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PROTECTING THE PUBLIC FROM FIRES

The Subcommittee on Investment, Jobs, and Prices of the U.S. Congress Joint Economic Committee held hearings on health and safety programs during 1986. One of them, on July 28, 1986, in Frederick, Md. (chaired by Maryland Senator Paul S. Sarbanes), dealt with “the impact of budget restrictions and policy changes on our ability to protect the public from fire.” In view of the substantial involvement of APL in fire research in the 1970s, I was asked to present my views.

What follows is a summary of my testimony to three questions posed by the Subcommittee:

1. What is the appropriate Federal role in fire safety, research, and prevention?
2. What are the economic and social costs of the reduction in Federal support for fire prevention, research, and safety?
3. To achieve an appropriate Federal role in these areas, what level of Federal funding and program resources would be needed? What improvements can be made in Federal programs that support the efforts of state and local governments?

The complete record will be published by the Committee.

WHAT IS THE APPROPRIATE FEDERAL ROLE IN FIRE SAFETY, RESEARCH, AND PREVENTION?

To ensure “domestic tranquility,” the Federal government is expected nowadays to play an active role in reducing hazards in the increasingly technological world in which we live. Health protection is foremost, followed by actions to mitigate environmental degradation; assistance in avoiding death and injuries from collisions in the air, on the sea, or on highways; prevention of exposure to harmful radiation and hazardous chemicals; and provisions to lessen the consequences of natural disasters (earthquakes, volcanic eruptions, floods, and windstorms).

Protection from unwanted fires and explosions is also of concern. Individual actions and self-help can do much to forestall incidents and diminish their severity, but help from other, more organized, sources is also needed. The Federal government must accept some responsibility for aspects of the fire problem that cannot readily be solved



La Maddalena penitente by Georges de la Tour.

on a personal or local scale or where assistance from voluntary associations is inadequate.

The Federal government has a particularly important role to build a broad base of technical information from which remedial or preventive measures can be developed. To provide leadership and funding, to select appropriate approaches, and to translate them into meaningful actions—these are the unique and compelling roles of enlightened governmental involvement.

Unwanted fires touch the lives and fortunes of nearly every citizen. Murphy’s Law (“If anything can go wrong, it will”) can be extended to say “Anything that can burn, will.” Recall the disruptive consequences of the following unwanted fires:

- The Challenger shuttle explosion

- The explosions within and subsequent burning of the graphite core of the Chernobyl nuclear reactor
- The costly fires in public buildings (the MGM Hotel (1980) and the Beverly Hills Supper Club (1977))
- The collision, burning, and total loss of two 747 jets in the Balearic Islands
- The gutting by fires of naval ships in peacetime (USS *Belknap*) and in wartime (HMS *Exeter*, Falkland Islands)
- The spectacular fires in high-rise buildings (Sao Paulo and Seoul)
- The week-long disruption of a large section of midtown New York City by the Bell Telephone Exchange Building fire (1975)
- The almost total destruction of cities by fire in both war and peace (Hamburg, 1944; Tokyo, 1923; Chicago, 1871)
- The 3,500,000 household fires annually
- The yearly fire death rate of nearly 8000 persons in the United States and serious injuries to 50,000; the need for 2,000,000 fire fighters to be on the alert; and the \$10 billion annual fire cost to the United States economy

Responsibilities for keeping unwanted fires in check are widely dispersed within the social structure. Individual errors are the cause of most civilian fire incidents. Large human and economic losses also occur in industry, in the transportation sector, in forests—in fact, whenever combustible materials are present.

Elaborate protection mechanisms have been devised in the past hundred years to minimize such losses: fire departments have been organized, building codes have been promulgated, burn centers have been established, and so on. Many of the efforts are clearly local or, at most, statewide responsibilities. Others depend on the effort of voluntary standard-setting organizations, on inputs from industrial trade associations, or on Federal departments with responsibilities for specific problem areas (such as the Department of Agriculture, for forest fires; the Department of Transportation, for airplane and vehicle transportation fires and for rail and motor cargo fire protection; the Department of Defense, for fire hardening of combat ships, planes, and vehicles; the Coast Guard, for ship cargo fire safety; the Department of the Interior, for mine fire safety; and the Consumer Product Safety Commission, for product fire safety).

Despite these widespread specific concerns, there remains an overriding Federal responsibility for crucial components of the civilian fire field. As spelled out in detail in *America Burning*, published in 1974 by the National Commission on Fire Prevention and Control, there is an urgent need for solutions to the following problems:

1. Nationwide statistics on all aspects of fires should be gathered consistently and evaluated over a long period of time to provide guidelines for trends and for future remedial actions. For example, the benefits of the recent requirements for residential smoke detectors and sprinklers can only be assessed if their effectiveness in reducing fire incidents can be determined in detail. This requires careful attention by people who are experts in statistical analysis and who also are acquainted with fire phenomena and human responses. No local establishment is in a position to carry out such an in-depth study alone.
2. The development and evaluation of better tools (both equipment and tactics) are beyond the resources of any local fire-fighting department. The New York City Fire Department, with a complement of 20,000 members and an annual budget of more than \$500 million per year, is not pursuing any instrument or equipment development or carrying out any operations research and analysis that would improve its own performance as well as that of fire departments elsewhere. The industry involved in the sale of fire extinguishment equipment is too fragmented to carry out forward-looking developments and see them applied in practice. This is in sharp contrast to Japan, where fire departments and fire research establishments are closely linked to develop and evaluate new ideas in the laboratory and in the field. No such technology transfer mechanism exists in the United States.
3. The development of novel ways to evacuate high-rise buildings (via, say, turbojet-propelled platforms), the design of portable instruments that would measure in real time the toxic nature of the atmospheres in which fire fighters are working, the use of helicopter-supported fire command and control posts on the fire scene, the use of rapid medical diagnostics to treat fire casualties, the design and evaluation of novel fire detection and control systems to minimize losses in high-rise and public-occupancy buildings—all these and many other developments cannot readily be done at the local level. They require Federal sponsorship and support. Improvements would benefit the entire society.
4. Federal responsibility also extends to the support of a vigorous research effort whose objective is to understand fire phenomena and to train a professional corps of practitioners. Inputs from the fields of applied physics, communications, and operations research; the chemistry of combustion; the medical fields of fire pathology, toxicology, and treatment; and the understanding of the psychology of people under stress can make invaluable contributions to the formulation of cost-effective building codes and structural designs, to the development of rational test methods, to the synthesis of new fire-resistant materials, and to the modeling and prediction of fire growth and extinguishment for the myriad conditions under which costly incidents are possible.

WHAT ARE THE ECONOMIC AND SOCIAL COSTS OF THE REDUCTION IN FEDERAL SUPPORT FOR FIRE PREVENTION, RESEARCH, AND SAFETY?

The societal costs of reducing Federal support for fire prevention are difficult to quantify. The fire safety record of the United States has been (and remains) among the worst of all industrialized countries.

The Federal role in fire research and development was formulated more than 10 years ago with the establishment of the National Fire Prevention and Control Administration as an implementation of the 1974 Fire Prevention and Control Act that, in turn, was based on the findings of the National Commission on Fire Prevention and Control. Because of modest initial funding, subsequent small increases in support, and the recent downward trend in budget allocations, the stated goals (to reduce United States fire losses by 50 percent in one generation) are not likely to be met.

Building technical competence in such diverse areas as the generation and analysis of reliable statistics; the development of cost-effective design standards and codes; the introduction of new tools and operations into fire departments; the training of senior fire officials in novel operational methods; the advancement of understanding and scholarship in the applied physics, engineering, medical, and public health aspects of fires; and the teaching of fire science in colleges and universities—that process needs to advance beyond the state of activity that was deemed unacceptable even 20 years ago. Capable people are forced to look elsewhere when financial support for their talents is not available. New people will be loath to devote their careers to this field. The most likely consequence will be that the already enormous social and economic costs will rise above the current levels.

WHAT LEVEL OF FEDERAL FUNDING AND PROGRAM RESOURCES WOULD BE NEEDED?

The current level of support in the area of urban fires is probably too low by a factor of 5, based on the number and competence of available persons, the urgency of the practical problems, and the state of understanding of principles. It is neither necessary nor desirable to staff a large Federal agency. Many projects can be contracted out to established organizations, using the Center for Fire Research of the National Bureau of Standards and strong university departments for building-related fire research; assigning to the New York (or other large) Fire Department responsibilities for equipment, tactics, and operations development; funding the National Fire Protection Association for statistics gathering and evaluation; encouraging universities and medical schools to teach fire science courses and train students; requesting the National Institutes of Health to study the treatment of toxic gas inhalation and burns; and employing not-for-profit establishments to undertake coordinated investigations on the causes, consequences, and prevention of fires. But it is important to have one central agen-

cy that can view the fire problem as a whole and can design, fund, and exploit strategies for its amelioration.

The public expects help from experts to reduce hazards (whether from natural causes or from human mishaps) and to apply solutions in practice when they promise clear benefits. In the 1950s, the Federal government was urged to play a more vigorous role in the fire field, triggered, in part, by massive forest fires that taxed the available resources and by concern about the protection of cities against destruction by mass fires, which became a possibility with the development of intercontinental ballistic missiles.

Initially, the National Academy of Sciences was asked by the U.S. Forest Service and by the Office of Civil Defense to enlist the help of the scientific community, which, with rare exceptions, did not appreciate that there were interesting problems to be thought about and solved. There was little concern then with the day-by-day “traditional” urban fire problems, even though they were present for everyone to see and caused by far the greatest fire losses to the nation.

That request resulted in the formation of the Committee on Fire Research of the National Research Council, spearheaded by Professors Hoyt C. Hottel (MIT) and Howard W. Emmons (Harvard). One of its first acts was to establish *Fire Research Abstracts and Reviews* in 1958. I was the editor of that publication for the first 6 of its 18 years existence (succeeded by my colleague R. M. Fristrom).

In 1961, an extended summer study was convened at Woods Hole, Mass., to survey scientific opportunities in the fire field and to give some thought on how to provide financial support, which was then almost nonexistent. It was proposed that a full-time fire group be established within the Federal government with primary emphasis on the urban fire problem. Neither the effort to establish that office nor the parallel effort to persuade skilled academic research workers to turn their attention to fire problems was successful.

However, 10 years later the National Science Foundation initiated a novel program, Research Applied to National Needs (RANN). Fire research (in addition to



the study of earthquakes, energy, tunneling, and other applied topics with a tie-in to fundamental principles) was an integral part of this forward-looking undertaking; the budget allocation was \$1.5 million. Harvard, the University of California at Berkeley, the University of Utah, and The Johns Hopkins University Applied Physics Laboratory became the four principal grantees.

When this part of the RANN program was terminated two years later and its functions and funds were transferred to the newly established National Fire Prevention and Control Administration, there was justifiable hope that the United States was on the verge of a sustained and fruitful path, with the enlarged Center for Fire Research at the National Bureau of Standards as the key Federal research agency.

Indeed, for a number of years there were spectacular developments. The Harvard group (along with the Factory Mutual Research Laboratory) made bold forays into the modeling of fires in compartments and buildings, laying foundations for a rational design of fire-safe structures. The University of Utah concentrated on the toxic products of combustion, which ultimately are the greatest danger to humans. The University of California pushed forward fire-test procedures to the point of representing real-life situations. The Center for Fire Research developed an impressive research and development program to provide better design standards.

APL's major contribution was a 7-year study on the causes and consequences of fatal fires in the State of Maryland. It was undertaken jointly with the State Fire Marshall's Office, with fire departments throughout the State of Maryland, and with the Johns Hopkins School of Hygiene and Public Health. This massive study was recognized worldwide for its path-breaking methodology and thought-provoking results.

By the end of 1979, APL was unable to maintain a research team of "critical mass" with the then-available funds and made the reluctant decision to leave the fire field. A promising extension of the Fire Fatality Study (with the participation of the Shock Trauma Center of the University of Maryland Medical School) to the treatment of serious fire injuries had to be abandoned. The publication of the bimonthly *Fire Technology Abstracts* that covered the worldwide technical literature in the fire field was stopped, as was research in the physics and

chemistry of ignition, fire suppression, and heat transfer. The skilled team was dispersed to other assignments. The cooperative network with the fire practitioners in the State of Maryland ceased to function.

Not much later, the Center for Fire Research found itself without direct budget support. It had to maintain its functions at a substantially reduced scale with the help of Congressionally mandated funds and with research grants transferred to it from other Federal agencies and from industrial and trade associations.

EPILOGUE

During my period of active involvement with fire problems, interactions with colleagues in other countries were vigorous. Since fire knows no national boundaries, all countries have developed strategies to minimize losses. Making allowances for differences in climate and living styles, we can learn much from an analysis of worldwide fire activities. Japan's success in maintaining an enviable record of relatively small losses, while at the same time profiting from the sale of useful products (such as control rooms that monitor the fire-safe status of high-rise buildings and provide rapid countermeasures during fire incidents) is an example of the benefits of an approach in which individual initiatives, community interactions, and enlightened public support reinforce each other to bring about desirable results.

In Madison's words, "The situation is too serious for despair." What lessons can be learned? In contrast to the 1950s when there were few capable people in research and practice who were willing to think deeply about fire research and technology, the situation at present is reversed. People in the fire service, in industry, and in design are aware of the benefits that could be achieved. What is needed is a consistent, steady, imaginative effort to formulate and support an extended Federal technical fire program.

It would be well to review the United States effort to solve problems that were so clearly visible in the 1970s but remain unsolved in the 1980s. Lessons can be learned from the fire-prevention efforts in Japan, in the USSR, and in other countries. What technical programs should be pursued with vigor? What danger comes from inaction? These are questions that test the will and desire of a nation to protect its people and its property.