection more effective.

59. The Commission recommends that the Council of State Governments undertake to develop model State laws relating to fire protection in forests and grasslands.

60. The Commission urges interested citizens and conservation groups to examine fire laws and their enforcement in their respective States and to press for strict compliance.

61. The Commission recommends that the Forest Service, U.S.D.A., develop the methodology to make possible nationwide forecasting of fuel buildup as a guide to priorities in wildland management.

62. The Commission supports the development of a National Fire Weather Service in the National Oceanic and Atmospheric Administration and urges its acceleration.

CHAPTER 15

63. The Commission recommends that the Department of Health, Education, and Welfare include in accreditation standards fire safety education in the schools throughout the school year. Only schools presenting an effective fire safety education

program should be eligible for any Federal financial assistance.

64. The Commission recommends that the proposed U.S. Fire Administration sponsor fire safety education courses for educators to provide a teaching cadre for fire safety education.

65. The Commission recommends to the States the inclusion of fire safety education in programs educating future teachers and the requirement of knowledge of fire safety as a prerequisite for teaching certification.

66. The Commission recommends that the proposed U.S. Fire Administration develop a program, with adequate funding, to assist, augment, and evaluate existing public and private fire safety education efforts.

67. . * . the Commission recommends that the proposed U.S. Fire Administration, in conjunction with the Advertising Council and the National Fire Protection Association, sponsor an all-media campaign of public service advertising designed to promote public awareness of fire safety.

68. The Commission recommends that the proposed U.S. Fire Administration develop packets of educational materials appropriate to each OCCUpational category that has special needs or opportunities in promoting fire safety.

CHAPTER 16

69. The Commission supports the Operation EDITH (Exit Drills In The Home) plan and recommends its acceptance and implementation both individually and community-wide.

70. The Commission recommends that annual home inspections be undertaken by every fire department in the Nation. Further, Federal financial assistance to fire jurisdictions should be contingent upon their implementation of effective home fire inspection programs.

71. The Commission urges Americans to protect themselves and their families by installing approved early-warning fire detectors and alarms in their homes.

72. , . . the Commission recommends that the insurance industry develop incentives for policyholders to install approved early-warning fire detectors in their residences.

73. The Commission urges Congress to consider amending the Internal Revenue Code to permit reasonable deductions from income tax for the cost of installing approved detection and alarm systems in homes.

74. * . . the Commission recommends that the proposed U.S. Fire Administration monitor the progress of research and development on early-warning detection systems in both industry and government and provide additional support for research and development where it is needed.

75. The Commission recommends that the proposed US. Fire Administration support the development of the necessary technology for improved automatic extinguishing systems that would find ready acceptance by Americans in all kinds of dwelling units.

76. The Commission recommends that the National Fire Protection Association and the American National Standards Institute jointly review the Standard for Mobile Homes and seek to strengthen it, particularly in such areas as interior finish materials and fire detection.

77. The Commission recommends that all political jurisdictions require compliance with the NFPA/ANSI standard for mobile homes together with additional requirements for early-warning fire detectors and improved fire resistance of materials.

78. The Commission recommends that State and local jurisdictions adopt the NFPA Standard on Mobile Home Parks as a minimum mode of protection for the residents of these parks.

CHAPTER 17

79. The Commission strongly endorses the provisions of the Life Safety Code which require specific construction features, exit facilities, and fire detection systems in child day care centers and recommends that they be adopted and enforced immediately by all the States as a minimum requirement for licensing of such facilities.

80. The Commission recommends that early-warning detectors and total automatic sprinkler protection or other suitable automatic extinguishing systems be required in all facilities for the care and housing of the elderly.

81. The Commission recommends to Federal agencies and the States that they establish mechanisms for annual review and rapid upgrading of their fire safety requirements for facilities for the aged and infirm, to a level no less stringent than the current NFPA Life Safety Code.

82. The Commission recommends that the special needs of the physically handicapped and elderly in institutions, special housing, and public buildings ,be incorporated into all fire safety standards and codes.

83. The Commission recommends that the States provide for periodic inspection of facilities for the aged and infirm, either by the State's fire marshal's office or by local fire departments, and also require approval of plans for new facilities and inspection by a designated authority during and after construction.

84. The Commission recommends that the National Bureau of Standards develop standards for the flammability of fabric materials commonly used in nursing homes with a view to providing the highest level of fire resistance compatible with the state-of-the-art and reasonable costs.

85. The Commission recommends that political subdivisions regulate the location of nursing homes and housing for the elderly and require that fire

alarm systems be tied directly and automatically to the local fire department.

CHAPTER 18

86. The Commission recommends that the Federal Government retain and strengthen its programs of fire research for which no non-governmental alternatives exist.

87. . . . the Commission recommends that the Federal budget for research connected with fire be increased by $26 million.

88. . . . the Commission recommends that associations of material and product manufacturers encourage their member companies to sponsor research directed toward improving the fire safety of the built environment.

CHAPTER 19

89. . . . the Commission recommends that the proposed U.S. Fire Administration be located in the Department of Housing and Urban Development.

90. The Commission recommends that Federal assistance in support of State and local fire service programs be limited to those jurisdictions complying with the National Fire Data System reporting requirements.

CHAPTER 20

No recommendations.

APPENDIX V

1971 FIRE LOSS DATA

Category	Life loss		Property loss		Fires	
	Number	Percent of total	Million Dollars	Percent of total	Number	Percent of total
Residential (houses, apartments and hotels)	6,600	56	$874.1	31.9	699,000	25.6
Commercial (public assembly, educational, institutional, mercantile and office)	970	8	580.5	21.1	141,400	5.2
Industrial (basic industry, storage, manufacturing and miscellaneous			811.6	29.6	156,500	5.7
Building fires (total)	7,570 [1]	64	$2,266.2 [4]	82.6	996,900 [4]	36.5
Brush, rubbish, grass	([2])	([2])	([3])	([3])	1,076,300	39.5
Forest fires	20	0.2	$119.0	4.4	111,500	4.1
Other outdoor fires	([2])	([2])	26.0	0.9	22,000	0.8
Aerospace vehicles and aircraft	125	1.1	192.0	7.0	200	.....
Motor vehicles—farm/construction	3,950	33.3	16.12	0.6	19,200	0.7
Motor Vehicles—pleasure/transportation		.....	96.54	3.5	482,400	17.7
Ships, railroads, etc	185	1.5	27.60	1.0	20,000	0.7
Non-building fires (total)	4,280 [1]	36.1	$479.26 [4]	17.4	1,731,600 [4]	63.5
Grand total	11,850 [4]	100	$2,743.46 [4]	100	2,728,500 [4]	100

[1] NFPA unofficial estimate for 1971.
[2] No separate estimates; totals included in other categories.
[3] No loss assumed for this type fire.
[4] NFPA official estimate for 1971.

APPENDIX VI

MASTER PLAN FOR FIRE PROTECTION, MOUNTAIN VIEW, CALIFORNIA

Fire Protection Section

The community fire protection system includes public and private organizations, personnel, facilities, equipment, laws and policy, all coordinated for life safety and property protection from fire loss through control, detection and suppression of fire danger. The objective of the community fire protection system is to provide adequate level of fire protection at a reasonable community cost. Adequate fire protection for Mountain View is that specific combination of public and private resources which provide the services and acceptable risks which meet the needs of this community.

Means of Fire Protection

Community fire "protection" is a combination of two factors-Public Sector Protection and Private Sector Protection.

- *Public Sector Fire Protection* consists of the manpower and facilities supplied by the city. Traditionally, the design of the system has reacted to problems rather than planning to manage problems. To be effective, the system must be designed in light of the community's goals and capablhties. In addition to the job of fire suppression, public protection, to be most effective, must include structural design review, control of hazardous contents, fire code enforcement, continuing inspection, and coordination of building, planning, law enforcement and public works activities as they relate to fire protection.
- *Private Sector Fire Protection* consists of fire resistive design of structures and materials, as well as fire extinguishing, warning, and detection systems. Fire resistive structural elements limit the size of the fire problem by dividing a structure into manageable fire areas. Through automatic detection and suppression, built-in protection is intended to limit the scope of the anticipated problem to that which is manageable.

Fire insurance also serves an indirect function in fire protection by compensation for losses. In addition, the fire insurance industry evaluates the capabilities of cities to cope with conflagrations. The Insurance Services Office maintains a 1 to 10 grading system and establishes a basic insurance rate for each city. In a Class 1 city fire insurance costs less than in a Class 10 city. Traditionally, cities have used this grading as the basis of their fire protection system design. Although the Grading Schedule provides adequate guidelines for conflagration control, it is not intended to meet the total fire protection planning needs of cities, since individual community goals and capabilities are not considered. The City of Mountain View will consider fire insurance rates and upgrading as one of the economic benefits resulting from adequate fire protection.

Fire Losses and Costs

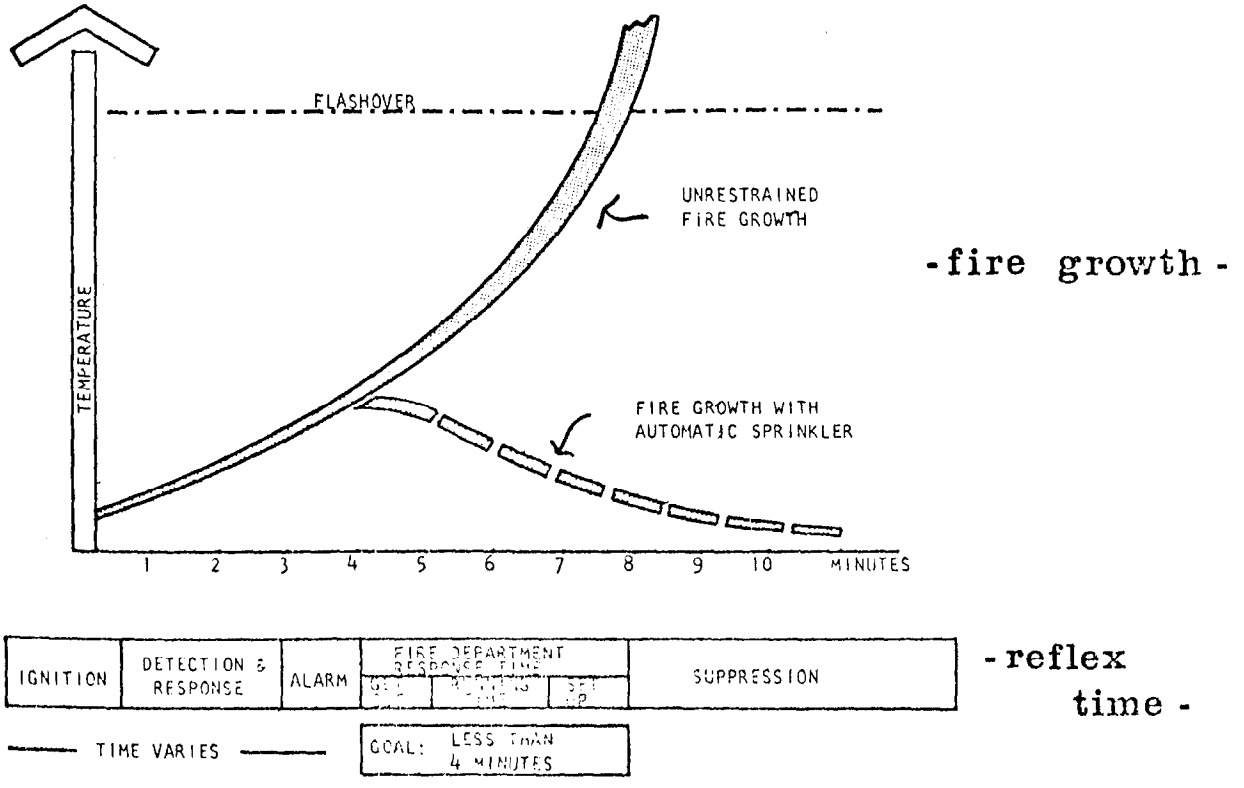
The number of fire department responses in Mountain View has grown in direct proportion to the population with approximately 22 emergency calls per thousand persons over the past 10 years. Increased concentration of people and goods, resulting from urbanization, has increased fire loss potential and reduced the effectiveness of traditional public fire protection methods. As concentration increases, building design, on-site automatic detection equipment, and private automatic and manual suppression facilities are of greater importance to reduce fire risk.

Along with increased fire losses, community costs, which include equipment and manpower, have also risen. With traditional community fire system designs, this trend of public cost can be expected to continue to increase in accord with urbanization. Only by planning for both public and private fire control responsibility can this trend be changed. In this plan, fire loss management is stressed as opposed to systems which merely react to new problems by adding more firefighting resources.

Reflex Time

The concept of reflex time is useful in understanding the public and private sector responsibilities with respect to fire risks. Reflex time is the total time which elapses between fire ignition and eventual extinguishment, and is illustrated on the next page.

Upon ignition, fire intensity grows rapidly. While the rate of growth varies with the materials and conditions, a dangerous fire will climb quickly to a point referred to as "flashover," the critical point for life safety and fire control. One of the primary objectives of adequate fire protection is to control fires prior to flashover. Fire department response time can be established by the system design. Historically, the time that elapses between ignition and alarm has been uncontrolled and fire extinguishment commenced only after arrival of firefighting forces. With automatic detection, a speedy alarm can be given and response time of firefighting forces can be reduced. With automatic suppression, fire danger can be controlled prior to flashover, and frequently prior to the arrival of firefighting forces.



THE COMMUNITY FIRE PROTECTION PLAN

The plan which emerges involves a combination of public and private responsibilities. The city shall establish a "normal firefighting capability" by building a fire protection force and providing equipment to cope with an anticipated fire risk. Standards will be set to define the level of public fire protection which is adequate to meet the normal needs at a reasonable community cost. Above that anticipated level of fire risk, built-in protection will be provided by the private sector. The community fire protection system shall include necessary public ordinances, codes, structural design review, and code enforcement procedures. In addition, inspection and maintenance programs are required to assure the reliability of built-in protection. Fires which exceed anticipated severity will require the implementation of emergency operations pians which include mutual aid with neighboring cities,

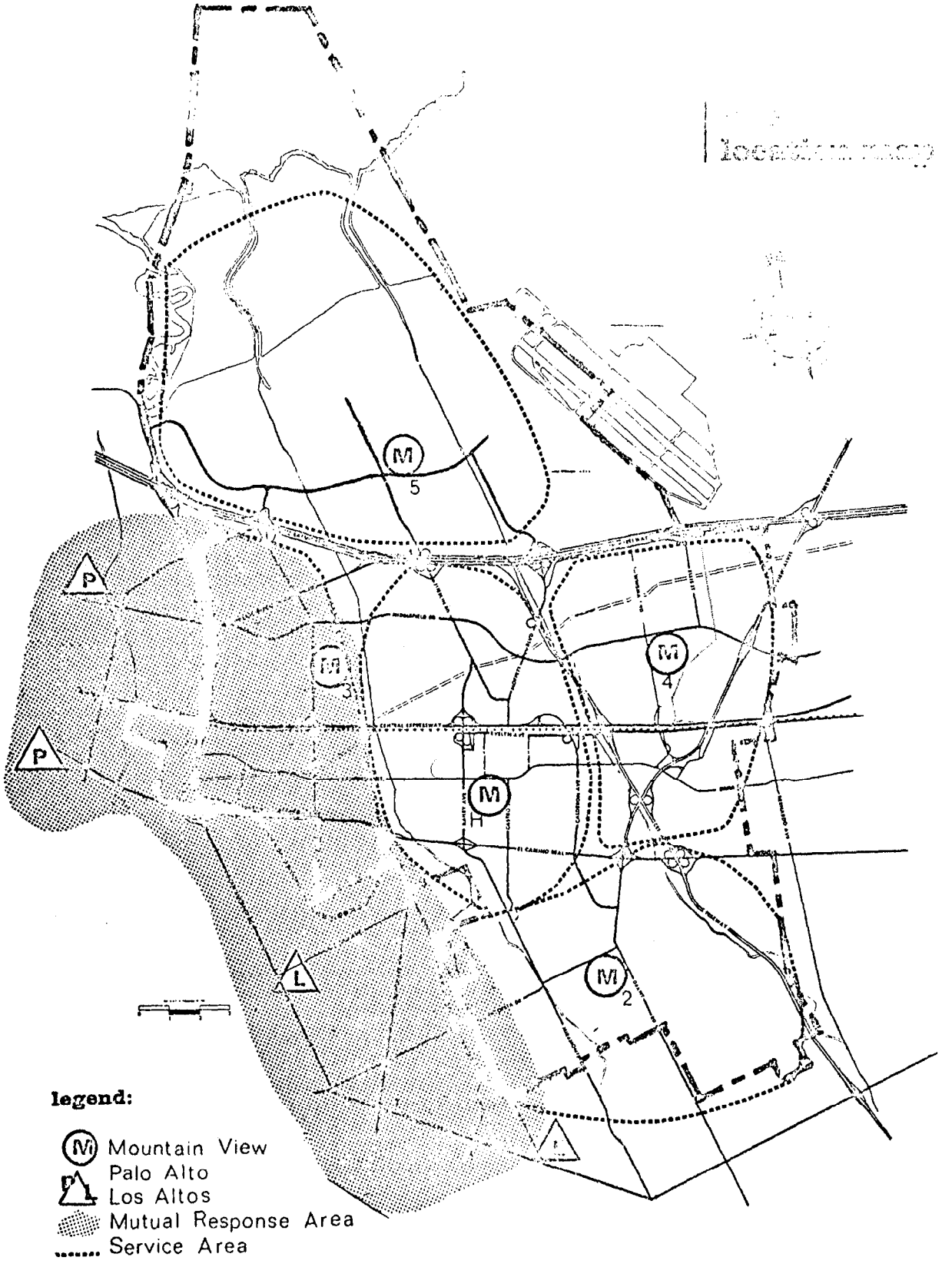
There is an insurance rating that is optimal for this community at any point in time. The total community cost of changing the rating will govern the decision to change. In 1972 the Class 4 rating is optimum; however, the fire insurance rating shall receive continual evaluation and changes may be sought to improve community benefits.

The figure on page 175 depicts the locations and fire prevention service areas for the City of Mountain View fire stations, needed at full development. Distributed as shown, the stations provide a first response and backup capability for fire suppression and rescue. Fire stations in Palo Alto and Los Altos have also been shown, indicating the areas that may be served by mutual response agreements. These fire stations are highly visible community facilities which not only provide a base for firefighting and prevention but also provide general community information and services.

The proposed plan is a balance of fire codes, fire protection personnel, and capital improvements. Under this plan, it is anticipated that the fire department resources needed at full development will be five engine companies, two truck companies, one rescue company and a battalion chief. A Fire Prevention Bureau, Communications Division, Training Divisions, and administrative staff are necessary to provide specialized services to the community and the department personnel.

Fire Station Locations

Fire stations provide many direct services within their assigned areas in addition to firefighting functions. Among these are fire prevention and hazard control programs; fire safety education; and rescue, first aid and resuscitation service. Fire stations also provide communications and a service point between city government and the community and, through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legend:
Mi Mountain View
Palo Alto
Los Altos
Mutual Response Area
Service Area

their strategic locations, they provide the quickest feasible response to citizen requests for service.

Headquarters Fire Station at Villa and Franklin houses the administrative offices, the Communications Division and the Fire Prevention Bureau. The firefighting resources are: one engine company, one truck company, a rescue company and battalion chief. An expanded facility will be developed when funds are available.

Station 2 at the intersection of Grant and Cuesta houses one engine company and one reserve engine.

Station 3 at the intersection of Rengstorff and Montecito houses one engine company and one reserve hose wagon.

Station 4 on Whisman Road also includes the training facility and the city emergency operations center. This station houses an engine company and a reserve engine and reserve truck.

Station 5. Property for this future station 5 has been purchased at Charleston and Stierlin Roads. The construction of this station is related to the rate of development of the area north of Bayshore Freeway.

The service areas extend beyond the city limits to include areas of mutual response with adjoining communities of Palo Alto and Los Altos. Fire stations are highly visible community facilities and shall represent the city within the neighborhoods as well as provide the base for fire services.

In order to implement the plan, the following programs shall be pursued :

1. *Fire Suppression.* Effective firefighting requires the training and maintenance of a wide variety of manpower skills combined into an effective team. A high level of efficiency is essentials to the safety of the firefighter. Also essential are the facilities and apparatus necessary for use by the firefighters.
2. *Life Safety/Paramedical Services.* The fire system shall have a rescue capability for emergencies. This capability shall include first aid, resuscitation, cardio-pulmonary resuscitation, and coordination of command at catastrophic medical incidents.
3. *Fire Prevention.* The fire system shall include building design and construction plan review, built-in private fire equipment and building inspection, fire code enforcement, fire cause investigation, fire hazard control and fire code updating, in order to provide the required fire protection reliability of built-in protection. The fire system shall provide education in fire safety, fire protection consultation, home safety programs, and first aid training for the public. The bulk of the firefighter's non-emergency time will be devoted to fire prevention activities. To assure the reliability of built-in fire protection, a major commitment of fire department personnel for inspection is necessary.
4. *Structural Rehabilitation.* In coordination with other city departments, the fire department shall work to abate serious hazards to health and safety caused by deteriorated structures.
5. *Regional Coordination.* The capability to cope effectively and rapidly with major emergency incidents requires close coordination with and use of resources of neighboring jurisdictions. This includes sharing capabilities, facilities and equipment, standardization, operational coordination communications, and logistical support.
6. *Data Development.* In order to better design the system (and measure results), adequate base data and feedback on fire danger, building design and operation, fire cause, and fire prevention results are necessary. Emergency operations require an extensive "on line" data capability to enact efficient and safe control methods for fire and/or hazardous materials incidents.

APPENDIX VII

ESTIMATE U.S. FIRE RESEARCH FUNDS

Sponsor	Program area	Funds (thousand)
TOTAL		**$105,200**
Federal Government		26,600
Atomic Energy Commission	Nuclear plant fire protection	500
Agriculture	Forest fire prevention and control, fire weather modification	5,900
Commerce	Fabric and building fire safety, fire behavior, combustion	2,600
Defense	War and disaster-related fire and countermeasures, fuel materials and ammunition.	3,600
Health, Education, and Welfare	Burn treatment, prevention and rehabilitation, epidemiology and surveillance.	2,200
Housing and Urban Development	Urban building fire safety	700
Interior	Fire weather modification	4,700
National Aeronautics and Space Administration.	Space systems fire protection	2,800
National Science Foundation	Fire behavior, materials flammability	2,200
Transportation	Aircraft inflight fire and crash fire protection, ship fire protection, railroad and hazardous materials fire safety, motor vehicle fire safety.	1,300
U.S. Postal Service	Postal facility fire protection	100
Private and Public Sector		78,600
Wood and wood product industries	Fire characteristics of products and materials	600
Paper industry		5,000
Plastics industry		40,000
Fabric and carpet industry		10,000
Gypsum industry		600
Metals industry		1,300
Cement industry		100
Fire protection industry	Fire detection and suppression equipment	14,500
City fire departments, private laboratories, etc.	Operational fire prevention and control	1,500
Insurance industry	Loss prevention	5,000

U.S. GOVERNMENT PRINTING OFFICE : 1973-O-495-792