TEXTILE FLAMMABILITY CONFERENCE

October 2-3, 1962

Edited transcript of two-day conference held at Boston, Massachusetts, October 2-3, 1962, under the joint sponsorship of the National Fire Protection Association and the U.S. Public Health Service of the Department of Health, Education and Welfare. The Conference reviewed the effects of textile flammability on the records of fires and fire casualties and discussed possible solutions to the problem. The papers presented and the discussions are summarized here. Transcripts of the meeting are on file at the headquarters offices of the sponsors.

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Morning Session

INTRODUCTORY REMARKS

Charles S. Morgan, Conference Chairman

Assistant General Manager

National Fire Protection Association

The problem under discussion is by no means a new one. The July 1861 issue of Scientific American carried the following statement. "The public has been painfully startled by the death of Henry Wadsworth Longfellow's wife which occurred in Cambridge on the 10th instant. Mrs. Longfellow was seated in her library and was in the act of making seals with sealing wax. A bit of paper caught fire and before the blaze could be contained she was painfully burned. The dresses commonly worn by women in warm weather are composed of muslin and such like flammable materials. Although we have urged the preparation of ladies' dresses with nonflammable material we trust that the subject of safety clothing will receive more attention from ladies. Their own sense demands this." It will be noted that the writer of this item in Scientific American one hundred years ago recommended the use of nonflammable clothing to prevent such accidents. It will be interesting to see whether this Conference will also suggest reduction in textile flammability as the most practical solution or whether some other answer to the problem now appears to offer a better chance of success.

Percy Bugbee, General Manager

National Fire Protection Association

Early in 1962, Dr. A. L. Chapman, Assistant Surgeon General, and Chief, Division of Accident Prevention of the U. S. Public Health Service, expressed great interest in the subject of textile flammability and a desire of the U. S. Public Health Service to participate jointly with the National Fire Protection Association in a discussion of the subject. Since the NFPA has been working toward solutions to this problem, both through the development of technical fire protection standards and through public education, the Association welcomed the opportunity that would be afforded by this Conference to exchange ideas, describe current efforts to reduce the frequency and severity of fires and fire casualties attributed to combustible textiles, and to explore the possibility of a more effective approach to the problem.

[For the benefit of those at the Conference who had not previously become acquainted with the NFPA, Mr. Bugbee described the history of the NFPA, its purposes, membership, and activities in the field of fire protection and fire prevention. A brochure describing the National Fire Protection Association is available from the Association's executive offices, 60 Batterymarch St., Boston 10, Mass.]

A working conference of this sort is completely in accord with NFPA traditions. The Association has long served not only as a worldwide clearing house of information on fire protection and prevention, but also as a meeting place where divergent views on fire problems can be aired, where a better understanding of the needs and objectives of all interested parties can be fostered.

William V. White, Chief

Family Safety Branch, Division of Accident Prevention

Department of Health, Education, and Welfare

When the U. S. Public Health Service was founded in 1798, its first mission was to provide hospital service for merchant seamen. Later activities included quarantine service, communicable disease control, research, mental hygiene, and many others. As scientific methods were applied to disease control, a marked change in morbidity and mortality figures was observed. Today, accidents are the fourth leading cause of death in the United States. Accidents are the first cause of death to persons from age one through age 35—the most productive segment of our population.

The number of fire deaths is exceeded only by the number of deaths from falls and motor vehicle accidents. Nonfatal fire injuries require a staggering amount of medical care and rehabilitation. It is felt that the same scientific principles that were used to reduce the incidence of disease may be used to reduce the incidence of accidental injuries.

Four years ago the Public Health Service, in cooperation with the Arkansas State Health Department, assigned a public health representative to the local health department in Blytheville. He was charged with three assignments: to establish a reporting system from hospitals, clinics, and physicians for fire injuries requiring medical care; to undertake epidemiological investigations of every fire and explosion that occurred in the county; to develop, implement, and evaluate a fire injury prevention program based on these findings. To perform his mission, he first established a good working relationship with the local fire departments, school authorities, and other interested community groups. His activities were not designed to replace any existing efforts by fire authorities in the community but were supplementary to these efforts. The weight of the health department was added to the total push on fire injury prevention.

He established a baseline for fire injuries by developing a basic reporting system. Overloaded electrical wiring and defective equipment were found to be the largest cause of fire incidents. Another cause of many fires was faulty and defective flues. The big offender in terms of fire incidents, injuries, and deaths was the misuse of petroleum products.

Through the application of a saturation-type community education program, the number of fire injuries requiring medical care was reduced by more than fifty per cent. Principal components of this program are being applied state-wide in Arkansas this year.

A new program to reduce burn injuries, particularly to children, is a special Public Health Service Project in Robeson County, North Carolina. The State Health Officer of Misssissippi has requested and been assigned a full-time representative by our Division to develop local health department support for a fire injury reduction program. In the greater Cleveland, Ohio, "Blueprint for Life" program and in our Shenandoah Valley, Virginia, study, the rate of fire injuries was favorably altered by educational methods.

Capitalizing on this experience, we have just signed a letter of agreement with the State Health Officer in Rhode Island to implement a special three-year fire prevention and poison control project.

This year, the Public Health Service produced a series of "Seven Films for Safety." One of these, "Why Daddy ?"was produced in cooperation with the National Fire Protection Association.

The sincere interest of the Public Health Service in reducing fire injuries is shown by its joint sponsorship of this Conference on Textile Flammability. The Division of Accident Prevention is not a technical resource on fire prevention. It is seeking information and guidance from the competent authorities represented here today. This information will be used to guide and promote program activities in state and local health departments, to provide subject material for films and exhibits, to stimulate basic research and community demonstration projects. The ultimate goal, of course, is to reduce significantly the number of injuries and deaths due to fire.

Fabrics that will not support combustion, that have a good "hand," that perform well, are attractive and modestly priced, apparently are a future possibility. Various interests are competing to achieve this goal.

How far away is it? Where will the technical answers to the problem be found? Can the fabric be produced by existing mills? How can a demand for the product be created so that volume can be increased and the price correspondingly reduced? What is the timetable for reducing fire injuries by implementing the use of flame-retardant fabrics? These are just a few of the problems to be discussed at this meeting.

THE FLAMMABLE FABRICS PROBLEM

A REVIEW OF THE PROBLEM

Louis Segal, Deputy State Fire Marshal

State of California

As Mr. Morgan has indicated, the flammable fabrics problem has a long history. Efforts to control the hazards associated with these materials cover a much shorter period and, in the case of wearing apparel, may be said to have first received widespread attention in 1945. That was when a popular boys' costume—cowboy chaps made from a fabric with a very long pile surface—was sold throughout the country in large numbers. Shortly after these dangerously flammable garments reached the market, reports began to come in of boys who were burned, and in some instances, lost their lives, in fires involving these cowboy chaps. One particular incident in Washington, D. C., in which three boys wearing these costumes burned to death and several others suffered nonfatal injuries, created a great deal of publicity throughout the country. The lawsuits resulting from fires involving this particular item of wearing apparel ran into the millions of dollars—a costly lesson!

In 1951, the so-called torch sweaters created even greater publicity. These were sold all over the country by the millions and, as in the case of the cowboy chaps, consisted of a piled rayon fabric.

It was also in 1951 that the NFPA Committee on Wearing Apparel was organized. Since that time, practically all of the efforts of this committee and of other interested groups have been directed toward development of a standard that, by measuring the relative speed of burning of fabrics, will provide a means of identifying dangerously flammable clothing. Standards have been developed both by the textile industry and by the NFPA; but despite this work, no measurable reduction in the number of wearing apparel fire casualties has resulted. It is obvious that the problem cannot be solved by setting up standards and drawing a line between "safe" and "dangerous" flammability where it will do any good. Investigations of clothing fires show that almost without exception clothing of ordinary combustibility was involved. If a law were enacted to take this type of clothing off the market, the public would be walking around in rain barrels.

In regard to textiles used for draperies and other decorative purposes, this problem is not so great as in the case of wearing apparel. There is evidence that due to the marvels of chemistry, it will be possible within a few years to eliminate decorative materials, at least in public places, that create any kind of fire hazard. Synthetic fibers are now in existence that are inherently nonflammable and that show promise of satisfying other requirements for decorative fabrics.

In the apparel field, synthetic fibers both solve and create problems. Many synthetics are flame resistant, others are slow burning. Unfortunately, however, some of the synthetics possess the dangerous property of melting when exposed to heat. In a typical wearing apparel fire, ignition of a natural fiber outer garment may cause undergarments of acetate or nylon to melt and greatly aggravate the type and severity of the burn injury. Strangely enough, had the position of the fabrics been reversed, that is, synthetic outer garments and natural undergarments, there might not have been a fire.

One final thought that should be injected into this brief review of the flammable fabric problem is that no fabric, by itself, will ignite, there must be a source of ignition. Thus, an important part of the solution of the wearing apparel fire problem is the elimination of sources of ignition. Many clothing fires are started by unsafe heaters. The use of such heaters should be forbidden by law.

WEARING APPAREL FIRE RECORD

Chester I. Babcock, Assistant Technical Secretary

National Fire Protection Association

One might hazard a guess—and please don't quote these guesses as NFPA estimates—that about 2,000 people are burned to death annually in wearing apparel fires, and perhaps as many as 300,000 others suffer nonfatal burns. These may be somewhere near the actual figures or as much as 50 per cent off. In any case, the number of wearing apparel fire casualties is much too high and more effort should be made to reduce it.

As undoubtedly will become apparent as this meeting progresses, the answer to the question "What can be done?" is not a simple one. However, two or three specific conclusions that may point to a solution to the problem can be drawn from a recent study of wearing apparel burn cases. The study consisted of an investigation of approximately one hundred wearing apparel burn cases that required hospital treatment, and was undertaken jointly by the Accident Prevention Committee of the American Academy of Pediatrics and the NFPA Wearing Apparel Committee. Obtained in each case were a description of how the accident occurred, an indication of the extent of the injury, and a sample of the clothing that was actually involved.

The objective of the study was to determine whether the textiles involved had any unusual burning characteristics.

If anyone had a preconceived idea that the fabrics were highly flammable, the results were surprising. The study was begun using the Commercial Standard test method—the method now used by the Federal Trade Commission in enforcing the Federal Flammable Fabrics Act. In this method, a sample is suspended at a 45^{o} angle and a small test flame is brought in contact with the sample near its lower edge for one second. Then the time required for the flame to travel five inches is measured. In the first ten tests, using the one-second standard ignition flame exposure, six samples did not ignite, one ignited but immediately went out, and only three ignited and burned. Since this momentary exposure was not sufficient to allow the observation of burning characteristics, the exposure period was adjusted. In the remaining tests, exposure of the sample to the test flame was sustained until ignition occurred. The exposure periods required for ignition ranged from 2 1/2 to 5 seconds.

In the Commercial Standard method of testing, a fabric is said to have normal flammability if a flame takes more than 3 1/2 seconds to travel 5 inches along a sample. In the first ten samples tested according to the revised method (i.e., the test flame was held against the sample near the lower end until the sample ignited), it took from 18 to 74 seconds for the flame to travel the five inches. Certainly, these samples could not be classified as dangerously flammable by any reasonable standard. The ten fabrics tested were cotton knits, cotton flannels, twills, corduroys, and mixtures of nylon and cotton, and were typical of the fabrics involved in the other cases studied. These fabrics did not burn with great speed, yet they sent ten people to hospitals for treatment of burns.

In not one instance did a fabric burn so fast as to be classified as dangerously flammable. In fact, 109 of the 120 different clothing samples tested did not ignite with the one-second flame exposure test. A proper conclusion, therefore, from these tests is that fabrics which cannot be classified as dangerously flammable by any stretch of the imagination are responsible for most burn casualties.

So much for the principal objective—determining the flammability of fabrics involved in actual burn cases. There were some other results of this study that should be mentioned.

How did these fires start? The most frequent ignition source was the gas stove. Victims of fires from this source were boys and girls standing with their backs to the stove with their shirt tails out, women working around stoves with kimono-type sleeves, and children playing around stoves. Electric stoves were also a common ignition source with ignitions occurring in much the same fashion as with gas stoves. Clothing ignitions from children's playing with matches or cigarette lighters were also frequent. Smoking in bed was another way in which clothing became ignited. Practically any ignition source imaginable was represented—a child's sleeping attire was ignited when she stood with her back to a fireplace; fuel oil that spilled on a man's shirt ignited while an oil stove was being filled.

There is nothing mysterious about the cause of any of these wearing apparel fires. They were due to carelessness or to a lack of awareness that a hazard existed. So, another conclusion from these tests is that carelessness on somebody's part or, in some cases, ignorance of the hazard, was a factor in just about every instance. Two exceptions were women who tried to commit suicide by igniting their clothing.

A third conclusion from these case histories is that the design of the garment sometimes is directly responsible for the ignition. The loose-sleeved housecoat above the stove, the full skirt, loose-fitting blouses—these are often involved in wearing apparel fires.

Finally, there is the age of the victims. It has long been known that children and elderly people account for more than half the fire casualties. The same was true in this sampling of wearing apparel burn cases. Children ten years of age and under accounted for 43 per cent, and people over 65, for 10 per cent.

To summarize, four logical conclusions can be reached from a study of these incidents: 1. the textiles involved cannot be classified as dangerously flammable; 2. the causes of these fires reflect great carelessness or lack of awareness of the possibility of clothing ignitions; 3. the design of garments is a factor in some fires; 4. children seem particularly prone to ignite their clothing accidentally.

FIRES INVOLVING NONCLOTHING FABRICS

Rexford Wilson, Fire Record Editor

National Fire Protection Association

There are two basic ways in which textiles are used in buildings—as hanging textiles and as coverings for furnishings and floors. Fire experience has shown that presently-used textile floor coverings do not affect to a significant degree, fire severity in buildings. On the other hand, hanging fabrics and coverings for furniture do have a marked effect on building fires.

Hanging textiles, i.e., curtains, tapestries, cubicle curtains in hospitals, wall coverings, can greatly increase the initial rate of fire spread. Large cloth panels, often with both surfaces exposed to air, can create a very rapidly spreading fire. Burning hanging textiles often generate intense heat that is sufficient to ignite other combustibles. The panic that is apt to result at the sight of a rapidly spreading sizeable flame is another hazard of hanging fabrics.

The following brief summaries of actual fires illustrate how hanging fabrics affect fire behavior in buildings.

A furniture store installed new floor-length draperies in one of its show-window displays. Unknown to a workman, his ladder had damaged the cord to a bedside table lamp in the display. The workman finished and left. At 7:00 p.m., an automatic timer turned on the display lighting. The cord short circuited and sparks ignited the drapery nearby. As a salesman in the nearly empty store grabbed a portable extinguisher and ran toward the show window, flames burst up the curtain, driving him back. The flames from the curtain ignited the combustible acoustical tile ceiling and spread rapidly across the first floor of the store.

Two vigil candles flickered on the altar of this unoccupied church building. The fabric hanging on the wall behind them ignited. Flames spread up the fabric surface, igniting other combustibles nearby. The fire was discovered shortly thereafter, but had made such headway that the church was completely destroyed.

In preparation for a dinner, draperies had been hung from the 25-foot-high balcony in the gymnasium of an athletic club. The draperies, 18 inches out from the wall, covered the entire 50 ft. by 90 ft. room, from the balcony to just above the floor, except for the doors. The gym was located on the second floor of a five-story building. Beside the gym an open stairwell led to the top floor.

As workmen were completing the last of the decorating, spotlight placement, and sound installation, a short circuit in temporary wiring ignited one corner of one curtain. One workman ran down the stairs and rang the building's fire alarm system. The other men looked around for extinguishers, which were hidden from view by the curtains. Fire spread across the surface of those curtains so quickly that they were forced to flee for their lives.

Smoke and heat poured up the open stairwell. Three building occupants raced for their rooms to get valuables. A maid fled upward to the fifth floor and in panic, sought shelter from the thickening smoke in a linen closet. Others ran into the adjoining building which was cut off from the involved structure by a masonry wall and fire doors. Smoke grew so thick in the adjoining building that several men were forced to climb down an outside drain pipe. In the building of origin, the three men in their rooms, and the maid in the closet, were asphyxiated. Sixteen other persons were seriously injured.

In the Melody Lounge in the basement of the Cocoanut Grove Night Club, combustible fabric and decorations covered the walls and ceiling. Most exit doors were locked or barred. For the staff it was a night like 5,000 other nights until just after 10:15 p.m. Combustible artificial palms in the basement Melody Lounge were ignited, possibly by a match flame, and flames ignited the fabric ceiling. As the fire raced across the fabric ceiling, a puff of heat surged up the stairway. The crowd of 1,000 in the club pushed for the exits. Like meat in a grinder, half were squeezed or pushed, or groped their way out alive. About 200 of the 492 who lost their lives in the fire piled up behind a revolving door. Another 100 piled up against a door swinging against the route of exit travel.

The fire behavior of fabric used as covering is quite different from that of hanging fabric. Fabric used as a covering is often horizontally positioned, near the floor. When it comes in contact with a cigarette, sparks from an electrical short circuit, carelessly dropped match, or some other ignition source, a smoldering-type fire is apt to be the result. Such fires generate their heat over a long period of time. Thus, the heat dissipation from the material to the room and from the room to the outside is very good, and the rate of temperature rise within the area can be extremely low, perhaps as low as five or ten degrees over a two- or three-hour period. While this smoldering fire does not generate much heat, it does consume oxygen from the surrounding atmosphere; it does generate copious quantities of noxious smoke and toxic gases. The combination of the reduced oxygen level and the toxicity of the products of combustion has been the cause of a great many fatal fires in homes.

Here are a few reports of fires involving fabric covering material.

From the evidence at hand, fire fighters were able to reconstruct the probable sequence of events which led to this tragedy. The husband was away from the house on duty as an intern at a local clinic. His wife was last seen, by a neighbor, working in the laundry room in the basement shortly before midnight.

Between that time and time to give the baby its 2 a.m. feeding, she sat on the sofa in the living room, smoking and possibly watching television. While there, a spark or a lighted cigarette fell on the sofa unnoticed. She gave the baby its regular feeding, left him sleeping in his carriage in the living room, and retired.

The smoldering fire developed in the sofa, eventually burning through and causing burning embers to fall on the rug beneath the sofa. The lethargic burning continued until the fire had slowly eaten its way through the floor and into the baseboard at the wall behind the sofa. Heat and smoke spread throughout the entire house.

Sometime between four and five o'clock, the mother of the three small boys awakened in the oxygen-starved house. She struggled out of bed, knocking over a lamp on a bed table as she attempted to get her bearings in the thick smoke. She succeeded only in getting the telephone off its cradle before losing consciousness. Apparently, the five-year-old boy awakened moments later and went to his mother's bedroom where he, too, collapsed. The 2 1/2-year-old's body was found in his crib in the bedroom from which his brother had come, and the baby's body was in the carriage in the living room downstairs.

Shortly before 6 a.m. a neighbor noticed smoke coming from the dwelling and telephoned the fire department. Upon arrival, firemen found the house completely charged with heavy smoke and heat. They were repeatedly driven back in their attempts to gain entry until windows were broken to provide ventilation. Although the entire interior of the house was blackened from smoke and the coroner set the time of death at one to two hours before the alarm, the actual fire was confined to a small area around the sofa in the living room and the basement ceiling.

A resident's smoking in bed was reportedly the cause of a ninth-floor fire in a 500-room fire-resistive hotel. A woman in the apartment directly above the room of origin smelled smoke, and called the manager who activated the alarm system. The system rang bells on each floor and transmitted an alarm directly to the fire department. Approximately 400 guests began escaping safely, both by stairtowers and elevators. Fire fighters climbed to the eighth floor, attached to the standpipe there, and proceeded to the ninth floor. On opening the fire door to the ninth-story hall, they were greeted by a blast of hot gas which fatally burned one of them.

Two guests in a ninth-floor room were asphyxiated and the resident of the room of origin died though he was alive when rescued.

A 50-year-old woman patient received fatal burns at a hospital when she attempted to smoke a cigarette in an oxygen tent. She obtained the smoking materials from her handbag on the bedside table. On noticing smoke coming from the room, a nurse looked in and saw the fire. She notified the switchboard operator, shut off the oxygen, and smothered the fire with blankets. The sheets and blankets on the bed were destroyed.

In summary, textiles used in buildings can be generally classified either as hanging textiles or as covering textiles. Both uses of textiles present, in general, different but equally hazardous conditions: one of extremely rapid, panic-creating fire spread, the other, of extremely slow, oxygen-robbing, gas-generating fire spread. Both conditions can lead and have led to severe loss of life.

DATA ON BURN INJURIES

Edward S. Sands, Assistant Chief

Family Safety Branch, Division of Accident Prevention

U. S. Public Health Service

Burn injuries represent a problem, not only to those in the field of safety and accident prevention, to the medical profession, and to the casualty insurance industry, but to all people.

In one decade (1940-1949), according to proceedings at the First International Congress on Burns, held in Washington, D. C., in 1960, 80,000 people died from burns in the United States and $625 million was spent for the hospitalization of burn victims.

Data from the U. S. National Health Survey indicate that in the year ended June 1959, there were 1,878,000 burn injuries, 929,000 of which occurred in the home. These were serious enough to be medically attended or to cause at least one full day of restricted activity. In the year 1959, there were 70,000 who required hospitalization.

Fire and explosion is one of the most common fatal accidents among children and the elderly. Children under 15 years of age (31 per cent of the population) experience 29 per cent of the deaths from fire and explosion; persons over 65 (9 per cent of the population) experience 28 per cent of deaths from fire and explosion; accidents in the home are responsible for more than three-fourths of all deaths from fire and explosion.

About 13 per cent of deaths, according to a study of Metropolital Life Insurance Company claims records of policy holders, was attributable to clothing's being ignited while a person was working at a stove, or standing or walking near a fire. (Stat. Bull., Oct. 1960, Met. Life Ins. Co.)

Twelve cases of accidental burns to children, caused by fire and explosion, have been investigated in St. Louis as part of an over-all accident prevention program in 1961. In seven of the twelve cases, the clothing of the children caught fire and either caused the injury, or increased the severity of the injury.

Reporting on causes of burns among 77 patients, Griswold has noted that 13 per cent were caused by smoking in bed or chairs. He states in his paper ("Treatment of Burn Cases," Martin L. Griswold, Jr., M.D., J.A.M.A., Vol. 164, No. 8), "It is doubtful if much attention is paid to the flammability of fabrics when they are purchased by the average housewife. I recently discussed the problem with the head of a large textile company, and the fact was brought out that there is very little demand for fire-resistant fabrics and that much more could be done in the way of coating fabrics to reduce the spread of the flame. Some children's costumes have been banned after the children have been burned, thus bringing the matter to the attention of the lawmakers. These accidents have usually happened because there have been open candles at parties. Untreated cotton is one of our most highly flammable fabrics and is the material used almost universally in such common articles as bedsheets and shirts.

"In general, flame will travel rapidly from the point of ignition on any cotton or linen fabric. Wool, nylon, and Orlon will only burn at the point of contact and are, therefore, quite fire resistant. Silk and rayon are less vulnerable to fast burning than is cotton or linen. We are certainly not going to exist without using fire, and the above discussion suggests one avenue that we can pursue to reduce the destruction."

Investigation of thirty home accidental deaths due to fire and explosion over a four-year period, 1954-58, in Colorado, in age group 65 and over, revealed that 23 per cent involved ignition of clothing; 17 per cent involved falling asleep in bed or in a chair while smoking.

In a paper prepared by Leonard Colebrook and published in the Bulletin of the New York

Academy of Medicine, July 1951, the author writes, "From all these sources I have gained the impression that the factors responsible for domestic burns in the United States vary somewhat widely in the different regions. Thus, in New York I was told that many serious burns were due to the ignition of clothing by gas cooking stoves. In other cities, where natural gas is not available, I gather that the same accident is more often due to mishaps with kerosene stoves.

"By and large, however, it appears that the problem is similar in our two countries. Flame, in one form or another, is the immediate existing cause of the most severe burns. In the series of 1,000 consecutive burns and scalds reported by Hoffman from Chicago, no less than 379 burns were attributed to flame. And of the 568 fatal burns and scalds analyzed by the Tennessee Department of Health (1939-43) no less than 292 were traced to an "open grate" or a stove.

"Summarizing the information I have obtained, the predominant causes of burns in the United States appear to be: gas and kerosene stoves, and open grates burning wood or coal; careless use of kerosene for lighting or reviving fires; careless use of flammable liquids, e.g., for cleaning clothes; matches and cigarettes, especially in bed; firecrackers; fireworks, and trash fires; hot fat and hot metals; chemicals; electrical burns.

"In the first four categories, the actual injury was usually caused by the ignition of clothing."

Hospital admissions for accidental burn injuries at a hospital in a southern rural county, for the period 1957-1961, show that 44 cases of 118 involved clothing's coming in contact with fire. Almost all cases involved young children or elderly people.

At a hospital in a southern city, a total of 457 children, ranging in age from 6 months to 16 years, were seen during the period 1921-1953 for treatment of full-thickness burns. Of these victims the 414 admitted for treatment accounted for a staggering total of 90,992 days at a cost of $545,942. The cause of burns in 46 per cent of the cases was ignition of clothing.

It would appear that burn injuries in which the ignition of clothing or bedclothes was a factor represent a significant part of both the burn injury problem and the total fire prevention problem.

To me, a burn injury represents one of the most painful and destructive types of injuries, which is good reason for taking constructive and practical action to correct the problem.

The Public Health Service is concerned with burn injuries and deaths for still other reasons. Besides being concerned with improving the health of the people and maintaining good health, it is concerned with reducing the cost of medical care, the cost of time lost, over-all costs which result from fire. Fires and burn injuries involving ignition of fabrics represent a specific aspect of the total problem. A significant breakthrough concerning this aspect would be most meaningful.

Action that is taken must be multilateral and have the cooperation of all parties—members of the business community, private agencies, and government—to be successful.

DISCUSSION PERIOD

Mr. Louis Segal: I would like to correct Dr. Griswold's statement as quoted by Mr. Sands, to the effect that rayon is less flammable than cotton. This is not true; rayon is as flammable as cotton.

Mr. Hans Grigo: What is a full-thickness burn?

Dr. Robert H. Kennedy: There are three types of burns: One, known as a first degree burn, is simply a reddening or possibly a blistering of the skin; one removes part of the skin's thickness and is known as a second degree burn; one, known as a third degree burn, destroys all skin in some parts and everything may burn, even down to the bone.

(Dr. Robert Trimby distributed photographs of patients with third degree burns.)

Dr. George M. Wheatley: The attendance here is an indication of how delighted we are at the leadership which the NFPA and the Public Health Service have taken in this problem. Some of us have been interested in it for many years and think this is a high water mark in this whole effort. We are looking forward to the outcome of this discussion.

Mr. Louis Segal: People continually come to my office to relate burn experiences. More often than not, they are attorneys who are considering filing suit for a client. Almost invariably the reaction of either the victim or a witness is that the article involved was practically explosive. From my own experience, I doubt that this is true. In all likelihood the garment was completely normal as far as flammability is concerned. Tests have confirmed this opinion. The public is so totally unaware of how fabrics burn that when something ignites, the fire is erroneously described as "explosive." Very often the newspapers use the words "extremely flammable, unbelievable, explosive." Take this with a grain of salt.

VIEWPOINT OF THE COTTON TEXTILE INDUSTRY

George S. Buck, Jr.,

Assistant to the Executive Vice-President

National Cotton Council of America

The Cotton Council is a central organization of the cotton industry, representing producers or growers and the intermediate groups of ginners, warehousemen, seed crushers, raw cotton merchants and spinners or mills. The Council has a staff of about 175 with offices in Memphis, Washington, New York, Paris, and Brussels.

The cotton industry is greatly interested in textile flammability since cotton is involved in a good many burn casualty cases. There are two reasons for this involvement. First, like many fibers, cotton is not only combustible but can be manufactured in relatively thin and flexible forms which lend themselves to ignition. Second, cotton is still the most widely used textile fiber and far exceeds all others combined in volume of consumption. Cotton has many uses as hanging or covering materials, as well as clothing. The cotton industry's concern with textile combustibility is long established. When I started in the industry as a chemical engineer twenty-seven years ago, there was interest in making fire-resistant fabrics, mainly for industrial uses. Early work was done by Clayton and Heffner, followed by the work of the Quartermaster Corps, and more recently followed by work at the Southern Utilization Research and Development Laboratories of the U. S. Department of Agriculture. Over the years there has been steady progress by the industry and by groups affiliated with or working with the industry, towards making textiles safer.

The point has been brought out that there has been progress in making cotton and other fabrics completely fire resistant; but the problem is far from being solved with complete satisfaction as far as fabric properties and cost are concerned.

One of the barriers to extensive use of flameproof fabrics is that consumers simply do not have enough interest in them or, perhaps, do not feel they can afford them. Ten or eleven billion yards of cotton fabrics are used in this country every year. If these were all flameproof, if the present finishes were entirely adequate from the standpoints of comfort, durability, attractiveness, etc., the consumers' bill for these fabrics would be approximately $2 billion to $5 billion more annually. I submit that consumers are not willing to pay that bill yet.

The cotton industry has worked very closely with fire protection people for many years. It cooperated in the development of the commercial standard which was designed to rule out unusually combustible fabrics such as pyroxylin-coated goods and the materials used in the flammable cowboy chaps and "torch sweaters" previously referred to. Neither of the latter articles, incidentally, was made of cotton. The industry has continued to work to improve the Flammable Fabrics Act and continues to be interested in research on better fire-resistant finishes.

This problem by no means pertains only to cotton. Many synthetic fibers, when combined with other materials, will burn quite readily. For example, nylon doesn't burn easily by itself; but when it is combined with a completely fire-resistant fabric like one made of glass fiber, it burns readily. Wool is a very good fiber from the standpoint of fire resistance; but wool, like many of the synthetics, is not adaptable to the requirements of consumers for comfort, durability, economy, the passage of vapor, and for a good many other properties. These are the properties the public demands.

A comment about the professional textile finisher is in order. The finishing industry should be looked to for materials that will do a better job of flameproofing and that will be otherwise acceptable; but one should not be misled by a finisher who has an interest in pushing one or another finish. There is not now, in my opinion, a fully satisfactory fire-resistant finish for textiles, satisfactory from the standpoint of cost or performance.

A word should be said about the fanatic. For a good many years, the textile industry was faced with people who wanted to do good, but whose approach was entirely unreasonable and fanatical. They first wanted to rule out all textiles that burned. Then they wanted to put all kinds of unreasonable limits on burning time. They wanted to insist on fire-resistant treatments when there were none. They wanted to use fibers that were unsuitable and unacceptable to consumers.

It is gratifying to be able to report that since 1945, there has evolved a more reasonable attitude toward fabric flammability on the part of people interested in fire safety. I think the NFPA and its committees typify the better understanding that has pervaded this whole atmosphere in fire safety. It is very refreshing and will probably result in a great deal more progress through cooperation.

What can be done about the problem? The cotton textile industry is as concerned with this as anyone. We think that the educational approaches which have been discussed in NFPA are perhaps among the best. If people under-

stand that it is the normal property of almost all textiles to be combustible, if they understand that the materials they play with rather carelessly sometimes—matches, open fires, cigarettes, and so on—will cause serious injuries, perhaps the number of injuries and deaths can be reduced.

It is not fair to point the finger at textiles entirely. People have said, partly in jest, that if this were a different type of country, one where someone could dictate what is done, it might be wise to require that all textiles be fire resistant. I submit that it would be just as reasonable to require that no flammable liquids be used. It would be more reasonable to require that people not smoke because smoking and the matches and lighters that are used in smoking cause a great many fires.

As we go ahead, let us keep this whole subject in perspective. Through education and through research on fire-resistant finishes, we can, if not solve the problem, make real progress toward reducing the number of wearing apparel fire casualties.

VIEWPOINT OF THE WOOL INDUSTRY

Dr. H. J. Wollner, President

A. C. H. Fiber Service

I wear three hats. One hat associates me with wool. Another associates me with industrial consulting and a laboratory service for the textile industry here and in Europe. The third hat represents an intimate relationship and long background of experience is administering laws and regulations which are based upon data, tests and conclusions through research.

The wool hat which started out very large this morning has become smaller and smaller with the help of the information which has been submitted, for example, information in the report distributed by Mr. Babcock that wool is not too frequently found among the fibers worn by individuals who were involved in burning accidents.

It is neither pertinent nor helpful, neither progressive nor moralistic, to suggest that there are some fibers that are more dangerous as garments, more dangerous in tapestry form, more dangerous as carpets and coverings than other fibers. It would, however, be inconsistent with understanding to say that all fibers were the same. This document distributed by Mr. Babcock seems to indicate that wool apparently is less frequently involved in burn casualty cases than other fibers.

As an American citizen, I am quite concerned with getting people cogently, fervently, avidly interested in their own good. During ten years' service in the Treasury Department, I had intimate contact with law enforcement involving narcotics, alcohol, smuggling, and the like. I went away from this experience with a profound respect for the old adage that if you want a donkey to move from here to there, you need a stick and a carrot; and if you fail in having both the stick and the carrot, you have possibly lost control of your donkey.

In the administration of laws, it must be recognized that the mere statement of a truth, legally or by regulation, provides no assurance that the emotions of the individual will be sufficiently strong to keep him from being seduced by the competition between what he likes to wear and the fear of some damage which may come to him if he does wear it.

To be asked to advise industrial people what to do about the fabrication of a piece of material and the fibers which should go into it, and the kinds of claims they can make for it, causes one to pause and reflect on the problem. There always is the lady who wants to wear something flimsy—regardless of whether it is highly flammable—to make an impression.

I am convinced that the advancement of the idea that fire-safe wearing apparel is desirable must accompany any rule or regulation. The textile industry can be relied upon to move in the direction of the carrot, but the carrot must be an image in the eyes and minds of our people.

Of a dozen people with whom I discussed this meeting, none of whom had any technological background, all indicated that it would be distasteful to be limited in the kinds of fabrics or garments they could buy. Even though there was reason to expect that they were acquainted with the problem through experience, they were not responsive.

In summary, the problem confronting us today has nothing to do with the qualities and characteristics of wool, nor does it involve a choice of cotton, or nylon, or wool, or cashmere. The problem lies not so much with the flammability of textiles as with lack of public awareness of their flammability and lack of an instilled desire for protection against the hazard.

Mr. Witt Langstaff: Can fabrics be made with wool, all wool, for use in vertical draperies, which will pass the stringent NFPA test without chemical finishes?

Mr. Louis Segal: While wool is highly flame-resistant in its natural state, it is not quite resistant enough. It will ignite and burn very slowly and then go out by itself. From a strictly life-safety view, I would think wool is completely acceptable in this regard; but the standards have been set so that wool, while comparatively nonflammable, requires flame-retardant treatment.

Mr. Burruss B. McGuire: Mr. Buck, with regard to flameproofing cotton fibers, did you say there are roughly 10 billion yards of cotton fabrics sold annually and it would cost from $2 million to $5 million to make that flame retardant?

Mr. George S. Buck, Jr.: That is what I said. The cost of applying a fire-resistant finish may vary from a possible low of five cents a yard up to twenty cents a yard or more, depending on the type of finish, the weight of the material, and so forth. A kind of cost pyramiding goes on throughout the textile industry: the cost of the fabric is raised a certain amount by the converter, then raised a certain amount by the wholesaler, raised another amount by the retailer, and again raised by the garment manufacturer. So, by the time any unit cost in a fabric reaches the consumer, it is anywhere from three to five times what it was when applied to the fabric and even greater in some cases. Of course, there are other costs involved, such as the cost of channeling fire-resistant materials into the particular uses where a consumer might buy. The $2 billion to $5 billion figure is probably fairly conservative.

VIEWPOINT OF THE AMERICAN ACADEMY OF PEDIATRICS

Dr. Robert H. Trimby

American Academy of Pediatrics

Mention should be made of studies made in Boston by our Poison Information Center, the lessons of which would very easily carry over to the burn problem. It was found that there were three categories of homes in which poisoning accidents were likely to occur: homes where the daily routine was interrupted by some unusual event, such as illness; homes where the development ages of the children were not anticipated by the parents (i.e., parents did not think child was able to reach stove); homes in which adequate safeguards were routinely disregarded.

One of the conclusions I have reached from my work in accident prevention is that we should think and plan for safety. We should try to establish safe habits. We should periodically eliminate the hazards around us. We should realize that worry and fatigue have an influence on behavior, and we should keep our minds on what we are doing.

The Accident Prevention Committee of the American Academy of Pediatrics was organized about 1945, when it became apparent that accidents were becoming the number-one cause of both morbidity and mortality in children. In 1955, the Accident Prevention Committee joined in a cooperative effort with the NFPA Wearing Apparel Committee to discover whether there was any correlation between burn injuries and the burning speed of textiles. The Accident Prevention Committee's part in the joint investigation summarized by Mr. Babcock was the obtaining of the accident reports and samples of involved clothing.

People must realize that accidents are caused by carelessness and that only they themselves can prevent accidents.

I would like to commend to you the paper "Teaching Children Fire Prevention" by Dr. H. F. Dietrich, that has been distributed at this meeting. Dr. Dietrich was an early member of the Accident Prevention Committee and has done a considerable amount of work in this regard. I think that we would be in almost complete agreement with his educational approach to this particular problem.

I should like to quote from another article by Dr. Dietrich, which emphasizes the need for education. In a report presented to the American Academy of Pediatrics in 1956, Dr. Dietrich said, "The basic problem in childhood accident prevention is one of education involving physicians, parents, and children. The physician must learn more about the causes of accidents. He must perfect his techniques of teaching parents how to assume their role in accident prevention. The ultimate responsibility for juvenile accident prevention falls on the parent but must be conveyed in a nonfrightening manner and with a goal of achievement. This embraces a reciprocal relationship between profession and education related to age."

It is essential that parents recognize their

responsibilities for their children's education. The most stimulating educational device is participation. If parental example is good, then instructions for the child will be effective. The Accident Prevention Committee is emphasizing the need for parental responsibility.

VIEWPOINT OF CASUALTY INSURANCE COMPANIES

Charles S. Rust, Assistant Secretary, Safety Engineering Department

Aetna Casualty and Surety Company

There are a number of different types of casualty policies within the casualty insurance industry which provide protection for various phases of the textile flammability problem. For instance, product liability insurance is written for manufacturers, processors, distributors, wholesalers, retailers. A product liability policy protects those insured against claims brought by users of their products who claim, "Your particular product caused me bodily injury or property damage when I used it."

The casualty underwriter who must quote a rate to a particular manufacturer for the protection he wishes, bases his decision upon the claim dollars which have been paid out over the past five or six years on products of a similar nature. If the claim payments have been exceedingly high, then the rate for this particular manufacturer is going to be high because we have to charge a rate which will produce the premium dollars we expect to have to pay out in terms of claims.

Another form of liability policy which is sold to a different type of businessman is that of general liability. A general liability policy is sold to hospitals, hotels, apartment houses, theaters, owners of other kinds of real estate where members of the public congregate for various types of activities. Again, this policy is protecting the owner against claims brought for bodily injury while a member of the public is on his premises. Again, the underwriter is concerned with the claim experience in public buildings and whether or not there are conditions within the buildings which can contribute easily to the cause of fire, with the result of the public's being injured.

The engineering department within the casualty company is extremely interested in the fabric flammability problem from a somewhat different point of view than the underwriter. The underwriter is primarily interested in the dollars and cents he has to charge to pay anticipated claims. The engineer is interested not in the dollars, but in trying to minimize the accident-producing conditions in the buildings, in the case of general liability, or of the product, in the case of product liability. From past experience, it is known that the more the claim or accident cost can be reduced, the less the insurance rate will have to be—a direct benefit to the public. In the insurance business, the dollar loss governs the cost the public will have to pay for whatever form of insurance is purchased.

Another type of casualty insurance is written in the form of individual accident, health, and hospitalization policies. In the group insurance field, there are group accident, group sickness, and hospitalization policies. Here again, the cost of these insurance programs is directly governed by what the cost of the claims may be.

There is no definite information within the casualty insurance industry as to dollar losses for burn cases of the type under discussion today. The statistical methods used in accumulating losses do not segregate burn claims. Losses are accumulated by types of business, in the case of product liability. In other words, a hardware manufacturer's losses go into one category; a sofa manufacturer's, into another. No attempt is made to find out how much of the cost is due to burns or to defective equipment.

However, it can be said that during the last ten years, there has not been any great difficulty as far as claims are concerned in the area of wearing apparel. That does not mean that the accidents and burns have not been occurring. It simply means from the method of accumulating statistics that there have not been many cases costing $100,000, $150,000 or $200,000. Due to the absence of this type of claim, it has not been necessary to make radical adjustments in the rates. The story might be a little different if the individual burn claims could be segregated.

Nevertheless, the casualty insurance industry is concerned with the over-all economic aspect of the problem, realizing that if it cannot develop methods to control burn claims in the years to come, it will be confronted with an increasing number each year. For that very reason, the casualty insurance companies are trying to develop an educational program which will reach the groups which, to date, they have been unable to reach.

Those groups that can now be reached with an education program are the ones that are purchasing different types of casualty insurance policies. The manufacturers can be reached very well. Other segments of the public can be reached through education, primarily in the school systems where there is a

great deal of interest in the subject of liability. But there are still tremendous segments of the public that the casualty industry cannot put a finger on and which must be reached if the number of textile burn casualties is to be reduced.

It is generally felt by casualty insurance people that this reduction can only be accomplished by education, because from the limited information available, it appears that most of the causes of these fires are due to acts of human carelessness. Most of the textile products today, be they sofas, clothing, or anything else, have built into them a reasonable degree of protection; and the manufacturer cannot go too much further in that direction.

That, in brief, is the casualty viewpoint on this matter. We feel that the time has now arrived where we should try with other groups, similar to the ones you represent here, to work out an over-all educational program to reach this large segment of people which, so far, has not been reached by individual efforts.

October 2, 1962

Afternoon Session

DISCUSSION PERIOD

Mr. Harry G. Kennedy: Has any consideration been given by insurance companies to the reduction of fire insurance rates in occupancies such as hospitals and sanitariums where all combustible fabrics, such as cubicle curtains, mattresses, and so forth, have been flameproofed?

Mr. Charles S. Rust: In building up the fire rates, the fire rating bureau may give credits or debits, depending on what materials are used in the building. Casualty insurance rates are not arrived at in the same manner. Rates in the casualty business are based on dollar claims paid, usually in the last three to four years.

Mr. Louis Segal: This question had an implication in it that I think is worth spending a moment on. The gentleman included flameproofing of mattresses and ticking. It is important to understand and be aware of the fact that merely flameproofing a mattress ticking or covering on overstuffed furniture is no guarantee of stopping a cigarette from doing the same amount of damage as would have been done had it not been flameproofed. Some types of flameproofing may be better than others but I do not think that flameproofing by itself will eliminate the cigarette problem. As a matter of fact, simple types of flameproofing will cause the cigarette to burn through the fabric more readily; so, sometimes flameproofing might make the situation worse than it was before.

Mr. George S. Buck, Jr.: Does Mr. Kennedy imply by his question that there are hospitals with cubicle curtains, blankets, mattress ticking, and so forth, flameproofed?

Mr. Harry G. Kennedy: Recent surveys indicate that many hospitals are thinking in this direction. Some of them are in the Midwest. One hospital in particular is noted to be a pioneer in this field. Their thinking is to protect everything from the interior mattress, which does not include the cotton batting which I believe Mr. Segal referred to, to the ticking, sheeting, blankets, spreads, and so forth. To date, however, there are not many hospitals that completely protect every item on the bed. Flame-retardant cubicle curtains are the predominant items at present.

Mr. George S. Buck, Jr.: Are hospital fires common occurrences? I should think that hospitals would be one place where, because of the presence of attendants, there would be no violations of smoking regulations.

Dr. Robert H. Kennedy: While I was serving in an Army hospital during the last war, it seems there was rarely a day when there was not a fire in one of the mattresses.

Chairman Morgan: Would it not be fair to say that smoking in bed in hospitals is a common practice?

Dr. Robert H. Kennedy: I fear it is, but the law in New York is that there shall be no smoking in any hospital.

Chairman Morgan: You can imagine how that would be breached.

Dr. Robert H. Kennedy: It would seem to be a foolish law to have.

Mr. George H. Moore, Jr.: In the last few years the majority of fires in VA hospitals involving patients were caused by smoking in bed. The second most frequent place of origin was day rooms where patients congregate and accidentally drop cigarettes. Unfortunately, older

patients sometimes cannot control their movements when they smoke and start fires when there are no employees nearby. This is particularly bad in ward toilets where fires are started by dropping cigarettes or flaming matches on pajamas or bathrobes while seated on the toilet.

A few years ago, the VA had a series of fires in oxygen tents. Since then, the use of oxygen tents and oxygen therapy has decreased because of change in treatment methods as well as the fire hazard.

The VA has increased the use of plastic mattress covers and conductive sheeting for better control. The former are used in ward areas to assist in the "wetter" and "soilers" problem, and the latter to assist in the flammable anesthesia problem.

The most significant point made today is the need for education. The VA hospital in Albany, where there are 1,000 beds, about four years ago, started to work on this smoking problem. They have gone to big badges—green badges for those who can smoke under certain control, red badges for those who cannot smoke under any condition, and yellow badges for others.

Mr. George S. Buck, Jr.: I think this is another case where we are perfectly willing to do all kinds of ridiculous things, like flameproofing mattresses and pillows and sheets, but we never tell people not to smoke under dangerous circumstances; that just would not do; and that is the primary cause of the problem.

Mr. Harry G. Kennedy: I think this could be summed up in a conversation we had at a major Air Force base. The officer involved was completely unaware that durable flame-retardant fabrics were available. He told us that since July there were ten instances of men, possibly under the influence of liquor, who had ignited their beds after falling asleep while smoking. Here, again, it is a matter of education.

Our company has endeavored to educate hospital personnel and others as to the availability of processed fabrics. We have found from experience that generally they do not know that flame-retardant cottons exist.

Chairman Morgan: It is apparent that people in hospitals are going to do as they do at home; and until we are able to overcome their ignorance, educate if you prefer the word, we are going to have to face the consequences.

Mr. Harry G. Kennedy: Mr. Buck, has the National Cotton Council established any opinion as to necessary price and performance in order to further the use of flame-resistant fabrics?

Mr. George S. Buck, Jr.: We have done this in various ways and quite elaborately. We do this in many cases in the market for wash-wear fabrics and for many types of special finishes and textiles.

I can say that there would be a large demand for fire-resistant finish if, first, it didn't cost anything and, second, it didn't change any of the properties of the fabric, such as comfort, absorbance, attractiveness, seam strength, ability to take dyes, and ability to be sewn. Starting from that point, as you add cost or as you detract from these useful properties, you begin to cut your market rather sharply. I would say that even with no additional cost or change of desirable properties, you would have to stimulate interest.

We feel that a finish would have to get into large consumer markets, would probably have to be sold at less than five cents a yard, or would have to be tied into something like the wash-wear finishes which offer the consumers a recognizable benefit. The public generally does not recognize the need for fire resistance. It does recognize freedom from wrinkles and easy care.

As Mr. Drake will tell you, we have long had an interest in these finishes. We encouraged his laboratory, which has been the leading laboratory in the world on fire-resistant finishes since World War II, to get into this field. The National Cotton Council does not sponsor a program at the moment because it thinks the U.S.D.A.'s program is so good.

In answer to your question, by itself, a fire-resistant finish would have to be below five cents a yard to be sold widely. The chances are better in combination with other properties recognized as being desirable.

Dr. H. J. Wollner: I would like to ask Mr. Rust a several-part question. Assuming that children's clothing manufacturers were interested in announcing the production of an authentic line of children's clothes that could be demonstrated to make children safer from fire than a line otherwise engineered, would insurance companies in the casualty field be receptive to the idea of issuing policies to the people who bought those for their children, presumably to be paid for as a merchandising venture by the manufacturer of the garments?

Mr. Charles S. Rust: I think what you are talking about is the so-called performance warranty, that is sold to some manufacturers now. One manufacturer of refrigerators has this type of insurance which guarantees the performance over a specified period of time. There is a similar type of insurance now provided to certain parts of the textile industry in the mothproofing area. I think my company is one of the very few that writes this type of insurance. What you are bringing up suggests a possibility for the future.

The warranty is against the damge of equipment and cost of replacement parts. The same is true of the mothproofing insurance. This is

warranty against a fabric's being eaten by moths after the fabric has been treated. Something along this line possibly could be worked out, applying to garments that have a permanent flameproofing treatment. But it is something that would have to be experimented with before any definite commitment could be made.

Dr. H. J. Wollner: Is there any interest at the present time by the insurance companies, in such material? Can we look forward to an exploration of the possibility of a warranty that a mother who buys a garment would understand that, in the event that her child suffered physical injury of one kind or another, there would be indemnity, not so much for the loss of clothing, but for the injury to the child? This would be selling safety.

Mr. George S. Buck, Jr.: I don't agree. How many people are you going to sell on the idea if their child burns, they can be indemnified? If you can say, your child won't burn, that is different.

A number of years ago, Macy's put out a great display of baseball shirts and other things and tried to promote these fire-resistant things in New York City, which is a good, big place with lots of consumers, but they had to dump them all in the end. I think they tried to burn them, but they wouldn't burn.

Dr. H. J. Wollner: I don't know as you are quite correct in painting the picture of Macy's difficulties. We are not talking of guaranteeing a piece of fabric. The basis for this insurance has been laid down over the years. Virtually all personal damage claims derive from these lines, so the novelty is not there. The novelty is in associating with a specific kind of consideration. What I am trying to advance is the recognition of the fact that, if you are to win people away from making a purchase which is ill-advised and poorly based, you must give them a positive value which they can recognize, to counterpoise against it.

Chairman Morgan: Is not the key to this problem recognition? Until people recognize there is a peril associated with their clothing, they are not likely to recognize it.

Dr. H. J. Wollner: This is the fallacy of our traffic accident picture today. People all know of the hazards of driving a car, but they don't see any good in reducing their casualness or lack of concern with ordinary safety procedures. If it had been left to the individual, there would be no safety glass on automobiles today in the United States. The automobile companies were not successful in merely selling safety glass. There had to be stimulation on the part of groups. Both recognition and stimulation are necessary.

Mr. George S. Buck: I believe there is a very dangerous philosophy you are proposing here. One of the problems today is an implied warranty of safety when we sell conventional things. I don't know as it is justified but that is the basis of lawsuits you are faced with. There is an implied warranty and the cases brought against retailers and manufacturers are based on this implied warranty.

You are in a sense promoting another kind of warranty which is connected with the fire-resistant fabric. This immediately would make a very sharp distinction, I concede, between those which are fire-resistant and those which are normal. In the present state of the art, I don't think we are in any position to invite that type of distinction.

Chairman Morgan: Is it safe to say, Mr. Buck, that people who are damaged don't know anything about this implied warranty until they go to their lawyers?

Mr. George S. Buck, Jr.: I think that is probably true. Incidentally, I might say that I am sure the wool people might like this type of approach, but I don't say you are offering it from that standpoint.

Dr. H. J. Wollner: In my bias I am strictly objective, Mr. Buck. I assure you, however, that I have not excluded from my thinking the other fibers, with which I am familiar, and including cotton.

However, this whole question which I have just placed before Mr. Rust I pose, not as a panacea or a way to pursue; I just wish to suggest again that there must be something which is considered very desirable which is offered to the buyer to alert him to the broad patterns with which he is concerning himself or should be concerned. Spell it out in some different form and I think it will be equally satisfactory.

Dr. George M. Wheatley: I think Dr. Wollner has presented a very interesting idea. It seems to me that parents already have this carrot concept built in with respect to the welfare of their children. I think our job is to make them better informed about how garments can be made safer. If they have a choice of buying something which is safer, I think the public generally can be persuaded in this direction although it takes time. The progress that is beginning to be made with regard to the use of seat belts is an example.

When the public begins to look for the less flammable material because it is believed to be more desirable, we have the carrot idea. I don't believe that a parent would buy something because, as Mr. Buck says, you are going to be reimbursed if your child is hurt. I think you want to know whether your child has reasonable safety in the wearing of some particular garment.

Mr. Percy Bugbee: I want to comment on the smoking problem that has been touched on here and say with some optimism that it can be attacked. There is a tendency to say nothing can be done about the smoking habit. Some years ago, a union attempted to write into its contract with industry, the provision that the workers had a right to smoke when and where they pleased. That was part of the comfort of their existence. I took it upon myself to get in touch with Mr. Meany of the AFL and Mr. Reuther of the CIO and ask them if they would give me a statement of policy that they could live by and stand back of. They promptly sent a statement of policy to the effect that management had a perfect right to prohibit smoking. So far as I know, that is being lived up to; and as far as I know, management has the right to prohibit smoking in some areas and with the backing of the union.

If smoking can be controlled in industry, it could be that hospital management and employees can agree on a smoking policy.

Mr. George S. Buck, Jr.: I think there are about 1,500 textile mills in this country, Mr. Bugbee, and in none of those that I know of is smoking allowed except in restricted areas. So, I agree with you, I don't see why there can't be rules in hospitals, and so forth.

ANSWERS TO THE TEXTILE FLAMMABILITY PROBLEM

THE FEDERAL FLAMMABLE FABRICS ACT

Charles F. Canavan, Assistant Director,

Bureau of Textiles and Furs, Federal Trade Commission

We at the Federal Trade Commission are cognizant of the responsibility that Congress has given us in helping to enforce the Flammable Fabrics Act and thus, in a small way, help to protect the American public from dangerously flammable materials. My assignment this afternoon is to outline briefly the provisions of the Flammable Fabrics Act and the rules and regulations promulgated under that Act by the FTC.

The Flammable Fabrics Act was enacted in June of 1953 and became effective on July 1, 1954. This Act followed the rash of burnings with the so-called torch sweaters made with the high-piled rayon material and the children's cowboy suits with the long rayon chaps which have been spoken of previously this morning.

Passage of the Act by Congress was delayed for several years because there was no suitable means of making tests. The law prohibits the sale of cloth and fabrics intended for the use in clothing which are dangerously flammable. The Act was designed to cover only fabrics coming into direct contact with the body. It has no bearing on industrial fabrics or fabrics used around the household such as drapes, bedding, floor coverings, toys, and other fabric products used in the home. The Act is not confined to fabrics which are made of textiles; it covers any materials which are woven, knitted, felted, or otherwise produced from or in combination with any natural or synthetic fiber, film, or substitute. Any article of clothing irrespective of what it is made from is subject to the law. In other words, fur coats are technically subject to the law. Of course, fur is a protein fiber similar to wool and we never have any trouble with fur because of the natural fire resistance of the protein fibers. Interlining fabrics used in coats are exempted from the law because of the ultimate use of the interlining in the garment. The Act also exempts certain other items of wearing apparel, such as hats, gloves and footwear.

This statute is not a labeling statute like the other statutes that the Bureau of Textiles and Furs administers. If a fabric does not pass the flammability standard, it is merely taken off the market and cannot be sold. I want to emphasize that the Flammable Fabrics Act covers only dangerously flammable wearing apparel. It does not cover the clothing that is normally flammable, such as the shirt I am wearing or the clothing that you have on your body.

The heart of the Act is found in Section 4, which prescribes the test to determine whether a fabric is dangerously flammable. The vehicle that Congress arrived at and has adopted in Section 4 is Commercial Standard CS191-53, entitled Flammability of Clothing Textiles. There is also a second Commercial Standard CS192-53, known as General Purpose Vinyl Plastic Film. The latter standard is used for testing vinyl or rubber films or fabrics with nitrocellulose fiber finish or coating on them.

In connection with the enforcement of the Act, the Federal Trade Commission issues cease and desist orders against the manufacturer or the seller of the flammable material or garment. In addition, the Commission has the right under the Act to bring injunctions in the Federal Court to prohibit the sale or shipment of this material, or it can condemn the material by an action in the Federal Court.

In addition, under Section 7 of the Flammable Fabrics Act, for willful violation a criminal action may be brought which is punishable by a fine up to $5,000 or a year in jail or both.

There are several factors that determine whether a fabric is dangerously flammable. These include the ease of ignition, the speed of the burning, the intensity of the spreading flame, and, if it is in a garment, the design of the garment. It is obvious that the garment design is still too complicated for proper regulation. The test set up under CS191-53 measures only the first three factors.

A reference to how plain surface textiles burn may make these criteria more under-

standable. Plain surface fabrics are those without a raised fiber surface, nap or tufting. The entire fabric is consumed in the burning process. Lighter weight and open weave plain surface fabrics ignite more easily and burn more rapidly than those that are heavier in weight and more closely woven. This is true because more oxygen can reach the fibers and help them to be consumed. When plain surface fabrics burn, the whole structure is destroyed. Consequently, the heat and flame will be transferred to the wearer of the garment. It is obvious that greater danger will be met when this type of fabric is used in long length, such as in ladies' skirts or in evening gowns.

Burning of a fabric with a raised surface, such as a chenille or brushed pile fabric, is more complicated. The raised fiber surface, as a rule, ignites easily and the surface flash or flame travels rapidly across the fabric face. Quite often in fabrics such as cotton and rayon flannel and coatings, the flame intensity is so low that the basic fabric does not ignite. In such a situation, the wearer of the garment, of course, is given a fright, but is not likely to be burned. However, if the surface flash of flame is of sufficient intensity to ignite the base of the fabric, then a person may be seriously burned.

With the foregoing in mind, it is apparent what types of fabric may fail the test are prescribed in the law. In general these include very sheer types of fabrics, usually but not always with a cellulose base, and certain types of cloth with a raised fiber surface. The latter include long pile rayons and cotton, highly brushed rayons and cottons and chenilles with long, loose, or shaggy tuftings. Generally speaking, cellulose-based fabrics such as cotton or linens are more flammable than animal fibers or the newer man-made fibers.

However, with certain combinations of construction and finishes, it is possible that acetate, nylon, acrylic, polyester or others will fail to meet the requirements of the law. It is safe to say that any plain surface fabric weighing two ounces or more per square yard will pass the prescribed test. This is, of course, assuming that such fabric has not been treated with any finish which might increase its normal flammability. This has been borne out by many hundreds of tests at the FTC. The Commission has recognized this fact in connection with tests that are required for the giving of guarantees under the Flammable Fabrics Act.

After the law became effective, it was found that certain voiles and organdies used and made in this country for generations without any unusual casualties, failed the requirements of the Flammable Fabrics Act. CS191-53 provided that fabrics that burned in less than four seconds would be deemed to be dangerously flammable. These voiles and organdies burned at that time under four seconds but over three and one-half seconds. The matter was presented to Congress and the situation was remedied by passing an amendment to the Act, August 23, 1954, which lowered the burning time on plain surface fabrics from four seconds to three and one-half seconds.

The law has presented some anomalies. For instance, silk, which is a protein fiber, is normally considered to be relatively safe. However, it has been found that extremely sheer silk fabrics, such as those used in ladies' scarves, fail to meet the requirements of the law. Most of these scarves were imported from Japan and were under the Japanese three momme weight. These fabrics were of low intensity, but the rate of flame spread was rapid. The scarves now being used are of a heavier fabric, many being a combination of rayon and silk. These scarves pass the test because they burn slower. However, the flame is more intense.

Since the enactment of the Flammable Fabrics Act, the Commission has issued cease and desist orders on brushed cotton fabrics, silk bridal illusion, oriental wood chips used in making leis, lightweight silk squares that have been attached to cotton dresses. In the latter cases, the Commission has issued its orders against dress manufacturers, with the idea that the silk squares were fuses that might set off the cotton dresses.

The Commission amended its rules pertaining to reasonable and representative tests under Section 8 in November of 1955, and in July 1962, amended Rule 5, to exempt bridal illusion from the dry cleaning test. This material had previously been given an exemption from the wash test. It was found that bridal illusion very seldom, if ever, is dry cleaned or washed.

DISCUSSION PERIOD

Chairman Morgan: How is the enforcement of the Act accomplished?

Mr. Charles F. Canavan: The Bureau of Textiles and Furs administers this and three similar acts. The Bureau has investigators and inspectors throughout the country. Many times they will pick something up and send it in to be tested. The Bureau of Customs has been extremely helpful by watching the imports. If it appears that items might be flammable, they forward them to us for testing. The Bureau receives complaints from state fire officials. Sometimes Better Business Bureaus, competitors, and consumers will send articles in for us to check.

Mr. Witt Langstaff: At what relative humidity are the flame tests conducted?

Mr. Charles F. Canavan: As spelled out in the Commercial Standards, the samples are dried in an oven, then are put into a desiccator until transferred to the testing machine.

Mr. Louis Segal: The fabrics are relatively bone dry.

Dr. Robert H. Trimby: Does the term acetate, mentioned today refer to a chemical radical?

Mr. Charles F. Canavan: Acetate is a generic name for a cellulose fiber. It does not refer to rayon.

Mr. George S. Buck, Jr.: It is an artificial fiber.

Mr. Deuel Richardson: How many cease and desist orders have been issued?

Mr. Charles F. Canavan: We have issued approximately thirty since 1954. These only cover materials that are highly flammable.

Mr. Louis Segal: Mr. Canavan has used the terms "dangerously flammable" and "extremely flammable." These are proper terms but possibly, may be misleading to some of you. It is important to understand that there is no line of demarcation between "dangerous" and "not dangerous" fabrics. In our laboratory, speeds of burning have ranged from 0.8 seconds upward.

By that token, I don't think it is proper to talk of dangerously flammable fabrics. Any fabric is dangerously flammable if it catches fire. It is not even true that the faster it burns, the more dangerous it is. We have been thinking in these terms for years. Just because a fabric passes the test doesn't mean per se that it is not dangerously flammable. It has been proved that this is not true. In investigations of burn cases, it has been found that fabrics passed the test; and yet, would you say they are not dangerously flammable when thousands of persons have been burned in fires involving these fabrics?

Mr. George S. Buck, Jr.: Just because you don't like a law, you don't have to flout it. At least under the law we can speak of "dangerously flammable" and "not dangerously flammable" because the law does define these terms. There is some virtue, Mr. Segal, in saying that the fabrics we make are at least not "dangerously flammable."

Chairman Morgan: The virtue may be more apparent to the manufacturer than the public.

Dr. Robert H. Kennedy: The term "normally flammable" has been used several times here. Does that term mean that the fabric is legal?

Mr. Louis Segal: We use these broad terms but, as I say, you can get many degrees of burning speed, from extremely fast to none at all. So you are faced with using broad descriptive terms. Some things that burn very fast could be considered normally flammable because other things burn faster. You could use the terms "moderately flammable," "somewhat flammable." These are all very general terms.

NFPA BUILDING EXITS CODE AND STANDARD FOR FLAMEPROOFED TEXTILES

Robert S. Moulton, Secretary

NFPA Committee on Safety to Life

This is somewhat of a departure in that we are now dealing with the building and its furnishings as contrasted with the clothing of the occupants. The Building Exits Code is a well-established NFPA document. It dates from 1913 and it has been continually revised and improved since that time. It deals with building exits and related features of life safety from fires. In fact, its title is now "Building Exits Code for Life Safety from Fire." Compliance with this Code will produce reasonable safety in buildings, and all major fires that have been recorded have shown significant differences between the actual building and the requirements of the Building Exits Code.

Now, these requirements of the Building Exits Code vary in accordance with the type of fire from which you must escape. There are differences depending on the class of occupancy—places of assembly, hospitals, stores, office buildings, and so on, have different requirements.

Furthermore, the Code is greatly concerned with the interior finish of the building because it is the interior finish over which fire may spread rapidly and, in extreme cases, outrun the ability of the occupant to escape. Reference was made earlier this morning to the Cocoanut Grove night club fire. Highly combustible interior finish played a very prominent part in that fire, as it has in many others.

The hazard of interior finish is measured in a so-called tunnel test, where the flame spread is measured under standard conditions

in an enclosure two feet wide and twenty-five feet long. The flame spread scale is zero for cement asbestos board and 100 for red oak. Most materials in common use have a flame spread of under 200. The Building Exits Code specifies a flame spread of 25 or less in exit ways, hospitals, nursing homes, and certain other occupancies. The flame spread of the ceiling in the Cocoanut Grove fire was 2500 measured by this test.

Although interior finish is not usually a fabric, it may be, as it is in this meeting room. Now, what is the flame spread of this fabric? Fire can spread so fast in fabric as to endanger the lives of the occupants of the room before they have a chance to get out through the available exit facilities.

The Building Exits Code often requires that fabrics comply with the provisions of another NFPA standard, the Standard for Flameproofed Textiles, No. 701. If a fabric is treated to meet the requirements of NFPA Standard 701, you can be reasonably certain that fire will not spread over the material in a dangerously fast manner. This standard deals with laundering and dry cleaning prior to making the test and also contains several different tests. Only that test referring to fabrics in folds is appropriately applicable to draperies, curtains, and so forth.

Not only does the Building Exits Code contain requirements that apply to all buildings, but it also has specific requirements pertaining to hospitals, nursing homes, nurseries, prisons, and schools, where an extraordinary hazard to life exists. In hospitals, particularly, people are not expected to get away from fires. Usually, the only way to save their lives is to slow the fire down sufficiently so the available personnel will be able to evacuate. That may take some time. Therefore, The Building Exits Code contains specific requirements that curtains and decorative materials in hospitals and nursing homes be flameproofed.

DISCUSSION PERIOD

Mr. Robert S. Moulton: I neglected to mention that the Building Exits Code is very widely used as a basis of law and as a guide in the preparation of building codes and by fire marshals in the exercise of their discretionary authority.

Mr. Charles F. Canavan: I was of the opinion that the decorations in the Cocoanut Grove night club were supposed to have been flameproofed. Is that so?

Mr. Robert S. Moulton: The artificial palm trees in that fire were supposed to have been flameproofed. Testimony in the trial indicated that one artificial palm tree had been flameproofed and that was the one the inspector always tested. The others had not been flameproofed.

Mr. Charles P. Macaluso: Are such items as wrap-around blankets and receiving blankets covered by the Federal Flammable Fabrics Act?

Mr. Charles F. Canavan: Up to the present time, the Commission has not brought any complaints against manufacturers of that type of item. We are considering it, however, and I don't know what action will be taken in the future.

Mr. Charles P. Macaluso: This type of item is not now considered apparel?

Mr. Charles F. Canavan: Up to now, there have been no complaints to the Commission. Definitely, bed blankets would not be within the area of the Act.

Mr. Raymond R. Stevens: Is there anything in the Act that covers automotive upholstery?

Mr. Robert S. Moulton: The NFPA Standard on Flameproofed Textiles could be made applicable to automobile fabrics. Automobile fabrics is not specifically mentioned, but I think the Standard applies.

Mr. George S. Buck, Jr.: Why is there interest in automobile upholstery? Is there a risk to life in automobile upholstery?

Mr. Raymond R. Stevens: There would be in any nap fabric. Mohair has been more or less of that type and that has been safe. If vinyl acetate were used instead of vinyl chloride, the fabric would melt and burn. Many automobile interiors burn up.

Mr. George S. Buck, Jr.: I seriously doubt if automobile upholstery constitutes a hazard to life in burning.

Mr. Witt Langstaff: Our Plant Safety Director tells me we lose one or two automobiles a year in the plant parking lot because a cigarette has fallen onto the upholstery. These fires are not a hazard to life.

Mr. Robert S. Moulton: In Philadelphia, a few years ago, a man stopped to do an errand and left his three children in the car. They played with the cigarette lighter and burned to death when the fabric ignited.

NFPA WEARING APPAREL STANDARD

Louis Segal, Deputy State Fire Marshal

State of California

The NFPA Wearing Apparel Standard has had a rather bumpy history. The Committee was formed about ten years ago, and during most of its existence it has been engaged in a rather violent battle with representatives of the textile industry, mainly as to who was right and who was wrong, if anybody, about the proper method of running rate-of-burning tests. The argument is still not resolved and may never be. I think we are all pretty much agreed that having the best possible standard and an absolutely unassailable test is going to have little effect on the over-all problem of saving some lives from the burning of clothing.

To show you how ineffective legislation can be in this field, please recall that Mr. Canavan stated that in the original law four seconds was set as the minimum burning time. Anything that burned faster than four seconds, when the law was passed, was "dangerously flammable." Shortly thereafter, it was found there were a few textiles sold that had been sold for some time, that happened to burn a little faster than four seconds. It seems to me to be very logical that that was just tough, but since it had been determined that these were dangerous, they could no longer be sold. That isn't what happened. The law was changed and the time limit was dropped to 3 1/2 seconds so these fabrics could be legal. Presumably if there were some big manufacturer with a load of fabric that burned in less than 3 1/2 seconds, the time limit in the Act would be revised to 3 seconds.

Again, this may not have an effect on public safety, because the mere fact that a fabric burns extremely fast doesn't necessarily make it dangerous. If a fabric were so light in weight that it burned extremely fast, it would release so little heat that it might only singe the wearer a little bit. Speed is not the only thing, by any means.

We have talked about speed of burning for so long we are mesmerized. It would be a little ridiculous, but I would rather be wearing a shirt made of silk bridal illusion, the most flammable fabric I have ever seen, than the ordinary cotton shirt I have on, if I were given a choice of wearing either one and setting it on fire. The bridal illusion would ignite more readily, but I would get a much worse burn from a cotton shirt, because the illusion doesn't have as much fuel in it as the cuff on the shirt. The more fuel, the more heat.

While I might be willing to wear this silk as a shirt in lieu of the one I have on, I wouldn't want to see anyone wearing it in the form of a formal evening gown in which there were many, many yards of it, because that person wouldn't have any chance whatsoever. So, a little bit of this might not be dangerous, but a lot of it might be deadly.

The deeper one digs into the technicalities of test methods and so on, and tries to relate them to actual life hazards, the more likely he is to conclude that it is a waste of time to talk of tests and methods. As long as the American people continue to clothe themselves in combustible fibers, these burn fatalities and injuries are going to continue. So, let's start doing some educating.

We have had some reference to torch sweaters and also a question about acetate.

This is one of the original torch sweaters; it happens to be the sleeveless type. This is all one hundred per cent rayon, front and back. (Applied flame from lighter to back side of sweater. The sweater was scorched.) I think you would all agree that this is "normal" if anything is normal.

Now, watch the difference. This is still the same fiber. It is all rayon. (Applied lighter to the nap side of sweater. Fire flashed over the surface.) The difference in burning is apparent. So, there is no solution to this problem by saying rayon is dangerous or nylon is safe or vice versa. It depends on not just what the fiber is, but on the fabric construction.

Conversely, it cannot be said that anything with a brushed surface is dangerous. Here is a sweater that looks exactly the same as the rayon torch sweater, but it doesn't behave the same at all. This brushed surface does not flash. All it did was melt because this happens to be acetate fiber on the surface. These quick sidelights will give you some idea of how complex this problem is technically.

As to the NFPA Wearing Apparel Standard, the first question, of course, is "Why is there an NFPA Standard when there already was a Commercial Standard?" The Federal law is based on this Commercial Standard. The NFPA Standard exists because there are many who do not feel that the present Commercial Standard is entirely adequate. Much of their argument is on a technical basis.

Here is an example. (Holds up a hula skirt) This is a very combustible fiber. I don't know exactly what it is. It is some natural cellulose fiber. It is quite dry and, most important, is very loose in texture. I wouldn't hold this and light it because of the danger. At least two children have lost their lives in Los Angeles from wearing this type of garment.

What is the point of discussing hula skirts? It is this. There is a Federal law which says that anything that is dangerously flammable according to the current Standard cannot be sold. The hula skirt is exempt because it

cannot be tested by the Commercial Standard. The Commercial Standard was developed by the textile industry which is concerned with textiles, not hula skirts. However, hula skirts are wearing apparel and very dangerous. Unless the FTC has some extra-legal means, a garment of this type cannot be tested under our Federal law. This is a serious deficiency.

Other articles of wearing apparel that cannot be tested by the Commercial Standard are Santa Claus masks, and costume articles covered with shredded paper. These may be extremely flammable. This major deficiency in the Federal Standard does not exist in the NFPA Standard, which simply says that because it is impossible to run a rate-of-burning test, the article must be flameproofed. This doesn't create any big problem for the manufacturers.

The NFPA Standard, after going through all the growing pains of many years, was finally adopted in Philadelphia in May of this year. It has no force legally. However, it is now possible at least to approach the Federal Government and suggest that they examine the NFPA Standard, compare it to the one they are now using, and see if perhaps the NFPA Standard is better.

I also brought along new types of decorative fabrics which are available. These are not flameproofed. These are Saran, Verel, Rovana; they don't burn. While the flammable clothing problem may be here for a great many years, there is a reasonable solution of our flammable decorative fabrics problem.

DISCUSSION PERIOD

Mr. George S. Buck, Jr.: In all fairness, when Mr. Segal criticizes the change in the Federal Flammable Fabrics Act time from 4 seconds to 3 1/2, he might have reported that California also had a regulation for a number of years where sheer fabrics or plain surface fabrics were tested at 6 seconds. When the people in California found out that all their dresses were going to be thrown out, they suspended that provision of the Act for a while. So Mr. Segal, as a fire protection official, faces the same things we are faced with in the Federal Act.

In regard to the NFPA Standard, I don't think that anyone in the textile industry, Mr. Canavan, would object to having an amendment to the Act or to the Commercial Standard on which the Act is based, to include these non-textile materials. It is true that textile people were not concerned with hula skirts.

The textile industry does not, however, see any sense in the elimination of the one-second flame impingement. Some of the members of the NFPA Wearing Apparel Committee argue that there is no use of testing a sample unless you can tell how fast it burns, and a great many samples do not ignite from the one-second flame impingement test that is in the Commercial Standard; but when a sample doesn't burn, it also doesn't burn fast enough to be considered under the Act and rules. The one-second impingement is a measure of relative ease of ignition and it eliminates an awful lot of useless testing under the Act. If it is desired to compile a record of burns as was done jointly by the Committee on Wearing Apparel and the Accident Prevention Committee of the American Academy of Pediatrics, then there is need of positive ignition; but why do a lot of useless testing?

Mr. Moulton commented on fabrics in public buildings, such as this hotel. We would certainly support regulations such as are now in existence in a great many states and cities that require fire-resistant textiles to be used in certain applications in public hearings, such as draperies, theater curtains, textiles of various types in hospitals and public assembly buildings. These can be provided with fire-resistant cotton fabrics or synthetics, as you point out. In fabrics for these uses, the textile industry is not faced with all the esthetic and comfort qualities considered when clothing is involved, and, in general, the laundering of decorative textiles is less frequent and less exacting than in many clothing textiles.

Mr. Louis Segal: California pioneered in the field of wearing apparel flammability regulations. There were state regulations seven years before the Federal Government or anyone else regulated in this field. To clarify a point made by Mr. Buck, originally the California regulations covered all fabrics, and the time was set at six seconds. This time does not correspond directly with the 3 1/2 and 4 seconds in the Commercial Standard because a different type of test rack was used. It is not because we found so many fabrics were failing to pass the test that the time limit was suspended. It was suspended because the Fire Marshal's Office was inundated with work it couldn't possibly handle. It is also true that the impact of the regulations had something to do with the suspension. The suspension gave us time to find some answers. I make no apologies for the fact they have not been put back in effect.

I would like to make a suggestion on the subject of one-second ignitions. Mr. Buck complained that if every sample was made to burn, it would make undue testing. I am in complete agreement. My only objection to the one-second flame impingement is that it is not a scientific approach. I would be in favor of an exemption from testing for all flat

surface fabrics weighing over 2 ounces a yard, if it is desired to eliminate undue testing; but, if we are going to run burning tests, let's run them.

If a one-second application of flame with no ignition is an indication that a fabric is safe, let's find out what fabrics will pass that test on the basis of construction and let's exempt them. That is a simple answer to that problem.

Mr. George S. Buck, Jr.: Basically I don't disagree with Mr. Segal as much as it might appear. The solution he proposes on exemption of flat surface fabrics has, in fact, been made in FTC rules so they are now exempted from testing.

Mr. Charles F. Canavan: Speaking personally, I believe Mr. Segal is right. Hula skirts just cannot be tested in the Commercial Standard apparatus. Some have been tried crosswise in the apparatus, some vertically. Attempts have been made to test them in single strands and in bunches. This is only one of the problems the FTC has run into. For example, there is no way of testing celluloid buttons under the Act.

Wood chips imported from Hong Kong or Nationalist China are soaked in oil and made into flowers. The FTC stopped the use of the oil-soaked chips as leis, but they are still being sold and made into flowers and the flowers may be attached to garments. There is no way of testing them. The flowers are an adornment and would not come under the Act. If they did, there probably would be no way of testing.

The FTC has also run into celluloid toys imported from Japan. These were not wearing apparel, but were highly flammable. The Commission made an effort to stop their import and I believe the importer stopped bringing them in.

Those are just a few of the problems we have run into. In my opinion, the Commercial Standard is not all that we need. We need something more, but what it is, I can't say.

One other thing, I don't think the present Commercial Standard would be a suitable test method for rugs or draperies because the one-second flame impingement on draperies, which ordinarily are pretty heavy, would not ignite them. If you were to use it on a rug, the flame would probably be buried in the pile and snuffed out.

Miss Dorothy Downs: As an employee of a company that is a member of the Factory Mutual Insurance group, I have witnessed small-scale and large-scale tests.

The Factory Mutuals recognize the value of a small-scale test, but know it is not the way to determine whether a material is flammable or not flammable, or the way to evaluate its degree of flammability. We go from a small-scale test to actual conditions in our test station where we duplicate those conditions.

This problem is not one entirely of Standards and test methods. Women are the people who are most involved. The clothing that you gentlemen have on is not nearly as susceptible to burning as our clothing is. Testing under standard conditions is all very good, but what the woman wants to know is, what is going to happen to the garment when it is worn? How a sample behaves when in a test frame at such and such an angle and with flame impingement in such and such a way doesn't tell how a garment of this material will burn when I am at a reception and somebody brushes a cigarette against my loose, filmy jacket.

A coordinated effort of the organizations represented at this Conference should be made to educate women and children, for it is they who are most concerned with this problem and the most frequent victims.

I think the solution to our problem is an educational program. There is a seat belt campaign. Seat belts are all right, but the trouble is that they give people a false sense of security. In conjunction with the seat belt campaign, there should be a campaign to educate drivers how to drive properly.

There is a campaign on having emergency escape plans for families to get out of their homes. This is fine in conjunction with planning a way to get out of a house. There should be a program to teach people how to prevent the fire in the home so they won't have to use the escape plan.

I feel that it is extremely important that we spend some time in trying to think through a plan whereby we can coordinate our efforts. The NFPA and the National Safety Council, who have representatives here, are the two great leaders in their separate fields. They do work together; but, there should be coordination also among the people in the industry, in government, in the medical profession.

I like to wear cotton clothes because they are more comfortable in the summer. Do not attempt to prohibit women or men from wearing flammable fabrics, but rather, tell them how to wear these garments safely.

Question from unidentified speaker: First, I note that the NFPA Wearing Apparel Standard calls for about a five-minute wash of fabrics that may have a fire-retardant treatment, before the flammability test is run. Has any consideration been given to the fact that the garment's first laundering will be longer than five minutes?

Second, in regard to the type of burning, there seem to be four or five different classifications. From the point of view of the wearer, isn't the important question whether the garment burns or doesn't burn? Mr. Wilson this morning pointed out that a woman and her children were killed by what would be considered a slow-burning fabric. They died of suffocation.

Mr. Louis Segal: Answering your second question first, there has been a lot of argument about this attempt at classification. It is debatable whether it is of much value. But, to the degree that there is agreement that speed of burning is most important, it can be useful to know what relative degree of burning rate we are talking about. The idea behind the classification system was that classes could be useful. For example, if in an industrial occupancy, it was desired to get workmen's clothing that was relatively slow burning, it would simply be necessary to order clothing that fell in a particular flammability class. If you were making children's clothing and wanted to make it a little less flammable than otherwise, you could use, let us say, a class three fabric. In other words, these are merely tools which can be used by people who want clothing with certain degrees of flammability.

However, as pointed out previously, it is not at all certain that the mere speed of burning is a criterion of the hazard potential of a fabric.

Answering your first question, everyone agrees that a flameproofing treatment is of practically no use whatsoever unless it has some reasonable degree of permanence. If it will come out in the first laundering, it could do a lot more harm than good. So far as I know, this is purely an academic problem right now. I don't believe anyone is flameproofing any fabric for general sale. As Mr. Buck pointed out, the better job you do from a standpoint of permanence, the more you take away from the other desirable qualities; and this limits the feasibility of the whole concept.

If you question the degree of laundering exposure that should be applied, this is a matter of opinion. Much more severe laundering conditions could be required and probably rule out some presently acceptable methods of treatment. We can only theorize on this point because we have no practical application of it. If we find the present specifications on flameproofing are too lenient, we can tighten them up. We can't do this until there has been some use of the Standard.

Mr. George S. Buck, Jr.: The only purpose of the washing requirement in the test was to rule out the water-soluble flameproofing solutions that could be applied to fabrics. If a finish stays in after that one wash, it may stay in five, fifteen, or fifty washes. It was considered impractical to establish a wash procedure that would go on to some point, such as twenty-five or fifty cycles.

October 3, 1962

Morning Session

RESEARCH AT U.S.D.A. SOUTHERN UTILIZATION RESEARCH AND DEVELOPMENT CENTER

George L. Drake, Jr., Head,

Special Finishes Investigations

Cotton Finishes Laboratory, U.S.D.A.

It is, indeed, a pleasure to have been invited to attend this meeting. It is also a pleasure to have the opportunity to pass on to you some of the research on fire resistants that has been done at the Southern Utilization Research and Development Center in New Orleans, Louisiana.

At the Southern Utilization Research and Development Center, work has been done on flame retardants for the past ten to twelve years. Prior to that, very little was known about flame retardants, especially the durable type. Consequently, before we could undertake a program to develop a durable flame retardant for cotton, it was necessary to work out the theory explaining why flame retardants work on cotton especially.

After making a theoretical and fundamental study, we knew in which direction to go to accomplish the task before us. From this study, it was learned that phosphorus- and nitrogen-containing compounds usually gave the best flame resistance.

From this study, it was also found that it was essential to the flame resistance of the cotton that Lewis acids be formed in the products of burning. Based on this knowledge, we began synthesizing numerous phosphorus- and nitrogen-containing compounds that could be attached to cotton chemically to produce durability. In the course of our study, we also learned that the decomposition of the cellulose played an important part in imparting flame resistance to cotton. We found that a decomposition point between 275°C and 325°C was necessary in order to get the optimum flame resistance from the cotton.

If the treated cotton decomposes below

275°C, the flame retardant comes off before the cotton ignites. If the flame retardant decomposes above 325°C, then the cotton will burn up before the flame retardant gives off Lewis acid.

Based on these facts we synthesized a compound which we call THPC, the technical name being tetrakishydroxymethylphosphonium chloride. Today most good flame retardants on the market contain THPC as one of the primary chemicals.

Numerous flame retardants were developed in cooperation with the National Cotton Council of America, the Quartermaster Corps and other military agencies and commercial concerns interested in fire retardants; but in each case, they did not meet all the requirements of a good durable flame retardant, having defects such as imparting stiffness, poor durability, reduced air permeability, etc. Such being the case, it was necessary to continue our search for additional flame retardants.

This is not an easy matter because of the numerous things that good flame retardants must possess in order to be satisfactory. For example, they should be applied from water solutions. Preferably they should be able to be applied from machinery and equipment now existing in most textile finishing plants. They must not wreck the fabric properties; that is, they shouldn't affect the comfort factor, the tear strength, or the breaking strength. They should be durable. They should not dust; that is, they should not fly out as a dust if the fabric is shaken. They should not pick up water to the extent that the cloth will be humid and sticky. They shouldn't affect the physiological problems associated with the people wearing or handling the garment. Preferably the treatments should form a tough char so that there will be some fabric left between the skin and the air. The treatments should also impart flame resistance and glow resistance to cotton, and they should not interfere with further processing of the fabric, that is, dyeing or waterproofing. So, you can see that no one chemical alone can make a satisfactory flame retardant.

Through our studies another chemical was discovered which we call APO, the chemical name being tris(1-aziridinyl)phosphine oxide.

THPC and APO are both water soluble. In fact, they are hydroscopic. By mixing these chemicals in a one-to-one mole ratio, wetting the fabric, squeezing out the excess solution, drying, curing and washing, we have a very good flame-retardant fabric. After application of these chemicals, the fabric is durable to laundering. Samples have been laundered over one hundred times in the home laundry washing machine. They have been subjected to sixty or more commercial launderings, including chlorine bleaching, without losing the flame retardancy. They have undergone fifteen or more Quartermaster launderings without losing the flame resistance, and finally, the samples have been subjected to five Sanforized or shrinkage washings without loss of their flame-retardant property.

Fabrics finished with these two chemicals have, in addition to fire resistance, crease resistance, rot resistance, mildew resistance, and glow resistance. There is no adverse effect on the hand (softness) of the fabrics. Strength of the fabric and shade of dye are very little affected. Fabric, once processed, can be dyed. If a water repellent is desired, it can be put on as an after-treatment or can be added to the flame-retardant bath. Tear strength and air permeability remain good. The sewability and seam efficiency are good. The flameproofing chemicals can be applied to any weight fabric, from marquisette or cheesecloth all the way up to 28-ounce belting duck.

With as low as 8 per cent weight increase, we were able to obtain a fabric which, after laundering, would pass the standard vertical flame test. To pass the so-called match test, about 10 per cent weight increase is required. These figures apply to 8-ounce fabric. The weight of a fabric plays an important part in the amount of weight increase necessary to obtain good flame resistance. For example, 28-ounce belting duck will require less than 2 per cent weight increase. Going down in weight, an 80-square sheeting may require as much as 16 per cent weight increase. Before the war, durable flame retardants required 50 to 60 per cent weight increase on a 10-ounce duck to obtain fire resistance.

The THPC-APO flame-retardant chemical can be applied to cotton at any stage of processing, whether it be raw stock, picker lap, fiber, yarn, or fabric. If applied to the fiber, the fiber can be carded, drawn, spun, and woven.

An additional feature of the THPC-APO process is that mills can apply this finish to soft filled sheeting which can be napped satisfactorily to produce baby blankets that have good hand and flame retardancy. As far as is known, this is the only flame retardant that can be used on soft filled sheeting which can be napped after treatment and still be flame retardant.

It should be pointed out that there is a difference between flame retardancy and noncombustibility. Any time flame is applied to an organic molecule, some charring occurs; therefore, it is not noncombustible. Asbestos, on the other hand, would not char, and could be properly called noncombustible.

Mr. Segal pointed out that covering a sofa with a fire-retardant fabric doesn't necessarily mean that the sofa will not catch fire if a cigarette is allowed to fall on this flameproof-covered sofa. I agree with Mr. Segal. I don't agree, however, with his preference for a thin shirt versus a cotton shirt, because it would burn up fast. The fast-burning fabric will endanger the wearer's hair. There would be a better chance of snuffing out a relatively slow

spreading flame on an ordinary cotton shirt than one that flashes up.

Work done at the Southern Utilization Research and Development Division has led to the production of a cotton batting which is lightweight, resilient, and which is flame resistant. A sofa can be protected from ignition by a cigarette by a light covering of batting beneath the flame-retardant fabric. This batting can be molded to any desired shape.

I am going to pass some fabrics around that have been treated with the THPC and APO. Notice that the drape and hand are good. [As Mr. Drake discussed the fabric samples, they were distributed to the Conference members for examination.]

This is 3 over 3 twill. Very few of you will find that it feels as if it had been treated.

This is an 8-ounce material that has been through over 100 home launderings. The drape and color are good.

This sheeting fabric has been processed with THPC and APO flame retardant. In New Orleans the Veterans Administration Hospital is evaluating 100 sheets made of this fabric. They have already gone through 40 launderings and uses and are still satisfactory. Other hospitals in the New Orleans area want to evaluate sheeting processed with this flame retardant. At present, the Veterans Administration is evaluating its use in rooms where patients are undergoing oxygen treatment.

This is lightweight voile and has been processed with APO and THPC. There is much interest in treated lightweight fabrics.

There is also a great deal of interest in application of a metal coating to these transparently thin, treated fabrics. One company has been able to apply a metal coating to fabrics for use in draperies and jacket interliners. These metal-coated fabrics will reflect light, but will allow some light to come through. This same company is able to apply a copper coating to obtain a fabric with electrical conductance. This sample happens to be rayon, but cotton has also been metal-coated and found to be satisfactory. Before cloth flameproofed with THPC and APO was available, metal-like finishes on cotton were unsatisfactory because the moisture content of cotton produced a gassing effect causing an unsatisfactory coating. Since cross-linking cotton with one of the flame-retardant chemicals reduces the amount of moisture retained, the metal coating can now be satisfactorily applied.

A fabric that is water repellent as well as fire resistant is often desired; this is a small sample of such a fabric.

Our Laboratory has been able to take cotton and make it stretchable without putting any rubber in it. Flameproofed, stretchable sheeting used as a covering for hospital bed pads is more comfortable for the person in the hospital bed.

The degree of stretch is dependent upon the fabric construction. [Several samples of stretched fabrics were distributed.]

A garment manufacturer has asked whether garments could be treated. It was found that coveralls could be flameproofed by simply dipping them in the THPC-APO solution, centrifuging, drying, and curing in a tumble dryer. These have gone through 30 launderings and a 2-hour soap-soda bath and have retained their fire resistance.

This sample is what is called a sliver. It has been treated. [An attempt to burn the treated sliver caused the sliver to char but there was no afterglow. An untreated sliver burned rapidly. There was an afterglow. A torch flame with a temperature of 4200°F was applied to a charred, 8.5-ounce, O.D. sateen fabric. It would get red hot but a person's hand could be placed behind it.] APO-THPC-treated cotton duck fabric is being evaluated as parachute pack coverings to prevent the nylon parachute from melting if exposed to high-temperature flames for short periods of time.

RESEARCH AT ARMY QUARTERMASTER RESEARCH CENTER

Thomas D. Miles, Supervisory Chemist,

Laboratory Branch, Army Quartermaster Research Center

Other speakers have discussed what fibers are flame resistant, what chemicals will make fibers flame resistant, and what needs exist for flame protective material. Although the work at the Quartermaster Research Center touches on all of these problems, it might be well to round out the general discussion with comments on tests that are used to judge flame resistance.

In examining test conditions, it is important to distinguish between two types of test methods. In one, the test result is independent of the test conditions. Chemical methods are examples. One can determine how much iron is present in this microphone by several different methods, all of which use different test conditions, yet all give the same result. Thus, a criterion or standard is available to check the test conditions. If a new method is proposed, or a step in an accepted method questioned, it is a simple matter to take a sample of known iron content and check the test conditions.

In another type of test, the results are

dependent upon the conditions used. Each change in the test conditions brings a change in the test results. All of the flame tests are in this group. Consider for example the burning rate of a fabric. Although this microphone has only one iron content, a fabric has many burning rates. The burning rate can be varied in many ways. One way is to change the angle at which the sample is held. Which of these burning rates is important in designating the fabric as a hazardous material when in contact with flame? There are no simple standards such as those for chemical tests to tell whether it is better to use a 45° angle rather than a 46° angle in a burning rate test.

What criterion can be used to judge the test conditions of flame methods? One criterion is, do they classify the materials for which they were designed? In other words, accident experience has shown that certain materials are hazardous. Test conditions are chosen that will distinguish these materials. The emphasis, then, should be on obtaining accurate and thorough information on textiles involved in flame accidents. This information is the only logical basis for burning rate test methods. And it seems as though it should supply other information as well. For example, in what areas should safety clothing be used? There has been much discussion of educating the public on flame hazards. It seems as though only such accident information could measure how effective these educational programs are. Any change in test methods, other than to improve reproducibility, should be supported by accident information on the materials that the change in method is designed to affect.

Since our test experience has been in the field of flame resistant test methods, let's consider some of these in detail. The vertical bunsen test is probably the most widely used flame resistant test method. A sample of the textile about a foot long and several inches wide is held in a vertical position in contact with a bunsen burner flame for twelve seconds. The length of time the sample flames after removal of the flame source is recorded as well as a measure of the amount of char that is present. This is estimated by the length of a tear made in the sample. The force applied in tearing the charred area is much less than that required to tear the uncharred portion. The method is widely used throughout the world. In this country it is Method 5903T of Federal Specification CCC-T-191, and ASTM D626-41T. In Great Britain it is British Standard 3119. In Germany it is DIN 53 906. It is a method that appears in procurement specifications for flame resistant fabrics and in various regulations covering the use of flame resistant fabrics. It is a quality control test method in which great emphasis is on insuring responsibility of test results. Whenever a factor which can affect the test result is uncontrolled, it usually shows up as the cause of a lack of reproducibility. An example is the composition of the gas used as the flame source. It was found that the variation in the BTU content of natural gas throughout the country was causing a variation in char length. On interlaboratory tests on the same material, char length varied with BTU content. To improve the reproducibility, a specific gas mixture composed of 55% hydrogen, 24% methane, 3% ethane, and 18% carbon monoxide with a BTU content of 539 is now specified in Method 5903T.

To illustrate how these test methods are limited to the materials for which they were developed and cannot be used as a test for the flame resistance of any material in any use, consider these two examples from our experience. In the first case, the fabric burns completely, the test says that it is not flame resistant. Its use, however, is in an air-supported shelter, and when the shelter itself is contacted with flame, the fabric chars and the escaping air from the tent is sufficient to put out any flaming.

In the second example, the fabric passes the vertical bunsen test. The test says that the fabric is flame resistant. It is a plasticized coated fabric intended for use in conventional tentage. When made up into a tent and shredded paper placed along one side, then ignited, the fabric bursts into flame and the entire tent is consumed. In use, the fabric was not flame resistant. In trying to find an explanation for the behavior of this fabric, it became clear that the plasticizer was the cause of the burning. In the vertical bunsen test, the short contact time with the sample was not sufficiently long to distill the plasticizer from the fabric. The plasticizer was flammable. However, in the field burning test, the conditions were right for the distillation and ignition of the plasticizer. By making a cone of the fabric and heating it with a bunsen burner, the plasticizer could be ignited with a burning splinter. No ignition occurred when the plasticizer was removed with a carbon tetrachloride extraction.

In addition to the standardized test such as the vertical bunsen test, there are special purpose tests. For various types of protective clothing, the flame source that will be the hazard in burning the textile is known. For example, it may be molten steel, it may be an explosive powder. A test method is designed, which uses the molten steel or explosive powder as the flame source.

A test method used in steel mills for protective clothing stimulates the splash of molten steel on the fabric. It is also designed to tell whether the fabric system provides insulation enough to the molten steel to prevent serious burns. The fabric sample is held at an angle and placed over a polyethylene film. The molten steel is poured on the sample and any flaming of the fabric or melting of the polyethylene film is noted.

In testing protective clothing for handlers of explosive powder, a weighed charge of powder is ignited at a set distance from the test garments stuffed with flame resistant cloth. Ignition or flaming of the garments indicates failure. In such a test, it is of interest to know whether or not the conditions at the site of the sample garment are severe enough to burn untreated cotton. Control of this factor has been introduced into this test. Bits of untreated cotton are suspended on a light wire fence in the same plane as the test garments. After the charge is ignited, the pieces of untreated cotton are inspected and designated as unaffected, scorched, or burned. Thus, they provide evidence of the areas where the conditions were severe enough to burn untreated cotton, in other words, evidence that the test garment was subjected to conditions severe enough to ignite it if it were untreated.

In summary, the various methods that have been developed for judging flame resistance of textiles are good guides to the performance of these textiles when the methods are limited to the materials and end uses around which they were developed. When extended to new materials or new end uses, they can often be misleading.

RESEARCH AND APPLICATION AT LYNRUS FINISHING COMPANY

C. F. Russell, President

Lynrus Finishing Company

Interest of the Lynrus Finishing Company in flame retardant application dates back to 1930 at which time we were engaged in production of a primitive type of outdoor finish for awnings and canvas. Progress was very slow and the methods complicated. Seven steps were used, whereas today a fire-retardant finish is applied in one step.

Much help has come from the Research Division of the United States Department of Agriculture and from the Army Quartermaster Research Center. Demands for improved fire-retardant finishes were stimulated over the years by every major catastrophe, such as the Morro Castle ship fire, the Hartford Circus fire, the Cocoanut Grove fire, and the recent Hartford Hospital fire.

In 1956 we were successful in producing a flame-retardant cotton fabric that met the requirements of the United States Navy for officers' flying suits. This required the upgrading of the fabric to give the following qualities: high air permeability for comfort and coolness to the wearer; moisture absorption; the passage of moisture vapor through the fabric; the unimpairment of tear strength and tensile strength; good hand flexibility; good sewing qualities; and the ability to retain these qualities after multiple launderings and/or dry cleanings; the ability to resist flame or intense heat without melting, dripping, or excessive shrinkage away from the heat source.

Since that time we have processed many millions of yards of this and other cellulosic fabrics with our fire-retardant treatment, known as FR-1. These treated fabrics have found use in all fields from tents to ordnance workers' clothing.

For non-military use FR-1 provides protection for workmen in steel mills, chemical plants, and so on. FR-1 gives safety for hospital cubicle and casement curtains, and in the near future, for bathrobes, pajamas and similar garments.

For this use cotton fabric so treated retains the properties of untreated cotton. Cotton draperies respond beautifully and, for example, are now being specified for Air Force theaters. Larger acceptance will mean larger volume and lower cost.

Application of FR-1 is of our own devising and the equipment is simple, arranged and designed to meet our own requirements. It is the well-known pad dry cure and wash method common to "wash-wear" and other treatments. Regular quality and laboratory controls are performed to insure uniform production. Our research efforts stress constant work with available new chemicals and development of new chemical structures which may produce superior results and ultimate cost benefits.

The capacity in this country for supplying flame retarding treatment is sufficient to supply the world, we believe, and no new plants need be constructed for this purpose.

A FLAME-RESISTANT SYNTHETIC FIBER

Witt Langstaff, Manager, Verel Fiber Sales

Eastman Chemical Products, Inc.

The company I represent, Eastman Chemical Products, Inc., which is a subsidiary of the Eastman Kodak Company, markets a modacrylic fiber called Verel. This fiber has outstanding flame resistant properties, and consequently, can play an important part in the reduction of fire casualties.

In order to further this discussion, a summary of the work done on flame resistant products made with this fiber has been prepared.

(Brochures were distributed entitled "Evaluation of Flame Resistant Products Made With Eastman Verel (R) Modacrylic Fiber.)

My remarks are intended to acquaint you with the flame-resistant textile products that are now being made from this fiber and those which can be made from it, and also to review briefly the flame resistance evaluations that have been conducted on these products.

Verel is a chemically modified acylic type fiber designated by the term modacrylic, as required by the FTC. Straight acrylic fibers contain at least 85 per cent acrylonitrile. Verel contains at least 80 per cent of a copolymer of acrylonitrile and vinylidene chloride. While the properties are very similar to those of the acrylic fibers, Verel is different in several ways. The only difference about which we are concerned at this conference is the fact that Verel has a high degree of flame resistance because of its chemical composition. This, of course, is a permanent feature built into the fiber, which is not affected by washing, dry cleaning, or aging.

Verel fiber is used in carpeting, both in 100% form and in blends with acrylic fibers. It is very widely used in various pile fabrics. A very popular item at the moment is a pile slipper fabric. Small pile rugs are made of 100% Verel and of blends with acrylic and nylon where Verel provides an important degree of flame resistance; Verel is knit into pile robes and liner fabrics with various textures, and into pile coats, which may be 100% Verel or blends. (Display boards of various fabrics shown to the group.)

Verel is being evaluated in upholstery fabrics; in blankets both tufted and woven, and in flame-resistant bedspreads. It is well established in a wide range of drapery styles.

There is growing interest in Verel wall coverings, furniture batting that will not allow penetration of flame, air filters, and knit and woven apparel of both 100% and blended Verel fabrics.

Cubicle divider curtains made with Verel have just been adopted by the Veterans Administration for use in some of their hospitals. There are bed pads with a blend of acrylic fiber, Verel, and nylon. Also pajama fabrics have been developed for the Veterans Administration.

In the area of flame testing, we have attempted to use test conditions which would be encountered in actual use of the product in question. As an example of a practical burning test, we hung on drapery rods three drapery panels made of Verel/Rovana/rayon, 100% cotton, and 100% Verel. A fire was started in a one-pound pile of shredded paper at the base of each drape. The open weave Verel/Rovana/rayon drape charred and fell apart in the lower third of its length but did not ignite. The untreated cotton drape ignited and was completely consumed in a matter of several seconds. The 100% Verel drape shrank away from the flame and charred but did not ignite. Both of the Verel-containing fabrics had passed the large scale test in NFPA No. 701 and the cotton fabric had failed this test.

Verel is used extensively in acrylic blend carpeting to inhibit propagation of flame. A study of various blend levels showed that a minimum of 20% Verel was required to prevent flame spread across the face of the carpet. Some manufacturers use 30% Verel as an extra measure of safety.

The burning characteristics of pile fabrics, particularly those used in robes, have been investigated by Eastman. To simulate an actual condition of use, sleeves of robes made with acrylic fiber and with Verel fiber were held over a flame source for two or three seconds. The Verel pile robe did not ignite but the acrylic fabric did ignite. Acrylic fabrics of this type burn more slowly than brushed rayon or cotton fabrics, however.

Our study of the Verel upholstery fabrics suggests an effective way of reducing the number of casualties from fires originating in upholstered furniture. In this study miniature upholstered cushions made with 100% Verel upholstery fabric placed over a cotton batting were used. Methenamine tablets were ignited to give a controlled flame source on the surface of the cushion. The fire did not spread on the surface of the Verel fabric and did not penetrate into the batting. Similar tests with cigarettes and matches also failed to ignite the cushion. There is evidence that up to 50% rayon can be used in the fabric blend with similar results.

A great deal of work has been done in developing flame-resistant mattresses with Verel fiber. As a measure of flame resistance, miniature mattresses were subjected to lighted

cigarettes, methenamine tablets, and wooden matches at both 0% and 50% relative humidity to see if any flame would result. From these tests it was decided that the best combination for flame resistance at the lowest cost consisted of a 50% Verel/50% rayon ticking fabric with a thin batting of 50% rayon and 50% Verel on top of the cotton batting. There is also evidence that the 50% rayon/50% Verel ticking directly over conventional cotton batting will do an adequate job of preventing ignition. Based on this work, a commercial flame-resistant mattress is now available from a major manufacturer.

Quite a few combinations of Verel with cotton and rayon were investigated for suitability in making flame-resistant mattress pads and several were found to be satisfactory. The 60% Verel and 40% rayon fabric over an all-cotton batting did not allow a lighted methenamine tablet or lighted cigarette to penetrate the batting and ignite the cotton batting.

A methenamine tablet was used to test the relative flame resistance of blankets made from 100% Verel modacrylic fiber and 100% acrylic fiber. Flame spread steadily across the acrylic fiber blanket until it was consumed but did not spread in the case of the Verel blanket. The blankets were tested in a horizontal position and a wool blanket which underwent this same test did not spread the flame.

A bedspread fabric made with 50% Verel and 50% cotton will not pass the vertical test used for draperies in the Standard for Flameproofed Textiles, NFPA No. 701, but it will pass a horizontal test. In other words, if a match or other ignition source were dropped on this bedspread on a bed, the flame would not propagate even though there were several layers of cotton fabric beneath the spread. We feel that some products don't need as much flame resistance as others and that bedspreads should not have to pass as stringent tests as draperies, for example. This helps keep the economics of the product in line by allowing the use of higher percentages of inexpensive rayon or cotton.

Cotton wearing apparel fabric can be given a degree of flame resistance with 25% or 50% blends of Verel fiber. Samples of this blend did not pass the test for flameproofed textiles in NFPA No. 701 although the rate of burning of fabrics containing 25% Verel was half that of all-cotton fabric. When a burning match is laid on a 25% Verel/75% cotton fabric, the flame does not spread.

We don't want to leave the impression that Verel fiber is a miracle fiber that holds all the answers to the problem which we are here to discuss today. However, because of its inherent flame-resistant properties along with its other desirable properties, Verel fiber has a unique ability to contribute to reduction of fire casualties by providing flame resistance to a large number of textile products. Eastman welcomes the opportunity to work with those interested in developing or utilizing products of this type.

For a free copy of the report on which this talk is based, "Evaluation of Flame Resistant Products Made With Eastman Verel Modacrylic Fiber", write to W. I. Langstaff, Eastman Chemical Products, Inc., Kingsport, Tennessee.

DISCUSSION PERIOD

Mr. Clarence B. Hood: Were the laundry tests on the sheets at the New Orleans Veterans Hospital the conventional VA laundry procedure?

Mr. George L. Drake, Jr.: Yes.

Chairman Morgan: Does anyone have any comment on how many washings a normal sheet can be expected to undergo in a hospital?

Mr. George H. Moore, Jr.: The average we get is 200 to 400, depending on the quality.

Mr. George S. Buck, Jr.: I was going to mention the figure of 280.

Dr. H. J. Wollner: What is the cost in terms of pounds of chemical to the end product for 10 per cent add on? Secondly, is there any change in the soiling tendency of the cotton as a result of this product?

Mr. George L. Drake, Jr.: We have done a projected cost study for APO ranging from $2.25 a pound down to 30 cents a pound and projected prices of THPC of 70 cents per pound to 30 cents a pound. It runs approximately 13 cents per yard for the high figures and down to 4 to 4 1/2 cents a square yard on 8-ounce fabric for the lower figures quoted using a hypothetical plant at a processing rate of 120 yards per minute.

In regard to soiling, there is some increased soiling with some soils. With others, there is a decreased amount. It depends whether you are talking of oily type soil or water type soil or dry soil.

Dr. H. J. Wollner: Which is higher, the hydrophilic or hydrophobic?

Mr. George L. Drake, Jr.: The hydrophobics soil more; but it depends on which hydrophobic fiber is used.

Mr. Charles F. Canavan: Would the per-square-yard costs quoted by Mr. Drake be prohibitive for ordinary commercial fabrics?

Mr. George S. Buck, Jr.: I think the basis of the cost figures given by Mr. Drake is questionable. They anticipate large-scale production of materials and reduction in price of raw materials. Mr. Russell might like to comment on the present commercial cost of this finish. My guess is that it would be in the neighborhood of 30 cents to 40 cents a yard. Getting costs down is a very vexing problem. The raw materials produced in relatively small quantities are quite expensive. You can't get the cost of these materials down until you get volume. You can't get volume until you get the cost down.

If the raw-material cost was in the range of 3 1/2 cents, which is the best Mr. Drake projected, it would be possible to make these finishes widely available.

Mr. C. F. Russell: The present cost of THPC is, I believe, $1.05 a pound in quantity. I don't know the present selling price of APO. To the best of my knowledge, it is not produced in this country in quantity. When we buy, we have to pay in the neighborhood of $2.50 to $2.80 per pound. As Mr. Buck says, this is a matter of volume before these prices can come down to this area.

Mr. Witt Langstaff: Does the THPC-APO finish have permanence to dry cleaning, and what are aging and oxidation properties of treated fabrics? Is the treatment effective on napped fabrics?

Mr. George L. Drake, Jr.: The finish is durable to dry cleaning.

If ultraviolet aging and oxidation of mineral khaki are done indoors with carbon, there is color degradation. On outdoor exposure, the reverse is true, vat dyes retain their color better. However, when this flame-resistant fabric has been exposed outdoors in New Orleans, where the average relative humidity is about 85 per cent throughout the year, it has been possible to extend the life of the flame retardant for a maximum of eighteen months.

Answering the question about flame resistance of napped fabrics, if there is adequate flame resistance, we get essentially no flash.

There are no problems in gas fading to my knowledge.

Mr. George S. Buck, Jr.: It ought to be pointed out that we are continuing to work in every possible way to get the cost of these fire-resistant cotton fabrics down. In all fairness we should say that the cost of Verel is not within the range of normal cotton fabrics. That is a relatively expensive fabric. As Mr. Langstaff pointed out, there are other things about the modacrylics that render them not the best choice in many uses. I would include hole burning, static properties, the fact they generally require low-temperature washing and low-temperature drying in order for wrinkles not to be set in them. They have poor dyeing properties. They show discomfort next to the skin. They have a hot melting character which is characteristic of all these artificial fibers other than the cellulose ones.

Mr. Witt Langstaff: I would like to comment on some of the points made by Mr. Buck. I would certainly agree that Verel isn't the panacea for all areas of application. Just as none of you would buy wool bed sheets, neither would Verel be the best choice for some applications.

Verel does not have poor dyeability as suggested. As a matter of fact, it dyes quite readily at the low temperature of 140°F, which has been very helpful in the manufacture of certain types of fabrics.

The abrasion of Verel is a little bit better than wool but is in the same range.

Mr. George S. Buck, Jr.: Will it take vat dyes?

Mr. Witt Langstaff: No, a different class of dyes is used with Verel but fastness of 60 to 100 hours can be obtained. Verel fiber ranges in price from 65 cents to 75 cents per pound as compared with combed cotton which is about 55 cents and raw cotton which is about 35 cents or 36 cents. So, there is a difference in cost.

Miss Dorothy Downs: Will Mr. Buck comment on the discomfort of the wearing of Verel blends?

Mr. George S. Buck, Jr.: We have been testing wearing apparel comfort of artificial fiber fabrics. We have been associated with and observed quite a few other tests. It is true that the polyesters, modacrylics, and acrylics in the same construction as cotton do feel hotter under many circumstances when there is bodily activity and perspiration. That doesn't mean they aren't useful. They are useful in such garments as sweaters, but not next to the skin. Many of the applications pointed out on the chart by Mr. Langstaff are legitimate. Some are less legitimate. But this is the normal practice of the normal artificial fiber manufacturer—to try the fibers in every use they can.

Let me apologize for rising and making this observation. We in cotton get a little tired of being stepped on. Mr. Langstaff did use a comparison between his fiber and untreated cotton, and we don't use untreated cotton in these fire resistants. Just a week ago, a manufacturer used, in a full-page ad, a wash-wear shirt with an untreated cotton shirt, showing the comparison on wrinkling. Why didn't he use the treated cotton which could beat the synthetic, hands down? These are the things we have to rise to.

Chairman Morgan: It seems to me that many synthetics appear in undergarments.

Mr. Louis Segal: It was my fond hope when this conference was first discussed that it would result in a strong campaign for public education about the hazards of flammable fabrics. I think it has been absolutely perfect in that respect because all of these discussions have proved nothing else. We have found that cotton has wonderful properties in many respects, synthetics do, too, flameproofing has a lot of merit, but none of these at least for now will furnish the answer we are looking for. I think that these discussions have done a great deal of good and I would like to thank all of the participants.

Miss Dorothy Downs: As flame-retardant fabrics come on the market and women, especially, buy them for clothing and for home decorative uses, their slow burning property will give people a chance to do something if fire occurs; namely, call the fire department.

Mr. George S. Buck, Jr.: I do not think we plan to develop a treatment that will make fabrics slow burning. Treated fabrics being developed will burn only at the point where flame impinges on the material and the artificial fabrics char away. I think it would be dangerous to develop a fire-retardant finish which only slowed down the rate of burning.

Dr. H. J. Wollner: There was a documentary put out on television by du Pont Sunday night. In the next-to-last segment, a woman who had gotten out of a burning tenement house was interviewed by a reporter while the fire was being put out. The one impression she had was that the curtain went up in flame at an explosive rate, and she received this as a signal to pick up her child and get out.

I was impressed with the hopelessness of her position at that point where a decision had to be made and rational thinking was not a component in that situation. She didn't have time to orient herself in putting in an alarm. She had to move right then and there.

I think if we take this as an example of the need at this stage in presenting the American public with slow-burning fabrics, a terrific advance will have been made in dealing with the problem without necessarily neglecting the ultimate objective of producing fabrics that will not burn. If we only accept the ultimate as the ideal, we may overlook correcting the problem to at least 90 per cent of its need at the present time. I think if my wife and millions of other wives could be educated to the fact that the hazard can be reduced at least in part by the purchase of slow-burning fabrics, a tremendous inroad in solving this problem will have been made.

Mr. Witt Langstaff: I would like to compliment Mr. George Drake on the work which he and his group have done on flame retardant finishes and, particularly, the work on permanency. Loss of effectiveness with age has been a major weakness of flameproofing treatments in the past.

Mr. Robert K. Lewis: It appears that it will be many years before synthetic fibers make a real impact on the volume of cotton that is necessary. Is any experimental work being done on developing a cotton which has inherent flame-retardant properties or on a plant which might absorb some flame-retardant chemical? It appears to me that if such a plant could be developed, it would answer many of the problems that we have. If we go to a manufacturing process, there will be the problem of selection—some manufacturers will and some will not apply the treatment to similar items—with attendant confusion for the wearer.

Mr. George L. Drake, Jr.: Work of this type is being tried. However, in order to impart flame resistance to the cellulose molecule, you have to change its structure. There are carbon, hydrogen and oxygen in the molecule. In order to impart flame resistance, we have to change this molecule either by reaction of the side chain hydroxyl groups or by polymerization or both.

Mr. George S. Buck, Jr.: I think it is biochemically impossible to make cotton inherently fire resistant. I don't believe that the process which lays down cellulose can be altered to that extent. You would have to introduce in some way rather complicated phosphorus compounds which almost surely would interfere with the chemistry of the plant. But it is not at all impractical to finish a fabric and to do it on large-scale production. This shirt I am wearing is what is called the wash-wear shirt. We finish 2 1/2 billion yards a year of this wash-wear fabric, a process which basically is not too far away from the process Mr. Drake is working with. The problem of getting the cycle of cost moving down, can be solved; I think this will eventually happen. A substantial amount of cotton goods can be made available with fire resistance.

Mr. Richard Knapp: Introduction of flame retarding by the manufacturer is probably in the distant future. Has any work been done on introducing a material into household detergents whereby the housewife, in her normal, daily routine of washing the clothes, could introduce fire-retardant properties to the fabric?

Mr. George L. Drake, Jr.: This is being done for the water-soluble type flame retardant, but there is no indication that the right amount is

added to get the result desired.

As Mr. Langstaff pointed out, draperies hung over a period of time lose their flame resistance. Many organic materials will decompose if not durable. In addition, water-soluble flame retardants will pick up water and run down the curtain and pool on the floor.

Mr. Louis Segal: It sounds good to think in terms of the housewife's doing her own flameproofing, but this is not a simple solution to the problem. Simple flameproofing chemicals are effective on cellulose fibers only. I shudder to think of the average housewife's being advised that she can flameproof cotton but not nylon or acetate. The average housewife doesn't look at labels, and even if she did, she probably is not qualified to make the distinction.

Do-it-yourself flameproofing may also create a false sense of security.

Mr. William V. White: It was mentioned that the APO-THPC process is applied to fabric before it is made into garments, sheets, or bedspreads. What have been the results of applying the finish after the garment is made?

Mr. George L. Drake, Jr.: In my remarks, I mentioned briefly that the finish has been applied to garments and sheets. We do not recommend this as the best application method; however, it can be done. The garment can be wet with the solution, centrifuged to a certain wet pickup, tumble dried until the fabric is dried, and then cured in a dryer at 140°C. However, it is much easier, simpler, and cheaper to apply at the mill where 120 yards a minute can be treated.

Mr. William V. White: In asking the question, I had in mind the motel operator or hospital administrator who has cotton sheets and drapes. He might be interested in having flameproofed sheets and drapes, but he certainly wouldn't want to discard the nonflameproofed items he now has.

Mr. George L. Drake, Jr.: Treatment of the finished product would be more expensive; but, it has been done by a commercial company.

Mr. George S. Buck, Jr.: Aren't there some problems with odors? The THPC-APO process isn't something a layman should apply.

Mr. George L. Drake, Jr.: I definitely would not think that the housewife should try to apply this treatment in the home. Precaution should be taken with the chemical. When THPC combines with APO, formaldehyde and HCl—both of which are toxic—are among the products. The cross-linking can react with the skin and, in fact, can cause dermatitis. After polymerization there is no toxicity.

Mr. William V. White: Did you say there is a company that applies the THPC-APO treatment to finished products?

Mr. George L. Drake, Jr.: They are not doing it for other people. They are doing it for themselves. The name of the company cannot be released at this time.

Mr. Rexford Wilson: Could you give us some idea of the initial cost of developing the chemicals that give wash-wear properties to cotton and the present cost of these chemicals? Also, how much does treatment increase the cost of the fabric?

Mr. George S. Buck, Jr.: Actually the initial costs of these finishes were not high because the first treatments that came on the market were relatively poor compared to the ones now available. Almost all the early ones sold for around 5 cents a yard. Within the last couple of years, some of these new types which are much more effective than the early ones, and which get away from some of the disadvantages of the earlier treatments, carry a premium of as much as 15 cents a yard; but a demand for this wash-wear quality has been created. Consumers will pay a dollar more for wash-wear shirts but consumers won't pay a cent more for fire resistance.

Dr. Hilla Sheriff: I would like to ask Mr. Drake if there would be danger with these treated sheets in an incubator for newborn babies? Would they break down in the heat to form aldehydes?

Mr. George L. Drake, Jr.: The chemical breakdown takes place during the processing of the fabric. Once the fabric has been treated and processed, it has cross-linked with the cotton and formed polymers and cross-links. We do not get a breakdown of material when polymerized except on decomposition. The decomposition point is at around 300°C.

Mr. Harry G. Kennedy: Mr. Langstaff, you mentioned some work that was being done with pajamas. Are there any figures available with regard to absorption of moisture and perspiration on Verel fabrics?

Mr. Witt Langstaff: The normal moisture regain of Verel fiber is about 3 1/2 per cent. However, there is a very high rate of transfer of moisture through Verel fabric and away from the body, but I wouldn't expect the comfort level to be quite what it is with untreated cotton. I would expect Verel to be a little bit warmer for a given weight.

Mr. Rexford Wilson: Would there be any breakdown of the treatment in a home dryer?

Mr. George L. Drake, Jr.: Once a fabric has been treated, the dryer is no problem. It doesn't get hot enough. The temperature is 140° centigrade. The chemist works in centigrade and the engineer and everyone else works in fahrenheit.

Mr. Charles F. Canavan: Does NFPA No. 702 have a method of measuring the flame spread of hula skirts and other non-fabric wearing apparel?

Mr. Louis Segal: Yes, the method is described in Chapter 5. The method is patterned after one in NFPA No. 701, Flameproofed Textiles. Briefly, the method determines whether or not the material burns sufficiently for the flame to reach the top of a vertical sample in 10 seconds.

Mr. Charles F. Canavan: If there is going to be an effort made to amend the present Commercial Standard 191-53, the method you describe will create problems for the FTC. The time element is so small people running such a test are going to vary in clicking the stop watch if timing is based on visual observation of when burning starts, and when the flame reaches the top of the sample. This sort of test would cause terrific problems for the prosecutors.

Mr. Louis Segal: The reason that the method is not delineated any further is that the materials to be tested may not be of uniform construction. I don't see much point in giving an exact method of testing hula skirts when everyone could take a different sample to begin with. It is not by any means the best method possible, but it is the only one to date.

Mr. Charles F. Canavan: I am one hundred per cent in sympathy but I am thinking of the problems.

Mr. Louis Segal: The hula skirt is one thing, the Santa Claus mask another, paper hats another. If the testing procedure were drawn up in greater detail, it would be impossible to run any tests on some materials.

Mr. William V. White: Could we get a rough comparison of costs of an average-weight drapery in cotton treated with APO-THPC and the same drape made of Verel, both with good fire-retardant quality? From what I have heard, I would think the cost would be about the same.

Mr. Witt Langstaff: From the Verel standpoint, I will have to give you an approximate range. At present the lowest-priced drapery fabric with Verel in it, which passes NFPA tests, is available from the manufacturer at about 80 cents per yard. From there, fabrics range all the way up to about $2.50 a yard from the manufacturer. In most instances the fabric goes through converters and/or jobbers before it gets to the final purchaser. Thus, the figures mentioned are starting points rather than final prices.

PUBLIC EDUCATION POSSIBILITIES

WHAT THE NFPA CAN DO

Deuel Richardson, Manager, Public Relations Department

National Fire Protection Association

From the very outset of this conference, it has been obvious that there is one point at least on which there is general agreement; namely, that whatever else we can do, we are going to have to rely very heavily on education to deal with this problem of clothing fire casualties.

The history of efforts to educate the general public on a national scale can be sketched very briefly. Since NFPA launched the first public fire prevention program in 1909, the problem has been attacked but in a way you might call indirect. The NFPA and the many other organizations which have been concerned with fire prevention education have talked almost constantly about the hazards of children's playing with matches, portable heaters, and smoking. The possibility of clothing's and other textiles' being ignited was sometimes mentioned, but the emphasis was on the source of ignition rather than on the combustibility of the clothing.

Important as these warnings were, and are, I think it is fair to say that the public never was really sold on the idea that ordinary clothing can burn and that the frequency of wearing apparel fire casualties can be reduced by selecting proper materials and designs, as well as by avoiding potential sources of ignition. The first NFPA folder attempting to do this job was prepared by the NFPA Committee on Wearing Apparel in 1956. After it had gone through five printings, it was followed this year by a new folder, a copy of which was included in your kit. The new folder is basically a condensed version of its predecessor.

The Facts About Fire Sheet that has been published annually by the NFPA over a period of years has fairly consistently contained an item on the subject of clothing fire hazards. Both the folder and this sheet have been very widely distributed by fire departments, industrial firms, and other organizations, and as many as two million families may have been exposed to this form of education during the past half-dozen years.

We have also made a concentrated effort to reach the general public through news media. A Fire Prevention Week clip sheet, a copy of which was included in your kit, contains an article on clothing fire hazards. Every daily newspaper in the country, many weeklies, consumer publications, and house organs have been reached with this material. Although there is no way of indicating the extent of its use, we think it has been widely used.

The same sort of material has been included in a kit supplied as a service to every one of the 20,000 fire departments in the country, and to county agricultural agents, to give them material to use at the local level.

Another approach has been to supply educational material to the schools. This has been done through Sparky News. Other materials for this purpose are in the planning stage in our office.

In describing these NFPA efforts, I don't want to give the impression that the NFPA has been carrying the ball all alone. Many other organizations have participated. For one, the National Safety Council has produced an excellent and comprehensive bulletin for educators. There have been good local and state programs, one of the most notable being California's.

As far as the future is concerned, we expect to continue our present efforts and expand them as far as our resources of time and money permit. Anything that can increase the distribution of literature and information by news media and magazines increases the number of individuals reached in this educational work.

One important tool we lack presently is film material. Our Committee on Wearing Apparel has attempted, so far unsuccessfully, to line up financial support for a feature film for public and school showing. We would hope to be able to lift footage from this for TV spots which would help to reach a great many more millions of people. We are still hopeful that this material will become available. It would make an enormous impact on the public.

I am sure your enthusiastic endorsement of the whole idea of education must be coupled

with some specific suggestions. We have already heard some, ranging from badges for hospital patients to an insurance program for individual purchasers of clothing. I am eager to hear others.

OPPORTUNITIES FOR PUBLIC HEALTH AGENCIES

Harold W. Demone, Jr., Executive Director

The Medical Foundation, Inc.

From the public health viewpoint, the problem of textile flammability would probably be incorporated in accident prevention programs. At this time, accident prevention is receiving a great deal of attention from public health officials; and, therefore, I would assume that the problem of textile flammability could be included. However, based on my personal lack of information about textile flammability, I would suggest that, for the moment, more effort be directed to education of the professionals than to public education. There could be special workshops for various disciplines, and papers given at various professional society meetings. Similarly, information about the problem and appropriate role assignments could be built into formal education channels in public health or even in architecture.

This conference illustrates the potentialities of the integration of all interested parties in a common subject. We, from public health, are cooperating with the National Fire Protection Association, the textile industry, the insurance companies, the authors of building codes, the Army Quartermaster Corps, the United States Department of Agriculture, Federal Trade Commission, and with our traditional partners in the medical profession to seek an answer to a problem. Such a combined partnership would have been unlikely not many years ago.

Our goals and their accompanying techniques and procedures extend beyond primary prevention—the flameproofing of textiles. We must know something about the causes and natural history of the problem if we are to develop action programs. The whole area of accident prevention illustrates this principle clearly. Preventive medicine "requires anticipatory action based upon the knowledge of the natural history of disease in order to make the onset or further progress of disease unlikely. Anyone practices preventive medicine who utilizes modern knowledge to the best of his ability to promote health, to prevent disease and disability, and to prolong life. This means merely good medical and dental practice for individuals and families and good public health practices for communities."[1] This implies knowledge based upon research. What are the epidemiological, ecological, demographic, and psychological characteristics of textile fire casualties? How do we apply our increased knowledge of "motivation, of the effects of anxiety or stress, of susceptibility to accident, and of the architectural and mechanical equipment"[2] and textile design that may reduce textile flammability? Who applies this knowledge? When? Where? To whom?

Public health uses a number of analytic operational models for problem solving. One such model is the host, agent, and environment. This is pictured as a see-saw or tester-totter with the host and agent sitting on each end and with the environment acting as the fulcrum. When the see-saw is not balanced, ill health results.

1. The Host. The host for this discussion will be the textiles. Here clearly the goal is to reduce textile flammability. It requires many ingredients—the technical know-how by the industry to bring this about, national cooperation and standards by those organizations most concerned, and local implementation. Perhaps most of all we need more information and skills. Incidentally, if successful, this would be primary prevention.

2. The Agent. Who accomplishes the many goals which we can set for ourselves? As suggested by the composition of this conference, there are many disciplines and special interest groups with a legitimate concern. In public health, specialists in Health Administration, Public Health Nursing, Environmental Health and Epidemiology all could play a role. The public health nurse, as recorder and educator about accident prevention, the environmental health people in setting standards, specifications and requirements for public and private buildings and furnishings, illustrate appropriate roles.

3. The Environment. All external factors influencing the area of textile flammability constitute the environment. While there are, no doubt, more factors entwined with the

1. Leavell, H., & G. Clark, Preventive Medicine for the Doctor in His Community, 12-13. McGraw-Hill Book Co., New York, 1958.

2. Freeman, R., & E. Holmes, Administration of Public Health Services, 464. W. B. Saunders Co., Phila., 1960.

problem of textile flammability than I can cover this morning, some of the factors that come to mind immediately are as follows:

a. Safety Code. The entire question of health, building, safety and standard codes needs a careful reviewing and up-dating, for both public and private construction, design and furnishings. Is there any community that possesses an ideal code? Do we have an ideal and realistic code which communities can use as a model?

b. Fire Extinguishers. Certainly industry, insurance companies, and the fire prevention people have been relatively successful in the development and placement of fire extinguishers. Are we satisfied by our recent status—our progress? Can it be improved? Are there other groups which might assist in this campaign—health departments, chambers of commerce, organized labor?

Should we have a campaign for home use of fire extinguishers? If sufficiently legitimate, might it be subsidized?

c. Public Information Programs. Before embarking on a public information effort, the goals must be clearly defined. Do we have something to say or will the issue be clouded? Can we give some concrete advice? Some possible areas could be to seek support for more stringent building codes; to secure regular voluntary home inspections of potential fire hazards; to arouse interest in groups who should be aware of the textile flammability problem, but for various reasons are not alert to the danger; and even to raise money for an educational program.

Enlisting public support for special concerns is a goal of most groups, but not easy to accomplish. Clearly the more diffuse or broad the goals, the less likely of success. The first decision to make when undertaking public information programs is regarding goals. Can priorities be placed, and goals sharpened?

Let us assume for the moment that our goals are clear. How do we develop community support and action? Since public communication means to many people the mass media, let us begin there. My bias will show now. The mass media in a democratic society cannot easily create needs, if at all. The professionals in the mass media know this very well although on occasion they will find themselves trapped in their own propaganda.

Nevertheless, the mass media can serve to make the listeners ready to accept the fact that textile flammability is a problem—if they hear it often enough. While we may not create a need, we can build an awareness. Of course, this is an expensive procedure. If you don't believe me, ask the plastic industry how much it cost to get people to destroy their thin plastic film bags before the children played with them and suffocated.

To be effective, whether your goals are commercial or noncommercial, the message must relate to need. There must be public demand. Further, we must remember that information is not education, but just one part of the total learning process. In our zeal to copy the advertisers, we overlook the fact that the advertiser is not trying to educate anyone, but rather is attempting to satisfy demands with a recommendation for specific action. He does not create a need for soap, but rather takes advantage of an existing need so that the name Rinso, Surf, or Tide pops into our minds the moment we think of purchasing soap. There is no evidence to support claims that the ad men can sell philosophy just as they do soap.

As an illustration of the difference between publicity and effective preventive or action programs, let me remind you of the National Safety Council's automobile safety activities and their recent critical review of this program.

Of course, mass media programs are useful. Unfortunately, they will do only a part of the job. Despite maximum cooperation of the media industry, as in polio or automobile fatality programs, much of the job remains to be accomplished by other means.

d. Public Education Programs. Although there is no general public, there are separate publics. Individuals do identify with groups. These groups have attitudes and values. They also possess decision-makers and "gatekeepers." An understanding of social class structure and beliefs, sub-culture values and ideas, peer-group relations, and organizational hierarchies are all essential for the mapping of an educational or informational campaign.[1] The economic interests of the textile industry, owners and renters of public buildings and private homes can be powerful motivators. Can they be made to work for you? How can the textile industry be really motivated to "go all out" in developing and using flameproof textiles?

I opened by stressing the need for additional knowledge—research. Let me reinforce this. Eventually we will need to understand why, for example, people have fatalistic attitudes toward accidents, or certain people have more accidents than others, whether the unconscious death wish is critical or to what degree sexual factors play a role in fire-setting. Similarly, we will probably need systematic reporting to a central source.

In Conclusion: Sometimes we have to move ahead, with preventive programs, because of the seriousness of the problem, without all the necessary information. Textile flammability programs are in this category. I urge only that in our uncertainty we recognize the limited nature of our efforts and try to step back regularly to evaluate them as a natural experiment.

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1. Johnson, R., "Mobilizing public interest in alcoholism programs" in Realizing the Potential of State Alcoholism Programs. State of Connecticut, Connecticut, 1959.

Mr. Percy Bugbee: I would like to pay tribute to Mr. Babcock for planning and arranging this meeting. When we first discussed this meeting, the Public Health Service left up to us the assembling of the right people to discuss this broad problem. The program we have had demonstrates very clearly that the right people were here. Obviously there were many other people who could have been invited and perhaps could have been here. We felt a group of this size was right for this type of conference.

In discussing this program, Dr. Chapman said, in effect, "I would like to assemble certain key people from the Public Health Service to become acquainted with this broad problem." Although most of these Public Health people present have been silent throughout these two days, I hope they have absorbed the sort of information that will be helpful to them in the years to come. If this has been accomplished, the Public Health people have the information needed to further the progress in reduction of loss of life and injuries to people—children and old people particularly—from textile burns.

It seems to me we have in this meeting developed a great deal of useful information which can be transmitted to many programs by the associations represented here.

I would like to assure all of you that we intend to prosecute from the NFPA point of view, the problem as vigorously as we can. We are confident that with the help of the Public Health people we can make substantial progress in this important field. The NFPA is most pleased to have had a part in this conference. We appreciate very much the contribution of the speakers and the discussion that has taken place.

Mr. Phil Dykstra: I have been impressed, as all of you have been, by the repeated emphasis that has been given to the point that this is a problem that can be solved most adequately and rapidly through education. That is the National Safety Council's forte, call it information or education.

We have produced a minimum of material on the subject of wearing apparel fires, primarily because we were at a loss to know what type of information and what type of educational material, would be most effective and should be promulgated through the various channels at our disposal. We do have an educational data sheet primarily written for educators and the information contained therein is disseminated by the educational fraternity to students, parents, and other audiences.

As we do with all areas of fire prevention, the National Safety Council has deferred to NFPA, and a note on this particular data sheet indicates that it was written by the NFPA Committee on Wearing Apparel. We also have a technical data sheet treating with fire-retardant fabrics and distributed through industrial channels.

Our Family Safety Magazine, written for the lay public and with a circulation of 300,000, has included articles in which the problem of flammable wearing apparel has been mentioned with precautions concerning the dangers of many of the present fabrics. Our home safety pamphlets have also included reference to the subject.

The Advertising Council claims that year in and year out, the problem of safety and more specifically the National Safety Council, receives more radio and television time than the next five causes combined. We regularly contact the press through monthly news releases as well as special news releases to the various news media.

Much of the correspondence which continuously floods our desks on all types of safety problems, is concerned with this problem of flameproofing of wearing apparel and similar material.

So we do receive excellent exposure to the public and will continue to utilize all of these means to reach the public with our messages.

The local safety organizations are probably our best channel for effective help in alerting and educating the public through conferences, seminars, institutes. They have the means of reaching key people in their communities—the chairmen of various safety committees of the various volunteer and professional organizations, the official agencies, etc. In other words, they are reaching people who can do something about the subject once they are informed.

There are many means at our disposal to educate the public. But the question remains, "What are we going to educate them about?" Are we going to continue, as appears from the general impression I have received from the past day and a half, to educate them simply to be careful? That is the easy way and that is what we often have to fall back on for want of something better. "Be careful of the type of clothing you wear; be careful of the type of upholstery and draperies you put in your home; don't play with fire." Those things we have been doing for years and will continue to do. They are standard cautions. To me, that isn't education. It is warning; it is alerting; it is informing. But I repeat, "What are we going to educate them about?"

To you who are representing industrial organizations concerned with this problem I say, "What are we to tell the mother of the homeowner who is constantly asking us—and I presume the NFPA—where she can get flameproofing material, or what she can do to make the existing material flameproof?" The National Safety Council will make as much of an educational effort as we can through the various channels and media at our disposal. But I urge each of you who have facilities at

your command to do something about answering that particular question, not to let down on your attempts to find an economically priced flameproofing process which will allow us to say, "Yes, there are materials available at a price which is reasonable to even the thinnest pocketbook."

So, education is right; but don't sit back and rely completely on education. Don't find yourselves in the position of certain other industries which were forced by legislation following a catastrophe or holocaust of some type to undertake a crash program. Help us in our educational effort by bending every effort in the research and production areas. Give us the answer for the mother of a burned child, who asks, "Where could I have gotten a blanket or robe that would have prevented my child's having this accident?"

We hope to have the opportunity to continue, with NFPA and other agencies, an educational program; but please let's not sit back and say that education is the complete answer. Our educational efforts must be backed as soon as possible with products on the market that can be flameproofed and flame retardant.

Chairman Morgan: Would Dr. Trimby like to comment from the point of view of the pediatricians or other groups in the medical field?

Dr. Robert H. Trimby: I can speak for the Academy of Pediatrics. As a member of the Accident Prevention Committee, I am here primarily to gather as much information as possible to help carry on a program of burn accident prevention.

I think many of you realize that the pediatrician has almost "prevented" himself out of the market. When I was in training, most of my time was spent taking care of polio, rheumatic fever, and scarlet fever patients. These illnesses have almost been eliminated. We have had to find other diseases to eliminate. Despite comments made against the medical profession, the doctor is really the only one who is trying to push himself out of a market.

We would perhaps appeal to you to do the same sort of thing and not let the economical aspects of the situation interfere too much with what we are trying to do. We will continue, of course, to do everything possible to prevent these burns. If you had to take care of one of the burn casualties, you would very readily see why we would want to prevent any more. These injuries are very disastrous to the individual, as I think all of you realize.

The plastic surgeons, whose livelihood depends on operations on people such as burn victims, are very active in trying to find methods of preventing burn injuries. Dr. Crikelair, who represents the plastic surgeons, thinks much more must be done to prevent these particular injuries.

The entire medical profession will do what it can in terms of prevention.

Mr. Rexford Wilson: Is a burn injury more difficult to treat than other types of injuries?

Dr. Robert H. Kennedy: By all means, if a person is seriously burned. I recall that during my forty-five years of private practice, if a person came into the hospital with a severe burn, you either practically closed up the hospital and devoted all your time to the treatment of this patient for seventy-two hours or more, or you found some particular hospital where they were treating burns.

Mr. Rexford Wilson: Is this the toughest injury that the medical profession faces?

Dr. Robert H. Kennedy: I couldn't go that far. From the standpoint of length of time that the patient spends in the hospital and the number of individuals concerned in the first few days of treatment, the amount of care required would be more than normal and might only be exceeded by the care required in multiple injury cases.

Dr. Robert H. Trimby: In one study, the average hospital stay for burns was 243 days.

Chairman Morgan: I am going to ask Mr. White if he won't make some observations on the point of view of the Department of Public Health.

Mr. William V. White: We in the Public Health Service are delighted to have had this opportunity to come here to learn. We want to thank the NFPA particularly for its part in organizing this meeting.

More and more often as we are learning in this field of accident prevention, we turn to our good friends in the National Safety Council. I was delighted to hear what Mr. Dykstra had to say. Last week he and I worked on another problem involving sliding-glass-door injuries.

Every day a new problem comes up in accident prevention, at least one that is new to us, because of new products coming on the market. New products are improving our way of living, but at the same time, many of them offer hazards. The hazards of the traditional items have not received the consideration they should from the public, one of them being the flammability of textiles. Certainly this is only one part of the total fire problem, only one part of the burn problem. It seems to be one that industry is trying to overcome by developing fabrics that won't burn as easily as fabrics now used in buildings and as wearing apparel.

What do we do from here? Do we go home and say it really is a problem and someday we hope to have it solved? I don't think we can leave it that easily. I think we have to leave here with the idea that we do have plans for getting additional facts to the consumer, particularly to the women of this country. I think we have to inform our organizations throughout

the country of what went on here during the last day and a half. As a starting point, the proceedings of this conference will be reproduced in quantity and made available to anyone in the country who wants them. We will distribute copies to every state department of health and every individual in the health service throughout the country, and will make copies available to anyone interested in the field.

The second problem brought up that we can take definite action on, is the lack of details on the deaths due to burn injuries. The National Vital Statistics Division, the keeper of records for us in the Public Health Service, has on file between 6,000 and 7,000 death certificates each year, classified as deaths due to fire and explosion from combustible materials. The 11,000 to 12,000 fire-death figures used by NFPA and others also include fire deaths in the transportation field. The 6,000 to 7,000 death figures are those recorded as "nontransport deaths" due to fire.

After a check is made of abstracts of these 6,000 to 7,000 certificates, microfilm copies can be brought back and analyzed in detail. Taking the information from these analyses, the professionals in the statistical field can undoubtedly come up with a lot more information than we now have. This will be my recommendation on returning to Washington. It will take some time, but within a year, this study should be initiated.

In our community demonstration project in accident prevention, this whole subject of fire injury will receive a lot more consideration than in the past.

More research can be done. Of the $2 million being spent on research this year, none has been spent in this field. Applications for grants, submitted by competent researchers on subjects relating to fire injuries, will be encouraged.

In cooperation with other organizations, we can provide films. For example, we are currently collaborating with an insurance company in the development of a film on family safety. For guidance on the technical fire safety aspects, we will refer the company to NFPA.

We are training public health workers every day in increasing quantity. Prevention of burn injuries will be a new subject in their training courses. Perhaps these new public health workers will be able to demonstrate the need for flameproof textiles to large users of textiles, and thus, create a demand for such fabrics. With availability increased, and cost decreased, these fabrics would be within the reach of the average consumer.

We would certainly welcome your participation on a committee to develop information for public consumption and to plan ways of bringing information on new developments in the field of textile flammability to the attention of the public.

Chairman Morgan: Thank you very much, Mr. White, for your very effective conclusion to our conference.

Are there further comments? There being none, the conference is adjourned.