Research on Fire Related Problems

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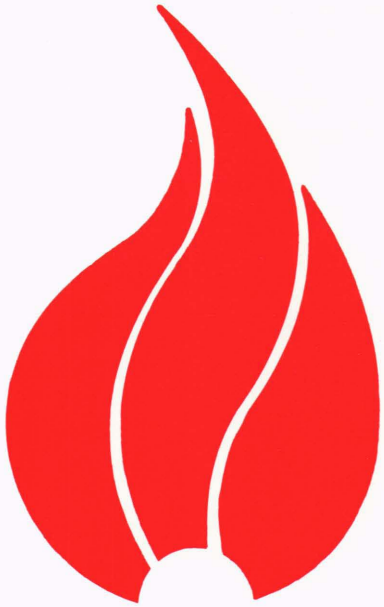

INTRODUCTION

UNWANTED FIRES—SMALL OR LARGE, TRIVIAL OR DESTRUCTIVE—are basically combustion processes controlled by the laws of physics and chemistry. Their qualitative behavior and quantitative description should be amenable to analysis and prediction. For example, suppose that the composition and placement of potentially burnable materials and furnishings in a room were known, as well as the nature of the ignition source and other relevant variables, such as the size and location of windows and doors. Should a fire start, one should be able to estimate how long it would be before the room or the structure containing it became unsafe or what measures would be required to stop it. Unfortunately, since the number of variables is so very large, one can, at best, furnish only rough answers in a few simple cases. Yet, in a narrow sense, the onset and the course of fires should be predictable. This, in turn, should provide guidelines for their prevention and control.

But an appreciation of their full social implications, particularly in urban settings, requires a broader outlook. It includes insights into the consequences of fires. What are the losses and why do they occur? It covers the techniques and tactics fashioned by the fire services to minimize damage. How well are countermeasures developed and how effectively are they applied? It deals with the training and equipping of hundreds of thousands of people who are needed to prevent or to extinguish fires. It involves the design skills of architects and products developers so that fires are avoided altogether or, at least, minimized when they occur. Not least, it requires an understanding of the behavior of people, as both the causes and the victims of fires, and of their actions and responses under stress. All these factors, and more, make up the intricate matrix of the fire field.

It may come as a surprise that only quite recently a federally funded research effort has been mounted to unravel this complex skein. Its size is modest when measured against the substantial annual losses from fires in terms of the number of people killed, seriously injured, or incapacitated and of valuable goods destroyed or damaged. Its budget is much less than 1% of the expenses spent by communities on protective forces that can be called on to prevent or suppress unwanted fires. Since 1970, the National Science Foundation, as part of its RANN (Research Applied to National Needs) program, has supported a number of centers throughout the United States in various aspects of fire research. The Applied Physics Laboratory was among the first grant recipients and has received substantial backing from this source ever since.

Recently, as the result of the National Fire Prevention and Control Act of 1974, the support function of this urban-oriented and people-directed research program was transferred to a new agency within the Department of Commerce. The National Fire Prevention and Control Administration (NFPCA), together with an expanded Fire Research Center at the U.S. National Bureau of Standards (NBS), has been given the responsibilities formerly carried by the National Science Foundation.

How many and what kinds of fires occur? What are the causes? Who is involved? Where are the hazards? How very little reliable information is at hand was shown by a recent National Household Fire Survey, conducted by the U.S. Census and involving 0.05% of all U.S. households. It indicated that one in every ten respondents had experienced a fire incident, but that fewer than one fire in 10 involved fire department help. Both results were unexpected. The very large number of fires (roughly estimated as more than 5,000,000 each year), their widespread occurrence, the numerous variations in causes, the difficulty of reconstructing the crucial events of initiation, propagation, and extinguishment, the contributions made by maladjusted people who, through arson and false alarms, nearly double the fire losses and fire departmental workloads—all conspire to make it difficult to achieve a reliable evaluation of the magnitude of the problem on a national scale. Comparison of results among different cities or regions is hampered by difficulty in acquiring data. Only in a few special areas (such as the number of fatalities that resulted as direct consequence of a fire or the per capita investment of a municipality in fire suppression activities) is it possible to draw valid comparisons.

Although there are large uncertainties in the statistical data, the human loss appears to have stabilized in the neighborhood of 10,000 to 12,000 yearly deaths in the United States with perhaps two or three times as many injuries that require extensive hospitalization and involve expensive, traumatic recoveries. The direct economic losses are estimated at $2 to 4 billion/year, with two or three times as much outlay on prevention forces, insurance charges, code compliance, and other indirect costs. Despite substantial investment in fire-fighting forces, the U.S. fire loss record rates high in comparison with other countries in terms of per capita fire fatalities or other measurable criteria (Table 1). It is not clear whether this unhappy record is the result of a more thorough data collection system, an inordinately large number of potential ignition sources and fuel supplies, or inadequate public understanding of the elements of fire prevention.

TABLE 1

FIRE LOSSES FOR U.S., UNITED KINGDOM, AND USSR

	U.S.	*United Kingdom*	*USSR*
Fires Responded to by Fire Service (per 1000 population)	4.5	3.1	0.16
Property Losses (per 1000 population)	$20,000	$2,500	$125
Life Losses (per million population)	50	12.6	1.2

From a multitude of choices, the research effort at the Applied Physics Laboratory covers four specific areas in which substantial contributions could be made, both to fundamental understanding of fire behavior and to practical implementations that would reduce fire losses. The four areas of primary interest are:

I. Fire Casualty Studies
II. Combustion Research
III. Systems Analysis and Development
IV. Information and Education

In order to carry out these tasks, a number of collaborative efforts (primarily with the School of Hygiene and Public Health of The Johns Hopkins University, SHPH/JHU, and with fire and health agencies in the State of Maryland) were instituted. Close working relationships with organizations charged with the day-by-day tasks of public fire protection makes it possible to relate the APL program to realistic conditions. It permits a rapid transfer of new insights and devices into the fire service, testing their value and effectiveness on the fire scene, and speeding up their adoption.

Work accomplished in the four areas of interest listed above is discussed in detail in the following sections.