April-May 1969

EMO

NATIONAL DIGEST

Standing Committee Evidence
Fire Aspects of Civil Defence
Alberta Conference
Organization in Disasters
"Emergency Measures Planning"
Our Vulnerable Breadbasket

CANADA EMERGENCY MEASURES ORGANIZATION

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Editor: A. M. STIRTON

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STANDING COMMITTEE EVIDENCE

The February-March 1969 edition of the Digest, Vol. 9 No. 1 republished the paper "The Effectiveness of Civil Defence" which was presented to the Standing Committee on External Affairs and National Defence. The following extracts were given in verbal testimony during the appearance before the Committee of Dr. Raymond Gastil and Mr. Robert Krupka of the Hudson Institute, Crouton-on-Hudson, New York, on January 30, 1969.

Mr. Krupka:

What do we really talk about? What is the sense of all of this? The sense is quite clear, and that is they are clearly prudential systems. You would not like to lose half your population by default when the technology is clearly there for protecting them even in time of emergency. One of my colleagues likes to use the statement that civil defence and protection is not over when the bombs fall. You keep digging, you keep putting stuff over your head as the weapons fall, as the fallout comes, what you are interested in is staying alive and you are interested in protection. So you are going to work very hard before a war, during a war, to keep yourself alive That is the name of the game.

On the other hand, it is very difficult to support those kinds of dynamic programs in peacetime. It is hard to make people — or Congress — much less people — think about nuclear war, on a sort of day-to-day basis. It is not possible and it is kind of unfair to do that. What we advocate in low-budget programs is what we call "crisis programs" — emergency programs — programs in which you are able to do things quickly in a crisis where essentially the country is up for grabs to protect people. You are willing to use almost all your resources in a very short time. You are interested in things like evacuation, emergency shelter building, resource allocation during that period, protection any way you can get it. We have tried a few programs, written a few programs, and we think it is possible to prepare emergency plans, well thought-out plans that might be given out to the country in a crisis. It might make a big difference.

Certainly the problem in the United States is a very difficult one because of the high urban population but, on the other hand, one would not like to lose the rural population for lack of knowledge about protection So my argument here essentially is, learn something about nuclear facts, about what is possible. Unless you do that somebody is liable to sell you a bill of goods. You want to be, it seems to me, very well informed about what fallout is, what you can do to protect against it, how much it decays, what blast effects are like, and what kind of supplies you may need in the shelter. Are there cheap things you can do in peacetime that would make a big difference in wartime? That is the kind of questions we are addressing ourselves to, and you might like to do that. We think the answer is yes, there are many things you can do and that will not cost a lot of money. . . .

Mr. N. A. Cafik (L): Would you anticipate that the primary purpose of an attack would be to destroy population? What advantage would it be to the Soviet Union to wipe out the American population as opposed to wiping out the deterrent effect, or the attacking effect, of the United States?

Dr. Gastil: This is a much discussed question. It is always assumed that if you are really looking at it as a purely rational attack, the overwhelming way to be attacked will be against our missiles, air bases and so forth — parts of the purely defensive apparatus — and if that type of attack occurs then, of course, overall casualties, and so forth, from the civil defence point of view will be much less. However, Soviets have, in their discussions in the past of what they would attack, listed categories of targets which range all the way from things such as transportion, communication and industrial centres — and by that you can read cities — to the types of stragetic forces, so I do not think we can necessarily assume that they are going to avoid cities.

Mr. Cafik: All right. In a massive attack against the United States and presuming that no weapons fell directly in Canada but very close to it along the border — Detroit, and so on — what would be the effect of fallout in this country? For how long a period would we be under this cloud of fallout?

Mr. Krupka: Well, the decay varies, but generally we try to think in terms of about two weeks.

Mr. Cafik: Then things would more or less be back to normal at that stage?

Mr. Krupka: At that time the fallout will have decayed sufficiently so that people in some places could emerge, or that decontamination would be possible. . . .

Later

Mr. Cafik: Many of us have heard of the civil defence activities of Sweden and Switzerland and I think it would be of interest, to me at any rate, to find out what you know about the civil defence activities of a country like Russia. To what extent are they concerned with this problem; more than the United States or less?

Mr. Krupka: I could say something about that. Leon Gouré of the Rand Corporation has written a paper which you might like to read, about Russian civil defence. He actually made a visit there and talked to a number of reporters, American and foreign newspapermen, in Moscow and categorically they have said there are not any fallout shelters in Moscow.

Leon, in his testimony before Congress, showed

pictures of fallout shelters in Moscow. He said the reason they did not know about them is that they did not know how to look for them. You see, the ventilator in the back of the apartment building in Moscow is, in fact, a ventilator for the basement shelter. The Moscow subway is a fallout shelter and has, in fact, blast doors, if you are willing to look for them.

There is a book on civil defence put out by the Soviet Union and they have some excellent designs for rural shelters — they are trench type shelters with a covering — and there is every indication that they take gas warfare — chemical, biological and radiological warfare — much more seriously than we do. We think they do have, in fact, a very good, ongoing program....

Mr. David Lewis (NDP): Is it on that kind of analysis that you propose a country like yours spend up to $40 billion and a country like ours up to $4 billion or $5 billion on civil defence?

Dr. Gastil: No. The $40 billion program would be meant to greatly reduce the effects of an all-out war. Any program you talk about would greatly reduce the effects of an all-out war. We are saying that if you are talking about wanting to hold casualties, fatalities, to some particular level and you have an intuitive feeling that beyond that level you might as well lose them all, then the chance of holding to that level should not be judged only in terms of worst case analysis, you should think in terms of a number of other possibilities and the ability of your civil defence system, whatever it is, whether low or high, to defend against these possibilities.

Mr. Lewis: What would be the minimum cost of the kind of civil defence that you would recommend for the United States if you were now giving evidence before a Congressional Committee? We will divide that figure by 10 and assume that that would be the cost for Canada. May I say that without any knowledge — let alone expertise — in this field that this 10 per cent figure does not strike me as logical for a country which is scattered across a large area, as is the case in Canada. The mere population ratio is probably not a logical ratio. My logic tells me that it is wrong because you have a different set of circumstances in the stretch of our population across the continent. What size of civil defence budget would you recommend as a minimum for the United States to a Congressional Committee?

Mr. Krupka: I have a feeling that if I were the Director of Civil Defence I would recommend that they do not cut my budget any more. Do you mean next year they give me the same amount they gave me last year?

Mr. Lewis: What is the budget?

Mr. Krupka: $79 million.

Mr. Lewis: What has it accomplished?

Mr. Krupka: Almost nothing, so I would hope they would not cut it.

Mr. Lewis: In order that you may continue to have almost nothing.

Mr. Krupka: In order that the entire thing does not go down the drain.

Dr. Gastil: We have made this point before. The system we now have in the United States, in almost any war you can imagine, would save many millions of people. What I think Mr. Krupka means is that the present system is not really adding much to this capability year by year but by having the kind of budget that we have had up until now we have been able to develop a system that can save some millions of dollars. We would hope with the $79 million to do some other things and perhaps add to that capability.

Mr. Lewis: You said "save some millions of dollars"; I presume you meant "millions of lives".

Dr. Gastil: Yes, save some millions of lives.

To go back to your question about what we would recommend, I think you would want to think of civil defence, in the large budget sense, as not being just an isolated item. In other words, I do not think you would want to go into a huge civil defence system without thinking about a rounded defensive system that included active and passive defences and other types of things, and then you would want to figure out the size of your civil defence budget in terms of that more complex system.

I personally am in favour of defensive systems in general, and the exact proportion of this to be spent on civil defence would have to be worked out after taking that possibility seriously.

Mr. Lewis: I have three more questions which should not take too long — at least in the asking and you are welcome, as far as I am concerned, to make your answers as long as you like.

What did you mean when you said that if you had a nuclear unit — whatever it may be — fall you would have dangers resulting from fallout for about two weeks and then you would return to normal. That sort of contradicts all I remember having read about fallout — it lasts much longer than two weeks.

Mr. Krupka: You really should not contradict that.

Mr. Lewis: I am not contradicting it, I am asking.

Mr. Krupka: No, no. It should not contradict all you have read because "The Effects of Nuclear Weapons", which is the bible in radiation effects, generally shows a decay rate such that after two weeks the biological hazard is very very low. That is, after deposition of fallout at the rate of, say, 3,000 roentgens per hour, that rate will fall sufficiently in two weeks such that one could emerge from the shelter for some periods of time and not have very damaging effects.

Mr. Lewis: You are talking now about the effect of the fallout on the human being?

Mr. Krupka: Oh yes.

Mr. Lewis: You are not talking about the effect of the fallout on grass, animals, vegetables, trees, fruits and all other things that you may later consume with deleterious results?

Mr. Krupka: We have done an awful lot of work on ecology in the United States — so-called post attack research. A lot of work has been done on that very subject, and we think that the limiting factor is the human being and not the food sources. We think there are lots of ways of decontaminating food sources. Uptake problems of strontium, iodine and so forth, into certain foods could be reversed or minimized. The roentgens on the human body are probably the limiting factor in post attack damage . . .

Later

Mr. Lewis: Now in connection with the Soviet civil defence system, how much credibility can one really put into the motions that are presented in good faith, let me add, by people like Mr. Gouré or any one else who visits the Soviet Union for the purpose of investigating civil defence? How much can they in fact learn?

Mr. Krupka: Well, he brought back pictures showing the blast doors in the Moscow subway; he brought back pictures showing the outside ventilators in apartment buildings — clearly for civil defence purposes; he brought back documents and he brought back two very good scintillation counters — radiation counters, which were an excellent device.

Mr. Lewis: Was that sufficient for you to make a conclusion that the Soviet civil defence program is higher than the American one?

Mr. Krupka: No. In that sense it is not for me . . .

Mr. Lewis: Is it for Mr. Gouré or anybody else?

Mr. Krupka: He makes the statement that they take the problem very seriously and that every worker has civil defence training. That seems very clear, and I have no reason to doubt it.

Dr. Gastil: I think if you look at their own statements and believe what they say they are doing in civil defence areas then you would assume they are doing a good deal more than we are.

Mr. Lewis: Do you believe their statements in other areas?

Dr. Gastil: Well, that is an interesting question. One thing is clear, that they do not accept the idea which has been prominently accepted in the United States, that it is good for the strategic balance not to have defences. In fact, they continue to emphasize the fact that they will be able to protect their people, and to emphasize evacuation as well as sheltering possibilities, which is one thing that has not been talked about in the United States officially for many years. So we assume they are doing things that we are not doing in our country. However, the actual size of what they are doing does not seem to be as impressive, particularly in terms of blast shelters, as in Sweden.

Mr. Krupka: We believe that the Soviets do not look at defensive systems as being provocative; it is merely an extension of their basic policy.

Mr. Perry Ryan, Vice-Chairman: We have seven questioners, and if Mr. Fairweather returns we will have eight. The next in order are Mr. Laniel, Mr. Brewin, and Mr. Howard. Mr. Laniel.

Mr. Gerald Laniel (L): It is my impression that in civil defence you have to give an emphasis on the involvement of people, that is in the protection of North America or of the United States against war. If it is a question of money, perhaps the people can criticize that. But you cannot establish a good civil defence system I think, unless you involve the people where they are, in their day-to-day life. How are the American people interested, involved in these programs of civil defence in the United States? Are they concerned about them?

Dr. Gastil: I would just like to make a couple of remarks. One of the reasons we have emphasized the crisis programs is the fact that we assume that you would not want to, and perhaps could not, involve the vast masses of people in civil defence until there was actually a crisis staring them in the face. Then they would start wanting the knowledge, and you would be there to give it to them.

Another point is that a number of studies have been made of the polling type as to the attitude of Americans towards civil defence type preparations. At least up to the last couple of years when the last poll was taken, an overwhelming majority of people are in favour of civil defence measures.

Mr. Laniel: Yes, but to make your system work, the question of information to the people is very, very important, and does that reach the people? I am just thinking of Canada here. There was a suggestion made that an approach to civil defence might be the establishment of a mobile civil defence force that could travel from one end of the country to the other, and establish public relations with regional and local authorities.

The problem is to inform the people, and especially to make the people not only depend on the state to protect them; they have to do their share. They must have the will to survive at one level of an attack or another.

It is all right to build protection shelters for blast fallouts, but there are little things that people should know about, as you said, sanitation, water, food, welfare, panic, morale, evacuation. Also the possibility which you touched on, of creating peacetime usage of civil defence forces as in Sweden, for conventional warfare or tactical nuclear weapons but also for riots. Public relations should be so good that the people of the United States and the people of Canada would really feel that these people are there not only for use on the eve of their death. What would be your opinion of some kind of a mobile civil defence force? Have you thought about that?

Mr. Krupka: Yes, we have; in fact that is going to be the subject of our latest paper. The point you make is well taken and we in the States have on-going state and local organizations that are funded by the federal government in matching funds; 50 per cent of the salaries are paid by the federal government, 50 percent by the state or local government.

Every state has a civil defence organization headed by a full-time civil defence director, and many of the states and localities have civil defence organizations. The information of this nature, how to protect yourself, is available at almost every office. It is also available on pre-program tapes on our emergency broadcast system. In case of crisis, it can be broadcast both on radio and television, and there is a system to distribute pamphlets on how to survive, on how to build a shelter, what to do in time of emergency. They have several pamphlets for industry too, for example on how to shut down and on how to protect your employees.

Of course, in peacetime there are not many people coming around civil defence offices picking up the pamphlets. In general people are not very interested in civil defence or crisis. Civil defence in the United States has gotten its best publicity during natural disasters, when they found, we think, a new direction, a new friend. They have been able to make really big inroads in cases of floods. In hurricanes on the Texas coast, the civil defence forces did a marvellous job.

So, although I think you are right in that everybody ought to know about it, we think it is impossible for everybody to be interested in it, or to be interested in it on a continuous basis. We believe that the attitude of civil defence is that it is going to be a very low-level interest organization. You are going to have to accept that in time of crisis, you are going to have to protect people, save people, in spite of themselves, that it is a very thankless job of prepare for nuclear war in peacetime.

Mr. Bruce Howard (L): Is there any peacetime advantage at or economic use for various civil defence measures? I am referring to multi-use structures, and this sort of thing. Can you turn a gymnasium into a shelter? Is this being done to any extent?

Mr. Krupka: Yes, it is in the United States. Dual use is the word; that is the word, dual use in any facility.

Dr. Gastil: In Sweden, for example, some of the blast shelters are built as underground parking lots in solid rock and, of course, they have blast shelters too. There are some estimates that in terms of the actual cost it might often be better to build single use. I have seen that suggested.

Mr. Krupka: Yes.

Dr. Gastil: But at any rate dual use is —

Mr. Krupka: Many organizations in the United States have done a great job in disaster control, in finding lost hunters and downed aircraft, and this kind of thing. Usually it is handled by civil defence in the West.

Dr. Gastil: Dual use of the organization.

The Vice-Chairman: Mr. MacRae?

Mr. J. Chester MacRae (PC): Thank you, Mr. Chairman. My first question is really addressed to you. What did we pay for civil defence in this country of ours in the last fiscal year?

Later

The Vice-Chairman: Mr. MacRae, I now have that information for you through the good offices of Mr. Debell. Would you like to take a pencil? It may be that the whole Committee is interested, too.

In the last fiscal year the total budget for civil defence in Canada was approximately $14 million, made up as follows: for the Canadian Emergency Measures Organization, which includes grants to the provinces, $7 million; for the Canadian Forces, including warning systems, Armed Forces survival support, etc., $6 million; for other departments, $1 million. The total will be $14 million altogether.

Mr. MacRae: Thank you, Mr. Chairman.

Dr. Gastil: As a remark on that, it appears to me as though the $6 million would probably be in another budget of the United States — the warning plan which you mentioned. The $7 million is probably the equivalent, and I would think rather equivalent to the size of the U.S. effort.

Mr. Allen B. Sulatycky (L): To what extent are community planners incorporating civil defence concepts in their plans?

Mr. Krupka: There is an ongoing program called CSP (Community Shelter Plan) and almost every urbanized area in the United States is preparing, or will have a Community Shelter Plan, which incorporates the National Fallout Shelter Survey plus some other things, tell people where to go, what to do.

The Vice-Chairman: Dr. Gastil and Mr. Krupka, on behalf of the members of the Committee I would like to express our sincere appreciation for your appearing before us, for your excellent testimony and the manner in which you have answered all our questions. I think we have learned a lot from your good offices and I wish you a safe journey back to the United States, particularly in view of the inclemency of the weather. The meeting is now adjourned. ▲

FIRE ASPECTS OF CIVIL DEFENCE

This report prepared by the Research Directorate, Office of Civil Defense in July 1968 was prepared for use by civil emergency planners and other interested persons as a summary of the incendiary effects of nuclear attack. Similar studies have been carried out by Canada and are reported in Canada EMO Manual No. 7 The Incendiary Effects of Nuclear Weapons.

Studies of this nature are used in the production of publications and pamphlets. Specifically the revised "11 Steps to Survival" contains information and advice which is supported by both the Canadian and U.S. studies.

An effort has been made in this report to summarize the state of knowledge in simple and direct terms and to relate this knowledge to current departmental problems. In doing so, there is necessarily some loss in technical precision and detail on the one hand, and some inclusion of material that is not strictly needed for operations on the other. The latter is considered desirable, however, so that the important reasons for the incendiary behavior of nuclear weapons and the consequent threat to life and property are generally understood.

Introduction

In the event of a nuclear attack on urban areas, fire may be a major threat to life and property. The detonation of a nuclear weapon results in the release of a tremendous amount of energy in a very brief period of time. A significant portion of this energy is emitted in the form of heat (thermal radiation). The thermal radiation resulting from the nuclear detonation may cause ignition of materials. Some of these ignitions will develop into sustained fires over wide areas. Blast effects, such as overturned appliances or broken gaspipes, may result in additional fires. These fires, if left unchecked, may spread and develop into mass fires.

This review will discuss several key factors affecting the firemaking potential of nuclear weapons and the threat to a population, whether in fallout shelters or not. Measures to reduce the fire hazard and to control the extent of fire damage will be cited, both those that require further research, development and planning, and those that can be undertaken immediately.

The effects of variation in yield will be illustrated for nuclear-weapon sizes ranging from 1 megaton to 100 megatons. For the present and near future, weapons with yields of up to approximately 20 megatons are considered to be the most likely offensive weapons which will be used against this country. Weapons in the 100-megaton range are not considered a likely threat, both because of the inefficiency of use and the problem of delivery to the target.

Ignition Thresholds

One of the major factors affecting the fire-raising potential of nuclear weapons is the amount of thermal radiation required to cause ignition of combustible materials. This amount of thermal radiation, known as the critical ignition energy or ignition threshold, will depend largely upon the thickness of the combustible materials. Of concern are thin combustible materials, such as newspapers and curtains, which can act as kindling fuels for heavier combustible materials. It is unlikely that thick combustible materials, such as wood siding on homes, will sustain ignition from the thermal radiation beyond the range of extensive blast destruction.

The ignition threshold is also dependent upon the rate at which the thermal radiation is delivered. As an example of the effect of the rate of delivery of thermal radiation, during a hot ray the sun delivers about 700 calories per square centimeter to exposed materials on the earth's surface, but does not cause ignitions because of the low rate of delivery. When a nuclear weapon is detonated in the atmosphere, the significant thermal radiation is emitted in a matter of a few seconds. The rate of delivery is most rapid in the detonation of a small nuclear weapon and becomes significantly less rapid as the weapon size increases. As the yield of a nuclear detonation increases, the ignition threshold for a given kindling fuel also increases.

In addition to the rate of delivery of thermal radiation, the critical ignition energy is affected by the composition, color, orientation, and moisture content of the kindling fuels. Table I presents for several weapon yields the current best estimates of the critical ignition energies necessary to ignite some common kindling fuels. (1)

TABLE I

Approximate Ignition Thresholds for Several Kindling Fuels Exposed to Burst of Nuclear Weapons in the Lower Atmosphere

(FIRST GLOWING IGNITION)

Kindling Fuels	Ignition Thresholds (cal./sq. cm.)		
	1 mt.	10 mt.	100 mt.
Newspaper, dark picture area, crumpled or folded sheets	7	11	25
Kraft corrugated paper carton, 18 oz./sq. yd.	25	38	50
White Typing paper	30	50	80
Light cotton curtains, 1-2 oz. black	6	9	16
Light cotton curtains, 1-2 oz. beige	32	48	70
Black roofing	—	45	—
Cedar shake shingles	15	26	—
Dry rotted wood (punk) and dry thin deciduous leaves	6	8	30

Ignition Points and Fire Growth

The effectiveness of thermal radiation in producing ignitions is dependent upon kindling fuels that are exposed to the radiation. In order to sustain an ignition and allow development of a fire, the presence of heavier combustible materials close to the ignited kindling is required. This combination of kindling fuel and additional combustible material has been called an ignition point or "incendiary equivalent". Most ignition points occur indoors. Residential and commercial buildings appear to have a higher density of possible ignition points than industrial facilities. Window fuel arrays, such as curtains, shades and drapes, will probably be responsible for most sustained ignitions. These have a high probability of exposure and may be sufficiently close to other readily flammable fuels to start sustained room fires. Cotton fabrics were found to be the most prevalent tinder fuels, being found at many windows as curtains, shades or drapes.

Since most potential ignition points are found inside rooms, the thermal radiation must penetrate the window to cause an ignition. Because the thermal pulse is delivered in a matter of a few seconds, it acts before the air blast wave can destroy window glass and screens. Window glass and screens substantially reduce the thermal radiation reaching the interior of the room, as shown in table II. ([2])

TABLE II

Transmittance Values for Windows and Screens Whose Angle of Incidence With the Radiation Is Less Than 45 Degrees

	Transmittance
Window screen only	0.6
Single pane window only	.8
Storn window (double pane)	.7
Single pane, with screen	.5
Storm window, with screen	.4

Atmospheric Attenuation

There are two major factors which contribute to the attenuation of thermal radiation in the atmosphere: natural dispersion of the radiation and the screening effect of the atmosphere itself. As the thermal radiation from a nuclear detonation spreads through the atmosphere, it continually disperses with increasing distance from the fireball. The amount of this dispersion varies approximately inversely with the square of the distance from the source. Thus at long distances from the fireball, the amount of thermal energy greatly decreases.

The screening effect of the atmosphere through which the thermal radiation must pass in order to reach materials on the ground is possibly the most critical and variable factor in terms of the distance at which ignitions occur. The decreased solar radiation reaching the ground because of smog, haze and clouds over cities, and the low intensity of the sun near the horizon are examples of this screening effect.

Because of current uncertainties in atmospheric transmission, estimates of the amount of thermal radiation reaching locations 20 to 40 miles from a nuclear detonation, especially in metropolitan areas, can vary by as much as a factor of 10. Using current estimates for medium hazy and clear days in conjunction with the ignition thresholds of table I for newspaper, the ignition ranges shown in table III were obtained. ([3])

TABLE III

Comparison of Newsprint Ignition Maximum Radii and Blast Overpressure Radii

Weapon Yield	Ignition ground radius (miles)		Blast ground radius (miles)		Height of burst (miles)
	Medium hazy day (6 mile visibility)	Clear day (12 mile visibility)	3 psi	1 psi	
1 megaton...	7	8	6	13	2
10 megatons.	20	26	13	28	5
100 megatons	44	59	28	60	11

These values are indicative of the maximum ground radii (in statute miles) for ignition from the various yields. It will be noted that the ignition radius for an air burst will be between the 1- and the 3-pounds per square inch (p.s.i) range, depending on the visibility of the atmosphere. A better estimate of the range at which many sustained fires should occur is obtained by considering atmospheric transmission for the medium hazy and clear days in conjunction with the ignition thresholds of table I for beige cotton curtains behind a window glass and screen. The ranges are shown in table IV.

TABLE IV

Comparison of Beige Curtains Behind Glass and Screen Ignition Maximum Radii and Blast Overpressure Radii

Weapon	Ignition ground radius (miles)		Blast ground radius (miles)		Height of burst (miles)
	Medium hazy day (6 mile visibility)	Clear day (12 mile visibility)	3 psi	1 psi	
1 megaton...	2	3	6	13	2
10 megatons.	7	9	13	28	5
100 megatons	19	25	28	60	11

It can be seen from table IV that the region in which substantial numbers of thermal ignitions are likely is also the region in which blast overpressures exceed 3 pounds per square inch. Tables II and IV are appropriate to detonations at a height that maximizes the extent of low overpressures (5 p.s.i.). The ignition radius for surface bursts will be smaller because of lower thermal emission from the fireball, obscuration and shielding by other structures and terrain. Since the range of low-blast over-

pressures is also smaller, the main fire area will remain within the 3-p.s.i. region. As the burst altitude increases, the ignition radius also increases, but at the sacrifice of blast damage effectiveness. High-altitude air bursts have been suggested as fire weapons. This threat is discussed in the next section.

Climate and Weather

Climate and weather may be significant factors in varying the fire-making potential of nuclear weapons. The transmission of the thermal energy to the ground, particularly from high air bursts, is strongly affected by the presence or absence of clouds, by cloud types and locations, by clearness of the air, and by other meteorological factors. Cloud transmission of thermal radiation is approximately 30 percent for light cloud to approximately 3 percent for dense cloud, ([4]) based on solar radiation data. For example, it has been estimated that, for a 100-megaton detonation at an altitude of 30 miles, a layer of high, thin clouds would reduce the ground ignition radius from 65 miles to 30 miles. A layer of lower, denser clouds would reduce it to 10 miles. ([4])

Weather factors enter into the problem in several other ways. Foremost is the effect of moisture and moisture history on the ignitability of the materials in the target area. Ignition thresholds may be raised significantly by increased moisture. Also the spread of fires after ignition may be influenced directly by weather conditions preceding attack, during attack, and immediately following attack.

Military planners would probably not be satisfied with a high-altitude fire attack so dependent upon weather factors. While it is conceivable that an enemy planner might choose a particularly advantageous day for the attack, the occurrence of clear skies simultaneously over all or nearly all of our major cities is extremely rare. Most of the time some of our cities have clear skies and others have cloudy skies. Under cloudy skies fires will be set but the area ignited will be smaller. So the enemy would have to settle for an uncertain chance of starting fires in a fraction of our cities as a result of attacks on all.

Fire Effects of Air Blast

Many secondary fires observed in Hiroshima and Nagasaki were attributed primarily to blast effects. ([5]) However, the use of many "hibachis" or open fires was probably partly responsible, as well as the use of light and flammable structural materials. Flying debris and structural collapse appear to be the main sources of secondary fires. Velocities of flying debris can be high. Maximum wind velocity at 2 pounds per square inch pressure differential is approximately 70 miles per hour, and at 5 pounds per square inch it is approximately 160 miles per hour. Stoves and other heating sources may be upset, electrical circuits and appliances may be broken, and containers of flammable gases and liquids may be ruptured, all of which would provide ignition sources or fuels.

The collapse of structures may alter the burning characteristics of the fuel, the probability of development of significant fires, and the rates of spread of such fires. Wood structures would be most vulnerable to secondary fires, particularly at longer ranges where other types of construction might withstand the blast. In many circumstances, blast-caused secondary fires may occur beyond the range at which fires are caused by thermal radiation.

Mass Fire Development

Under some vaguely defined conditions, a stationary mass fire called a "fire storm" might occur. The critical elements appear to be a large number of nearly simultaneous ignitions in a heavily constructed area, little or no ground winds and, perhaps, unstable atmospheric conditions. These conditions are not likely to occur very often. In a "fire storm", the convective currents rising from the many small fires combine in a central vertical column and cause air outside the fire area to be drawn in. This action eventually creates an intensely burning fire together with violent indrafts at its outskirts. The radial inrush velocity of the wind at the edge of the area under stable atmospheric conditions has been related to the energy release rate of single burning structures and the number of initial fires in the area. ([6]) The "fire storm" will burn out within 3 to 4 hours without spreading much beyond the initial fire areas. ([7]).

In most urban areas, a critical factor in determining the extent of fire damage might well be the likelihood of fire spread, in addition to the number of ignition points. Fire spread is largely dependent on the density and type of fuel, that is, the height and proximity of combustible buildings or of buildings with combustible contents. Topography, vegetation and wind conditions may also be key factors in fire spread, depending upon the particular locality, season and time. Mass fires, in the form of conflagrations, will continue to move downwind as long as favorable conditions exist. Eventually winds may reverse or the conflagration may reach an area where there is no fuel or where the fuel is too widely separated. Parks, large bodies of water, rocky ridges, deserts, and wide areas for highways or railroad tracks may act as barriers against fire spread. Within the area circumscribed by the ignition radius of a large weapon burst there could be several "fuel areas", each of which might support a mass fire. Scattered fires are likely to occur in the remainder of the potential ignition area.

Life Safety in Fire Areas

In the fringe areas of blast, large numbers of survivors can be expected in fallout shelters. These shelters generally offer protection against flash burns from the initial thermal radiation. They also provide some degree of protection against blast. Therefore, many will survive the initial weapons effects in the region of one to ten pounds per square inch blast overpressure. For a 10-megaton surface detonation, this region extends from 4 to 16 miles from ground zero and includes most of the damaged area.

It is in this peripheral region of survival that the secondary threat of developing fires from ignitions caused by

both blast and thermal radiation will be encountered. There will be places within this general overall fire area which will have no fires. These include: (1) areas clear of any fuels; (2) fire-resistant buildings without openings exposed to the surrounding fire; or (3) buildings so located that they are not seriously exposed to the fire. Within these areas, survival is considered probable, especially for people in fallout shelters within the less fire-vulnerable buildings and in separate shelters. Moreover, there are documented reports from World War II that people survived within the "fire storm" area in the "bunkers" and other shelters in Hamburg and in fire-resistant buildings in Hiroshima.

An official German report on the Hamburg "fire storm" noted that:

> "Many Air Protection bunkers and splinter-proof surface shelters were situated in the middle of extensive area fire and fire storm zones. The heat round these buildings was more than human beings could stand. Nevertheless in no instance either in bunkers or surface shelters did shelterees come to any harm from the heat, nor did they have to leave the buildings prematurely. Shelterees remained in many of these structures until the fires surrounding them had abated. In some cases a covering of water had to be supplied at the exit by the Fire and Decontamination Service in order to get the occupants out. This was the case especially in special buildings situated in narrow courtyards. Often the ventilating plant could not be operated because of heat, smoke and fumes and had to be abandoned.
>
> In spite of much overcrowding, air conditions even in buildings not provided with ventilating plants, as well as in bunkers full of homeless persons, remained bearable for days. The presence of openings for natural ventilation was found to be of advantage." ([8])

At the time of these raids, Hamburg had an estimated population of 1.5 million. An estimated 470,000 of the people were within the area subjected to attack and heavy damage. Within this damaged area was the actual "fire storm" area of about 5 square miles in which there were an estimated 280,000 people. Of these, an estimated 40,000, or 14 per cent, who were either in poor basement shelter or outside shelter, were killed by blast or fire. Some 142,000 people survived in basement shelters or escaped by their own initiative, and 45,000 were rescued in addition to an estimated 53,000 who survived in the bunkers. ([9])

It is possible that areas of fire involvement in a thermonuclear attack would be significantly larger than those at Hamburg and Hiroshima, thereby making rescue and escape more difficult. This possibility would depend primarily on the size of the conflagration areas of U.S. cities. Additional studies were made of World War II attacks on nine German cities including Hamburg ([10]). These cities were Barmen, Cologne, Damstadt, Dresden, Elberfeld, Hamburg, Kassel, Krefeld, and Solingen. From these studies, urban casualty prediction have been made.

A study of past conflagrations has shown that their average speed has been less than one mile per hour, with surges of up to 3 miles per hour under the influence of strong winds. ([11]). These data suggest that there would be time to conduct remedial movement of threatened shelter population to areas not exposed to the fire danger, although such movement might involve exposing the people to the hazard of nuclear fallout.

Perhaps the most serious complication that the use of modern weapons has injected into the problem of life safety in fire areas is the imminent threat of nuclear fallout that could hamper firefighting or remedial movement. There would be a short period of time immediately following a detonation in which countermeasures could be undertaken. The downwind part of the area threatened by fire would shortly be threatened by fallout unless the attack had employed air bursts or high-altitude detonations. In practice, the preferred defensive actions would depend upon the relative severity of the threats of fire and fallout. Because of these threats, it would be desirable to provide a high degree of life safety from fire in fallout shelter areas through a careful selection of such areas, as well as to prepare for the prevention or control of the ignitions that might occur.

Fire Countermeasures

The reduction of fire vulnerability is as important as planning for control and extinguishment. Many of the ways to reduce the fire hazard in times of war are essentially the same as those recommended for peacetime fire safety. Measures to make urban areas less combustible and to reduce fire losses not only result in greater safety and lower insurance rates in peacetime, but also reduce a city's vulnerability to wartime fire. It should be emphasized that countermeasures to reduce the vulnerability of an urban area fall into three categories: (1) urban design; (2) everyday actions; and (3) emergency actions.

(1) Urban Design

The fire hazard to life may be reduced significantly through changes in the structure and composition of urban areas. The concepts of good city planning, such as residential clusters instead of disorganized urban sprawl, with ready access to arterial highways and surrounding open areas of parks or farmland, are all elements which are compatible with reducing a city's vulnerability to both peacetime and wartime fires. The design, construction and siting of buildings can reduce the incidence of primary fires. Analysis and identification of potential conflagration areas in cities are necessities for community planning and urban renewal.

(2) Everyday Actions

National fires prevention, cleanup and family safety programs, and local fire inspections by fire marshals and fire departments are significant everyday actions that help reduce fire vulnerability. The adoption and enforcement of model building codes are essential in controlling undesirable construction. Support of these programs, especially those that continue throughout the year, will help reduce the vulnerability of a city to wartime fires.

(3) EMERGENCY ACTIONS

Good fire-prevention practices can prevent many fires which might otherwise occur during a nuclear attack. Trash should not be allowed to accumulate, especially near heat sources. Flammable liquids should be stored with great care, preferably out of doors. Faulty electric circuits should be repaired quickly and circuits should not be overloaded. Electrical appliances, such as irons, should be disconnected. Electricity and gas should be turned off.

Windows, particularly large ones, should be coated with whitewash, household cleaning powders, or other soluble opaque materials, even mud in an emergency. Metal venetian blinds should be lowered and closed. Easily ignitable curtains should be removed from windows. At such a time of emergency, window coatings can easily be monitored from outside by firemen, block wardens, police, or others. Inside houses and buildings, easily ignitable furniture, such as chairs and sofas, should be removed from window areas.

The garden hose, available in almost all homes, should be connected and ready for use. Water and sand should be stored in bath tubs and other containers. Blankets, towels and other fire-fighting cloths should be ready for wetting and use. Fire extinguishers should be ready for instant use. However, caution should be exercised when using vaporizing-liquid types of extinguishers in small enclosed spaces.

Bulky pieces of furniture, such as chairs, sofas or beds, which catch on fire may be taken out of the house. With electrical fires, the electricity should be disconnected first. If it cannot be disconnected, water should not be used in fighting the fire. With an oil fire, the oil supply should be cut off first. Then the fire should be smothered with sand, dirt, heavy rugs or materials. Water should not be used. With a gas fire, the gas supply should be disconnected first. Then water, sand or dirt may be used to put out the fire.

It should be remembered that the three components of fire fighting are:

(1) Take away fuel.
(2) Take away the oxygen (smother fire).
(3) Cool fire with water or other extinguishing materials.

Summary

This report describes the general dimensions of the fire threat resulting from nuclear attack, particularly as a result of ignition of thin materials by the thermal (heat) flash.

A review of the best available information on the thermal ignition capabilities of air-burst nuclear weapons with yields from 1 megaton to 100 megatons indicates that thermal ignitions may occur, under average to good visibility conditions, at ranges where the blast overpressure is between 1 and 3 pounds per square inch (p.s.i.), with perhaps 2 p.s.i. as a reasonable estimator of the region within which ignitions may occur.

The severity of resulting fires and the likelihood of fire spread depend on the amount and spacing of combustibles within the ignition area. Mass fires are likely only in built-up urban areas rather than in suburban or rural areas. Thus the potential ignition areas cannot be considered as a single fire area "engulfed in flame" since the controlling factors are the occurrences and size of the combustible area rather than the ignition range of the weapon.

Experience with large fires of the past shows that only a small portion of the population at risk is killed as a result of the fire. The rate of development of large fires has been sufficiently low to permit control or movement of people to areas of relative safety. The most serious complication introduced by modern weapons is the threat of fallout that could hamper firefighting or remedial movement.

In planning a fire defense program against the threat of nuclear attack, the reduction of fire vulnerability by removing or covering ignitable materials and by reducing the concentration of combustibles in cities is equally important as the development of a capability to control and extinguish fires. ▲

1. The estimates in Table I for ignition thresholds of kindling fuels are based on experimental measurements made by the U.S. Naval Applied Science Laboratory, the U.S. Naval Radiological Defence Laboratory, and the IIT Research Institute using radiant pulse simulators developed at each laboratory. The results are generally in good agreement. Variations, such as color, weave, weight, density, and moisture content, can materially affect a kindling fuel's ignition threshold. For example, a dirty, crumpled, and loosely folded newspaper exposed to a 100-megaton detonation in the lower atmosphere would require only 25 cal. per square cm. (as given in table I) for ignition, while a single sheet of finely printed text would require approximately 45 cal. per square cm. The reduction under similar circumstances for 10-megaton detonation was only from 12 to 11 cal. per square cm.

2. Bracciaventi, J., "Window and Window Screens as Modifiers of Thermal Radiation Released in Nuclear Detonations", U.S. Naval Applied Science Laboratory, Brooklyn, N.Y., Sept. 12, 1966, p. 9.

3. Gibbons, Mathew G., "Transmissivity of the Atmosphere for Thermal Radiation from Nuclear Weapons", U.S. Naval Radiological Defense Laboratory, San Francisco, Calif., Aug. 12, 1966. AD 641 481.

4. Passell, T. O., "Transmission by the Earth's Atmosphere of Thermal Energy from Nuclear Detonations Above 50 km Altitude", Stanford Research Institute, Menlo Park, Calif., Apr. 30, 1963. AD 404 590.

5. McAuliffe, John, and Kendall Moll, "Secondary Ignitions in Nuclear Attack", Stanford Research Institute, Menlo Park, Calif., July 1965. AD 625 173.

6. Lommasson, T. E., "Preliminary Investigation of Fire Storm Start Criteria", Dikewood Corporation, Albuquerque, N. Mex., June 15, 1965.

7. Chandler, Craig C., "A Study of Mass Fires and Conflagrations", U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif., 1963. PSW-N22. This publication was based on a study of past mass fires by the U.S. Forest Service for the Office of Civil Defense.

8. Police President of Hamburg, "Report by the Police President of Hamburg and local Air Protection leader of Hamburg on the large scale raids on Hamburg in July and August 1943", Experiences, vol. 1: Report, (translation), p. 88.

9. Earp, Kathleen F., "Deaths from Fire in Large Scale Air Attack — with special references to the Hamburg Fire Storm", British Home Office, Scientific Adviser's Branch, London, April 1953, CD/SA 28.

(*Continued on page 20*) **FIRE ASPECTS**

ALBERTA MUNICIPAL E.M.O. CONFERENCE

The following is the text of the opening address delivered to Alberta municipal officials by the Hon. Edgar H. Gerhart, Minister of Municipal Affairs and Minister-in-Charge, Alberta Emergency Measures Organization. The conference was held in Calgary, February 18 and 19, 1969.

EMO Association in Government

Since the last Municipal Conference, Alberta Emergency Measures Organization has been moved from the Department of Agriculture to the Department of Municipal Affairs for administrative purposes, and I believe this is probably the most appropriate department for it in the Government. A major portion of the Emergency Measures work is related to the development of preparations in the municipalities, and it seems to me that being associated with the department which also has a major relationship with our municipalities is a logical arrangement. I want to assure you I consider the continued development of the Emergency Measures arrangements in this province to be an important aspect of the total government program, and it will continue to receive my personal support, as well as the continued financial support of the provincial government.

International Situation

The basic reason for the existence of the program is, of course, the threat of nuclear war. We are advised by the Government of Canada that this threat continues to exist, and a cursory examination of the international situation would lead any rational person to a similar conclusion.

We, the provinces, have little influence on the international climate, but it can readily be seen how its deterioration can bring a major threat to our doorstep. We must rely on the Government of Canada to make a continuous appraisal of the situation and to advise the provincial governments if and when the program of preparations should be accelerated. I have some concern about this matter. I am not fully aware of a formal machinery whereby, on a day to day basis, I and the Premier of our province would be kept appraised of a deteriorating situation, and in turn, be in the position to keep municipal governments informed. The Director General of Canada EMO, is, I believe, going to deal with the subject of increased readiness, and perhaps he will touch on this matter.

Fallout Shelter

While the two major urban areas in Alberta are included in the Federal list of areas subject to higher risk from the direct effects of a nuclear bomb, and while we are well aware that random bombs could fall anywhere, I am advised that the major threat to our province in the event of a nuclear conflict is from radioactive fallout. It seems that there is a significant probability that a large part of Alberta could be subjected to this hazard. The methods of dealing with the hazard are relatively well known, and include shelter — until the radiation deteriorates over a period of time.

Since 1964, the Government of Canada has been conducting an examination of buildings which would provide suitable shelter, and this survey is almost complete across Canada. It seems to me that we must now apply the information we have about the available shelter, to determine how best it could be used in an emergency, and in particular, how it could be improved during a crisis.

The shelter available outside our residences — that is, in public and private non-residential buildings — is concentrated mainly in our major urban areas, and a significant percentage of our population may have to rely upon their own resources for shelter. It seems to me that the time is rapidly approaching when major decisions regarding a national public fallout shelter policy must be made, and we will be anxious to discuss this matter at a forthcoming Federal/Provincial Ministerial Conference.

Plans and Training

Most of you have been associated directly with this program somewhat longer than I, and will know that the main emphasis has been given, over the years, to the development of plans to use our resources to maximum advantage, and to a relatively intensive training program for citizens in the municipalities. Basically, this continues to be the principal method of approach, but we are considering some modifications of the training arrangements, to concentrate upon the leaders required, rather than to train large numbers of volunteers whose normal duties are not related to government activities.

We must identify which of the many facets of the emergency measures' program can be undertaken with the limited resources available, and this leads us to a requirement to establish priorities. You will hear a presentation regarding studies which are being done in this area, and I think you will recognize that we are trying to make an organized and objective approach to selecting those things which will be of the greatest advantage to our citizens.

Further to this matter of using our resources to best advantage, I believe that one area requires fairly urgent attention from our municipal authorities, particularly those from our urban areas.

The first people we should look to, to be leaders and directors of government services during an emergency, should be to those people presently employed by our several governing bodies. I am thinking, in particular, of the staffs employed in our urban municipalities, including those employed by the school boards. It is clear to me

that these are the first resource to be used, to ensure that organized leadership will be given during an emergency. This is not always occurring, and I would urge the municipal authorities, to adopt as a matter of policy — to the extent possible — the development of their emergency government arrangements based, in the first instance, on the personnel already engaged in the conduct of municipal business in peacetime.

Public Apathy

I know that Mr. Halmrast, when he was Minister responsible for Emergency Measures, and many of you who have attended these conferences in the past, have wondered how the program could proceed adequately in the face of apparent public apathy both towards the possibility of nuclear war and their ability to protect themselves from it. This, of course, is one of the most difficult aspects of the program. As international tensions increase or decrease, so the interest of the public in civil emergency preparedness waxes and wanes.

We have realized, and I trust that you have now realized, that there is no real usefulness in attempting to develop and maintain a high level of interest among the general public in this program in peacetime. Our citizens are not prepared to give priority attention to the possibility of disaster, until that possibility is very high. This is the very reason why the program is being somewhat reoriented, to focus mainly on the development of plans by governments — federal, provincial and municipal — and the training of leaders, most of whom should come from within the government services. We know that government services cannot provide all the leaders, but the majority can come from this source.

One of our major tasks, therefore, in peacetime, will be to develop the public information instructions necessary to give our citizens when, in fact, the situation becomes serious. This is the time they will seek, and expect to receive, information and leadership from government authorities.

What we are saying, is that it is our task, in peacetime, to develop those arrangements whereby we can quickly and adequately inform our citizens. We are not saying, there is no place for a low-key public information program in peacetime; this, too, will be continued.

Peacetime Disaster

The development of suitable plans and procedures to enable municipal authorities to undertake their function during a national emergency, does of course, lend itself to providing a much improved capability to deal with peacetime disaster. Fortunately, in Alberta, we have not been faced with a large series of peacetime disasters, but we would be foolish and imprudent if we were not to recognize that, at any time, in our sophisticated society today, major disruptions could be caused to our way of life by natural or man-made disaster. Our program in the province of Alberta recognizes this, and you will be aware that we have developed arrangements at the provincial government level, to provide a rapid response to any disaster situation which a municipal authority considers has gone beyond the resources of the community.

We have provided, and will continue to provide, advice to the municipal authorities in the matter of developing adequate plans to co-ordinate and direct any disaster operation which might have to be conducted at the municipal level. This is a most important aspect of the program, as there is every evidence that when a major disaster strikes, perhaps the most important thing required is a co-ordinated response by the many services which become involved in restoring the situation to normal.

I hope that you will make yourselves familiar with the procedures developed by the Provincial Government and, if it has not already been done, that you will arrange to have the necessary plans drawn up for your own municipalities.

Mutual Assistance

The establishment of Emergency Measures "Units" has made an effective contribution to the better use of available resources in the province. As you know, the organizational philosophy in this respect is that a municipal district or county, together with the towns and villages within its boundaries, constitute itself as a "UNIT", and develop plans which cover the whole area.

We have had a fair amount of success in pursuing this concept, and it is probable that the municipalities which most of you represent are already so organized. However, we still have some way to go. Of the 48 Units which could be established in Alberta, only about three-quarters have, in fact, been constituted. I would urge those of you who may not be aware of this organizatonal concept, to utilize the services of my Co-ordinator and his staff, and undertake this development as a priority assignment.

Financial Assistance

In general, the programs at the municipal level are financed by grants from the federal and provincial governments to the extent of 87½% of the required funds. There are, of course, limitations on the extent of the expenditures, but I am advised that the funds available are adequate for the continuation of the program to reach goals that seem realistic at this time. As I said earlier, the support and assistance of the provincial government will continue, and together with the identification of the priority objectives, we can continue to improve our province-wide capability to meet a national survival or peacetime disaster operation.

Conclusion

In conclusion, let me reiterate that the many departments of the provincial government are aware of their responsibilities and obligations to this program, and will continue to give attention to them. I have not talked about their work, as you will be hearing something of it during the course of the conference. ▲

ORGANIZATIONS IN DISASTERS

The following chapter was extracted from a report to the United States Office of Civil Defense by the Department of Sociology, Disaster Research Center, Ohio State University. The paper by George Warheit and Russell R. Dynes, "The Functioning of Established Organizations in Community Disasters" was published in September 1968. The introductory abstract to the full report stated:

> *"Established organizations refer to those which respond, in a disaster context, with their regular personnel engaged in familiar tasks. A theoretical framework is presented viewing such organization's pre-disaster operations as constituting a situation where their capabilities exceed the demands made on them. From this conceptualization, certain hypotheses are derived indicating conditions of organizational stress. Operational problems of established organizations in a disaster context are discussed as well as forms of differential adaptation, problems of mobilization and types of interorganizational relationships. Based on observations of DRC in a variety of disaster situations, it was concluded that established organizations normally minimized stress and could function with a high degree of effectiveness. On the other hand, the reluctance of such organizations to accept new tasks and additional manpower would force others within a community to assume these obligations in a widespread disaster event."*

Interorganizational Relationship

Organizations do not function in isolation during the emergency period after a disaster event. Other organizations become part of the emergency environment as well as the tasks which are created by the event. The way in which a particular organization can function is in part dependent upon the larger context of the activities of the other involved organizations. We have already suggested that a distaster event reduces the autonomy of each organization since it no longer has the same control over its environment that it had previously. Much of this lack of control over the environment is created by the diverse activities of other community organizations. No organization has complete control since its actions are conditioned by the activities of others.

Two major types of interorganizational relationships can be observed in disaster activity. One form is seen in terms of the exchange of goods and service among organizations. Another form is the exchange of communication during the emergency period. Established organizations become the focal point of the interorganizational relationships, necessary for community-wide coordination.

Since established organizations have disaster responsibilities "assigned" by the community and since they are more likely to be mobilized early, such organizations become quickly involved after impact. This means that established organizations need to solicit information from others. Since information as to what actually "happened" is difficult to obtain and essential for effective operation, the centrality of established organizations is enhanced as they become the major repository of knowledge about community activities. Too, as the scope of impact becomes clearer with the cumulation of information, the necessity for added resources may also be apparent. Established organizations then become involved in seeking out and acquiring needed resources.

The central position of established organizations in the pattern of interorganizational relationships is encouraged by the greater availability of what might be called boundary personnel. Many established organizations have personnel with positions which, during their predisaster operations, necessitate continued contact with others outside the organization. For example, an employee whose responsibility within an organization is to obtain various kinds of supplies will develop knowledge of potential sources of supply as well as techniques and procedures of acquisition. In some instances, a person may become a member of two or more organizations. This is more likely among members of established organizations and can be illustrated by the police chief who is also a member of a Red Cross Disaster Committee. (Conversely, membership on the disaster committee is not likely to lead to an appointment in the police department.) These multiple memberships often provide a basis of knowledge of the operations of both organizations and facilitate the development of interorganizational communication. Too, through continued participation, friendships among members of community organizations develop. These friendship patterns, during the emergency period, become a major basis for interorganizational communication.

Established organizations also have the added "advantage" of greater organizational legitimacy within the community. During the emergency period, some community organizations, particularly business and educational ones, suspend operations since they find it difficult to claim that their activities contribute to ongoing disaster activity. Organizations which have a claim on the competence and skills necessary in a disaster context will necessarily continue their activities and these are more likely to be established organizations. Interorganizational relationships tend to occur most frequently between organizations that consider each other as being legitimate. Pre-disaster contact among such organizations give initial

legitimacy which is reinforced by further contact in the disaster context. By contrast, even though a degree of legitimacy might be attributed to the cadre of Type II expanding organizations, the rapid expansion of these and the emergence of "new" leadership reduces the legitimation which ordinarily stems from stable leadership. Too, the lack of previous contact with particular organizations in pre-disaster activity would tend to cast doubt upon its legitimacy operating in a disaster context.

The major point here is that the interorganizational relationships necessary for the development of community coordination have their central focus around established organizations. These organizations have pre-disaster experience working together and, as a by-product of this, members develop knowledge and acquaintance across organizational boundaries. Such organizations have greater legitimacy within the community which provides traditional authority which in turn other organizations, as they become involved, have to accept.

Since many of the established organizations are local governmental units, such as police, fire, public works departments, or are quasi-public organizations, such as utilities or hospitals, perhaps a final note should be added on the legal and jurisdictional context in which interorganizational relations take place. Many established organizations have their responsibilities and their jurisdictions defined by law. The actual disaster "responsibilities" seldom correspond completely with the pre-disaster definitions nor is the impact area identical with jurisdictional boundaries. Given these complications, legal limitations tend to be ignored during the emergency period and, in effect, do not present an obstacle to the accomplishment of organizational tasks nor to the development of interorganizational cooperation. The emergency period is more likely to be characterized by pragmatic decision making based on what has to be accomplished even if legal limits have to be placed aside. This process is illustrated as well in the pattern of intergovernmental relations during the emergency period after the Topeka tornado.

> From approximately 7:20 p.m., June 8, to 7:00 a.m., June 9, 1966 the initiative for decision making and action rested with hundreds of individuals, who, through the first night after the tornado struck made individual decisions which slowly mobilized the vast human and material resources necessary to deal with the aftermath of a major disaster. During these same night hours, the mayor, the city commissioners, the county commissioners, the governor, adjutant general, and city and county department heads met to begin the process of re-establishing communication networks and to forge bureaucratic machinery. By the next morning, the political officials had worked out a scheme for apportioning responsibilities and assigning authority so that recovery operations might begin in earnest when daylight arrived June 9, 1966.
>
> The remarkable thing about this process of assignments and specifying responsibilities and defining authority was the relatively casual and pragmatic way in which they were worked out. The planning for a disaster which had occurred over a period of fourteen years had been characterized by long, delicate, very difficult face-to-face and "behind the doors" negotiations. There had been repeated clarifications, revisions, re-negotiations, drafting and re-drafting of operating procedures in a disaster situation. This kind of pre-disaster difficulty was contrasted with the relative effectiveness of the political leaders during the recovery operations. . . . The mayor continued as nominal head of the recovery operations committee made up of various elected political officials, heads of city and county departments, and representatives of quasi-public groups. These leaders would meet together late each evening to go over the problems of the day and decide what would be done the following day.
>
> Of greatest significance for the discussions here was the obviously easy intergovernmental cooperation during the recovery operations. In addition to the cooperation between the city of Topeka and Shawnee County during this period a great number of municipal and county governments from Kansas and Missouri willingly provided men and equipment in vast quantities for the recovery operations. While it seems startling, and possibly hard to believe, the best inventory that can be made indicates that more than sixty discrete units of government representing local, county, special districts, and state government ranging from a volunteer fire department to the Executive Office of the President were directly involved in the recovery operations.
>
> The emergency recovery period covering the period of June 8-18, 1966 approximately, was characterized by a pragmatic approach to problem solving. Decisions were made on the basis of what needed to be done. Responsibility for carrying out decisions was given to those who had the skill and ability to get the task done. This period was not heavy with questions of legal and fiscal authority nor were problems of the law relating to private and public property evident. No attempt was made to delineate clearly the authority and responsibilities of various governmental units.
>
> During the disaster recovery period political officials exercised authority and held a degree of autonomy that removed their decisions from review or control by the voter. Governmental officials during the disaster exercised a degree of authority which most would consider to be undemocratic since the decisions of elected officials during a disaster are generally not subject to review by the voter and rarely are they subject to any sustained scrutiny by the courts.
>
> Within 10 days after the tornado had struck, governmental officials and department heads increasingly spent more time in their offices and progressively less time in the Emergency Operating Center. Lower level department heads and bureaucrats assumed responsibility for the tasks the elected officials had held from the early hours of the disaster. By now, the bureaucratic machinery of government had been re-established. Elected officials and department heads reverted to their more traditional ways of dealing with governmental affairs. Questions of legal authority became prevalent at this point. Citizens and elected officials became increasingly concerned with questions of property rights, and the power of government in relation to the property rights of an individual. Elected officials were particularly sensitive to the charge of government interference in private property matters. The

(*Continued on page 19*) **ORGANIZATIONS**

"EMERGENCY MEASURES PLANNING"

by

John F. Wallace
(National Programs Director)
CANADA EMO

The following is a translation of an address to the Conference of French-speaking Mayors and Elected Officials at Arnprior, Ontario, February 17, 1969.

It is with pleasure that I address you, this morning on the subject of Civil Emergency Planning.

Public and governmental interest in such planning fluctuates as the situation in international relations waxes and wanes.

What are the aims of the EMO or of the Protection Civile Provinciale? How does the Organization function? What have we accomplished, and what remains to be done? These are the questions I wish to deal with.

As far as the Government of Canada is concerned, a program of emergency measures is important because of the danger of nuclear attack. The danger is real inasmuch as our only likely enemy currently possesses long-range missiles and bombers and a large submarine fleet. This continent could be attacked by any or all of these delivery systems.

In a word, the danger is real because our potential enemy has nuclear weapons sufficient to cause untold casualties and damage.

We should understand, however, that we are not in any immediate danger. In other words, the growing atmosphere of détente between East and West suggests that neither side is about to start a world war.

Ten years ago, our planning was oriented towards protection against the sudden nuclear war which, according to some, might fall upon us like a thunderbolt at any moment. We were then thinking in terms of plans which could be translated into instant action for without this capability, they would not have been worth the paper they were written on.

The situation has changed a great deal since 1959 and our current planning is based on the assumption that we may have a period of time in which to implement or speed up our plans.

In principle, the Canadian Government's policy with respect to emergency measures is fairly simple, and may be summed up in two sentences. Firstly, governments need plans which will enable them to continue to function in an emergency; it goes without saying that governments also need the services of a group of organizers capable of drawing up such plans.

Secondly, in developing these plans we should not be overly concerned this time, with the apparent lack of public participation nor should we try to inflict too many exercises on the public.

The problem here is what many term "public apathy". I do not wish to dwell on this point, but I would nevertheless point out that trying to solve the so called public apathy problems constitutes a waste of time. The important thing for us, as emergency measures organizers, is to develop and maintain all the necessary elements in a state of readiness, so as to be able to supply the authorities with details of the steps to be taken in case of emergency, so that they will be able to direct and assist the public in carrying out the measures needed. As I am sure you are aware, in any kind of emergency, past, present or to come, the public follows guidance provided that those providing it seem to know what they are doing. Most of us, then, are responsible for drawing up plans which would actually be implemented by our municipal leaders.

In the twenty years that this program has been in operation, one of the most persistent problems has been: how is our progress to be measured? What have we to show for the many millions that have been spent? We believe that the only realistic method of assessment is the simulation of an attack, followed by estimates of the probable numbers of dead and wounded, and damage without emergency measures.

This is a complicated procedure, involving a great many mathematical formulae, but, as I have said, the results do give us an indication of the scope of the problem. For your information, we studied an attack in which seventeen cities received a total of 236 megatons. The breakdown of casualties (from both direct and fallout effects) without emergency preparations would be as follows:

a.–Dead ..... 8.5 million
b.–Seriously wounded ..... .79 million
c.–Slightly wounded ..... .77 million
d.–Non-wounded survivors ..... 11.91 million

This gives us a yardstick on which to base the evaluation of our procedures.

During this course, you will be hearing from other lecturers who will explain how this tremendous toll of casualties can be reduced.

The national objective of Canadian peacetime civil emergency planning has been defined as the formulation of civil plans and procedures to assist the survival of the population and the recovery of the nation following an attack. These procedures combined with military defence measures to constitute Canada's total national defence posture against nuclear attack.

This is a very formal definition. It can be expressed differently and, I believe, somewhat more effectively. What it means is, firstly: plans to protect lives and property, in other words, to assist the population to survive;

secondly, the creation and maintenance of a system to ensure the continued operation of government and such essential services as will enable all the mechanisms of government that are important in an emergency situation to continue to provide leadership; thirdly, measures to ensure controlled and rational utilization of all surviving resources, with a view to the eventual resumption of economic activity.

These three aspects constitute the central theme of our emergency planning. A year ago, the Canada Emergency Measures Organization, in very close consultation with all the provinces, began an exhaustive study to determine the full scope of the emergency planning program.*

The analysis of our national objective led us to break down the program into six main divisions, plus one division to cover service activities. These were further subdivided into 40 fields of activity. I shall now discuss each division in turn, explaining objectives and nothing, briefly, what has been accomplished.

The first division is POPULATION PROTECTION. Plans and preparations must be made in order to protect the public against disasters resulting from nuclear war.

This division includes such measures as: evacuation and dispersal of the populations of target cities, nuclear defence measures and fallout shelters. Although we do not have a well defined policy on shelters in Canada, we are working steadily to establish one. We carried out a survey of all public buildings in Canada, in order to determine what kind of protection would be available should the population ever have to seek shelter against nuclear attack. This survey, which cost 2½ million dollars, showed a total fallout shelter capacity of over 25 million spaces. In many cases, however, such facilities are poorly located to provide protection for the public — in the centres of target cities, for example.

Over the last four years, we have assisted the provinces in the field of radioactive fallout detection by supplying more than 50,000 detection devices. This activity is continuing.

To sum up, although a great deal remains to be done under the heading of population protection, we continue to make progress.

The second division is that of PUBLIC INFORMATION. What we are trying to do here is to supply the public with emergency instructions through the use of films, television "shorts", radio announcements and a variety of brochures and other publications. As you know, we have already produced a series of pamphlets for families and individuals.

We have also made arrangements to supply the public with information in an emergency. We are hoping that each family will be informed of the effects of nuclear war, and of the measures which can be taken to reduce these effects.

Another very important activity in this division is that of supplying and operating a warning system, by which the public may be warned of impending attack or fallout. As many of you know, the alert originates at NORAD headquarters; it is subsequently transmitted to the Federal Warning Centre, located outside the city of Ottawa, and then passed on to the various provincial Warning Centres. The populations of probable target areas can then be warned by means of sirens that an attack is expected.

In addition to this, we have an emergency broadcasting system to relay instructions to the general public in areas that are not equipped with sirens. This system anticipates the use of all radio and television installations in Canada. In my opinion, this is one of the key survival measures, because it will enable governments to tell the people what they must do in order to survive.

The third division is that of ESSENTIAL SOCIAL SERVICES.

Health services are an important element. Since 1952, the federal emergency health service has stock-piled more than 21 million dollars' worth of medical supplies in various places in Canada. All these supplies are stored in operational units, and steps have been taken to distribute them to various authorized provincial organizations. This program will enable us to care for nuclear war casualties. We would be the first to recognize, of course, that this would not be sufficient for all needs.

An interesting aspect of these supplies is that they are similar to those employed by the Red Cross in forwarding medical supplies to countries or areas struck by earthquakes or other disasters. Use of these supplies not only permits the Red Cross to give the required aid more rapidly, it also allows us to rotate a large portion of our stocks.

In the area of welfare, we wish to establish courses of action which will facilitate the organization of emergency welfare services, and will ensure the continued functioning of essential welfare agencies and programs. We are aiming at the setting up of 1,375 welfare centres across the country. The federal Department has also made arrangements to stockpile sufficient emergency types of clothing for approximately 275,000 people.

One of the most important divisions is that of CONTINUITY OF GOVERNMENT.† We have made very significant progress in this field. At the central government level, we have a complex of protected installations, located in the region of Ottawa, to which the principal officials of the government would move to continue their work.

At a lower level, and in addition to the central installations which have been provided for, we have six regional emergency government headquarters, one of which is located at Valcartier. The current program calls for the completion of the four regional headquarters for the provinces of Prince Edward Island, Saskatchewan, New Brunswick and Newfoundland, for which we have made interim plans. All these headquarters are linked by the

*Project PHOENIX
EMO National Digest
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†EMO National Digest Vol. 9 No. 1
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necessary emergency communication systems. They have been furnished with all the necessary equipment, and can thus go into operation as soon as their personnel are at their posts.

We are in the process of establishing a system of zone headquarters, 32 of which will be required throughout the country. We now have eleven. These establishments will provide co-ordination between provincial governments and municipalities.

At a still lower level — but one which I believe is the most important of all — are the 400 municipal emergency government headquarters required across Canada, 120 of which are already in existence. They, too, are equipped with intercommunication systems.

In a sense, it can be said that we have completed the establishment of the principal mechanisms through which government will be able to function in an emergency. In most cases, the key personnel assigned to these installations (at the federal, provincial, zone or municipal level) have received their instructions, and know — certainly at the federal level, at least — where they must report should the need arise. The cost of these arrangements exceeds $30 million.

This division also includes providing for policy formation and international civil emergency planning, and exchanges of information both between Canada EMO, the provinces and our United States counterparts, and between Canada and NATO.

The fifth division covers arrangements in such fields as fire and rescue services and public utilities. Our plans call for the continued functioning of essential municipal services. We hope to develop, firstly, a fire-prevention and fire-fighting capability, secondly, the organized conduct of salvage and rescue operations by municipal governments, and thirdly, the continued functioning of sewage, water and other essential services.

The sixth division is that of ECONOMIC PLANNING AND RESOURCE CONTROL,* which embraces the following objectives: supplying the population with sufficient food and water to sustain productive work, satisfying total defence needs and maintaining the viability of the national economy. The bulk of this work is assumed by the appropriate agencies of the Government, the necessary co-ordination being supplied by my Organization.

Although most of this is directed by the Federal Government, the work so far accomplished would obviously not have been possible without the co-operation of the provincial departments concerned and of a number of leaders in business and industry.

During the study I have already mentioned, it was found that some activities were difficult to classify because they support almost all the others. The title "Service Activities" was therefore given to:

1.–Communications
2.–Damage assessment
3.–The preservation of public order
4.–Postal services
5.–Provincial management and control
6.–Transport
7.–Vulnerability analysis.

Gentlemen, we have now seen the kinds of emergency measures which exist today, and which did not exist ten years ago. I believe that our country is now better and more rationally prepared than it has ever been to withstand a possible nuclear war. I would like to point out that visits I have made to seven European countries, in which emergency measures organizations have existed for approximately the same number of years as our own, have shown me that our programs certainly compare favourably with those of the best European organizations. There are, perhaps, some aspects in which their current programs are superior to ours, but considering the situation as a whole, from public information to emergency government installations, I would say that we have nothing to be ashamed of.

Of one thing I am very sure, and it is that, with a certain amount of preparation, we can reduce the effects of any kind of catastrophe, whether natural disaster or act of war.

In the event of a world war, and a nuclear attack on the United States, even if our own country were not attacked, we could have hundred of thousands of fallout casualties. In other words, a need for civil defence measures could be created by events over which we have no control.

Some of you here today come from small municipalities, some from urban centres, and some from rural and other areas. The problems involved in the establishment of programs in your communities are exactly the same as those faced by people like you in Norway, Sweden and Denmark. If it is any consolation to you, consider the fact that you are not alone in facing such problems.

We can draw some satisfaction from the measures I have discussed, but we must also see to it that they are followed by a great deal of practical execution.

It could perhaps be said that a greater need for emergency planning exists at the municipal level than at any other. In so saying, my purpose is to state that when we speak of survival following nuclear attack, we are speaking not of the federal or provincial governments but of the municipalities, for that is where the people are. Consequently, the key to survival will be found in action taken at the municipal level, regardless of anything that the federal government does or tries to do. I therefore believe that more initiative — if I may use the word — should be taken by municipal co-ordinators in planning survival programs; and these all important local plans should not necessarily depend on precise directives from "higher" levels of government.

I will give you a word of warning. As organizers, and because we are so imbued with the importance of the Emergency Measures Organization, we have a tendency

(*Continued on page 20*) **PLANNING**

* EMO National Digest Vol. 9 No. 1 February-March 1969.

OUR VULNERABLE BREADBASKET

by

L. B. Baldwin

People must eat — particularly nuclear attack survivors. The more numerous the survivors the greater are the survival and recovery problems in terms of food. Professor L. B. Baldwin, a serious student in both agricultural and nuclear attack fields, here throws a revealing light on potential farm production in nuclear post-attack situations.

Historically, natural and man made disasters have had important effects on the production of food crops and livestock, sometimes resulting in human suffering and starvation which have altered the destiny of nations. Conversely, the availability of food has always played a vital role in recovery following any disaster. Yet, today, widespread famine caused by war or natural disasters is not remembered in the United States. The sustained high productivity of United States agriculture is due to the resourcefulness and management capabilities of our agricultural industry, developed in an era of progressive research. Adequate food supplies, produced now by only some 6% of the population, have been available through several wars, survived hundreds of major floods, droughts and storms, and have contributed materially to the strength and recovery capability of the nation.

Floods and other natural hazards to production have been limited in area. Disease and insect infestation have been eliminated or controlled through technology. Food production has been maintained on the majority of the nation's agricultural lands through all recent disasters, both natural and manmade.

This would not be possible following a nuclear attack, when large land areas would be affected for varying periods of time by radioactive fallout. Although much has been learned about the effects of radioactivity on food crops and livestock, there is little information available to help livestock and crop producers prevent a serious reduction in food production capacity. Consequently, estimates of damage vary greatly and may be misleading, both in planning effective defenses and in managing survival and recovery operations following a nuclear attack. In order to appreciate the importance of the lack of research and knowledge in some areas, it is necessary to evaluate some of the data that has been obtained in terms of the food production situation today. In doing this, eleventh hour technical innovations and food supplies from nonconventional sources must not be relied upon.

Major food items in the U.S. diet include those listed in Table 1, below, which shows the per capita consumption and energy provided in terms of percentages of total diet.

Attention should be directed first to the food items supplying the larger percentages of energy in the diet. The agricultural industry is presently oriented to the production, transportation and processing of these foodstuffs, and substitution will incur changeover delays. It is to be recognized, however, that changes in production

TABLE 1.
Annual U.S. Consumption of Major Foods, 1965
(From: USDA, Agricultural Statistics 1966)

Item	Pounds Per Capita (Per Year)	Energy Supplied (% of total diet)
Flour & Cereal.....	145	20.9
Meat & Fish*.....	203	19.2
Fats & Oils.....	51	16.4
Sugar, Sweeteners.....	112	16.3
Dairy Products.....	364	12.6
Fruits.....	158	3.3
Eggs.....	39	2.2
Other Crop Products...	328	9.1
Total Animal Products..	629	40.5
Total Crop Products...	787	59.5

*The meat and fish consumption of 203 pounds per capita consists of beef (88 lbs.), pork (52 lbs.), poultry (41 lbs.), fish (14 lbs.), veal (5 lbs.), lamb and mutton (3 lbs.).

methods and a considerable alteration in diet makeup would follow a nuclear attack.

Crop products, both for direct human consumption and for livestock feed, would be affected by radioactive fallout in three basic ways: beta radiation damage from direct contact and fallout deposits near plant parts, tissue damage from gamma radiation, and uptake of radioactive nuclides from the soil during plant growth. Enough data is available to establish the fact that radiation effects on plants can be significant through any one or any combination of the above means. The effects on plants are much more subtle than on animals, however, and great variations were observed, depending on stage of growth, species of plant, and even between varieties of a given food crop. For example, wheat grain yield has been reduced by more than 50 percent by 1000-rad irradiation of plants at seedling stage. Lethal doses for vegetable crops range from 1,500 to 36,500 for the species tested. Radiation sensitivity varied six-fold among 18 varieties of soybeans — a very important protein source.

In addition to these factors, it has been shown that the condition of a plant — its nutrient balance, the adequacy of moisture, disease or insect infestation — influences its tolerance to irradiation. It appears that these other environmental stresses interact with radiation effects to tip the balance and compound the resultant yield reduction. It should also be noted that plant varieties developed in

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regions of less favorable growing conditions showed greater resistance to radiation.

This information is further modified by the fact that even the most serious of radioactive soil contamination will be so weakened within a year's time that the soil will be again fit for food crops. This is possible due to the rapid decay rate of fallout radiation. Coupled with national food surpluses good for over 18 months this gives room for considerable hope if survival and recovery planning are seriously developed.

Table 2 sets forth some predicted short term exposures required to produce vegetative growth effects, and death, in some important food crops. The limited data available indicates that extreme caution should be exercised in applying these values to predictions of crop losses or post-attack production planning.

TABLE 2.

Predicted Acute Exposures Required to Produce a Slight Effect on Vegetative Growth and Lethality for 13 Vegetable Crops and 12 Field Crops (Sparrow et al., 1965).

Common Name	Slight Effect* (rads)	Mid-lethal (rads)**
Vegetable Crops		
Onion	380	1,500
Broadbean	460	1,800
Corn	1,060	4,200
Peas	1,200	4,600
Lettuce	1,800	7,100
Asparagus	2,200	8,600
Cabbage	3,100	12,300
Tomato	3,140	12,400
Radish	3,200	12,600
Potato	3,200	12,600
Winter squash	3,400	13,500
Swiss chard	3,700	14,800
Okra	9,200	36,500
Field Crops		
Broadbean	460	1,800
Oats	960	3,800
Wheat	1,000	4,000
Barley	1,100	4,350
Sorghum	1,900	7,600
Cotton	2,600	10,100
Sugar beet	3,400	13,400
Soybean	3,600	14,200
Sweet potato	4,700	18,600
Rice	5,000	19,700
Flax	5,200	20,700
Kidney Bean	9,100	36,100

*A slight vegetative effect was defined as a 15 percent reduction from controls. Seed yields are considerably more reduced.

**A "rad" denotes an "absorbed dose" of ionizing radiation. For our purposes it is the same as the roentgen.

A review of available information indicates urgent need for further research to provide a basis to better evaluate: the retention of fallout particles on food and forage crops; fallout distribution and radiation (particularly beta) that would be experienced on farm lands under various crop canopies; and radiation effects on crop production and propagation. When the most critical hazards to continuing crop production have been identified, cultural practices and equipment can be developed to reduce them. Such research, to be effective, requires the definition of specific, critical, problem areas.

Animal products supply 40 percent of the food energy, 68 percent of the protein, and 83 percent of the calcium in the American diet. Cattle provide the greater portion of these quantities, as is shown in Table 1. These animals are vulnerable to the effects of fallout, since they are generally kept on pasture most of their lives, and would consume fallout particles retained on forage grasses, as well as being subjected to contact with fallout particles retained on their coats. Also, they would usually have no protection against gamma radiation from fallout in their environment. Swine and poultry are more often housed and fed concentrated feeds which could be protected from contamination.

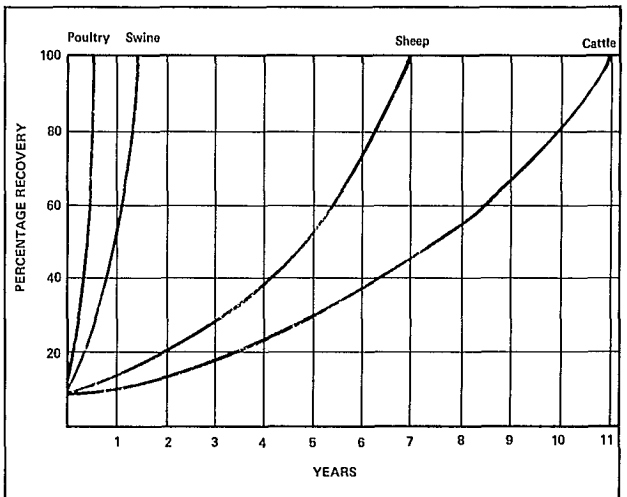
Livestock tolerance to short-term doses of radiation is quite predictable, as it is with humans. The cumulative dose of gamma radiation received over a period of a few days which would cause death in 50 percent of the irradiated animals is listed below for the more important food animals.

TABLE 3.

Total radiation dose delivered in four days or less that will kill one-half of exposed livestock.

Species	Roentgens
Sheep	350
Swine	450
Cattle	750
Poultry	900

It can be seen from this data that livestock can tolerate very little more radiation than humans, who have a median lethal dose tolerance of 450 rads. There would be a heavy loss of livestock from fallout following a nuclear attack, and a very substantial portion of the nation's food supply would be curtailed. Presuming a 90 percent loss of female breeding stock, the time required



Years Required to Rebuild Livestock Population after 90% Loss of Female Breeding Stock.

Figure 1.

to rebuild the livestock population would be as shown in Figure 1.

It is significant that survival of greater percentages of breeding stock would shorten the rebuilding period substantially in the cases of sheep and cattle. The survival of cattle, the present most important animal food source, would require more changes in production methods than would be necessary to save swine and poultry. Shelter or prompt decontamination of the immediate environment would be needed, as well as a continuing supply of uncontaminated feed. Further research is needed to develop practical means of decontaminating large land areas for forage crops, as well as for crops to be used for human food.

Livestock serve as a screening agent in the human food chain. Radioactive nuclides ingested while grazing, or from contaminated feeds are not absorbed by livestock to any great degree. Plants grown on contaminated soils will take up only a small percentage of radioactive nuclides, and livestock will absorb only a small portion of the nuclides present in the plant as they utilize these plants for feed. Ingestion of radioactive fallout is damaging to livestock, however, through tissue damage from large quantities of fallout on forage and through longer term cell destruction from strontium isotopes which may be absorbed and utilized in bone growth. Research data is not sufficient to accurately determine levels of feed contamination which can be tolerated by livestock and still not constitute a threat to human health through utilization of animal products for food.

Nuclear attack, and the resultant fallout, would produce an immediate food supply crisis, primarily due to difficulties in harvesting, processing and transporting available supplies. Many of these difficulties can be overcome by emergency planning and food storage. The long range problems which must be overcome if famine is to be averted require the knowledge and capability of reestablishing crop acreage and livestock population while at the same time supplying adequate food to the surviving population.

Research and planning must continue toward developing practical methods of restoring food production in an environment contaminated by fallout. In this way recovery from nuclear attack will be accelerated. ▲

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ORGANIZATIONS (*Continued from page 13*)

press particularly gave a great deal of attention to discussions by elected officials of the authority of government to act when conditions on private property endangered the health of the private citizen.

Government operations after the close of the disaster recovery period were devoted almost exclusively to establishing the legal authority for taking certain actions after the close of the recovery period. Most discussions centered around the legal authority of various units of government to take certain kinds of constructive action, particularly any that involved expenses for reconstruction of facilities destroyed by the disaster. Increasingly attention was riveted on the attorneys and the statute books. It is surprising to note that during the 10-day period immediately following the tornado, a tremendously large number of decisions were made but relatively few of these were ever questioned in the press nor were they subjected to review by the courts. Decisions made subsequent to the close of the recovery period, however, have been significantly more subject to legal issues, particularly those which commit financial resources. Even at this point, a number of invoices are still pending approval for payment by either the city commission and/or the county commissioner about which there are legal questions about the authority of either the city or the county to pay.

Based on the Topeka Tornado, it is clear intergovernmental relations will generally be quite harmonious immediately following the disaster. Few questions of authority are raised, for everyone is committed to restoring order to the environment so people can get on with life. As the emergency nature of the disaster disappears and life returns to a more normal pace, relationships among units of government revert to their old characteristics of: legal difficulties, chronic disagreement on the tasks that are ahead and how to meet them, jealous guarding of prerogatives. The change is so striking as to suggest that intergovernmental cooperation will be close, easy and productive when there is a high degree of agreement among governmental officials and the voters about the tasks that must be undertaken. When there is less agreement, a much greater strain will be placed on intergovernmental cooperation and there will be increasing evidence of intergovernmental non-cooperation. ▲

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PLANNING (*Continued from page 16*)

to forget that governments these days are occupied with many important matters; they have to concern themselves with the daily routine of government. They regard the EMO as a secondary activity, and in times of peace this is exactly as it should be. It is only for you and me that this is a primary activity.

I should like to conclude my talk with a few words spoken eight years ago by our late Governor General, Georges P. Vanier, on the subject of civil defence:

"I do not wish to predict that an exercise will become reality, but it could happen. It is our duty to do everything possible, both as individuals and as a nation, to avert such a disaster. But if it does come — please God that it may not — we will have to be prepared to face it, not simply with resignation, but with a firm determination to fight and to overcome, no matter how alarming the situation is or how unprecedented in the annals of history. We must face this prospect, not fearfully, but fearlessly, not accepting it passively but fighting with all our strength." ▲

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