V. THE RESPONSE

1. THE CREW

The transcript records Engineman Pruss's words at 23.54.27 "We're in the big hole Ted, but still moving" and 20 seconds later "Jesus Christ Ted, one of them tank cars blew up...". The first excerpt is a report of the train going into emergency (the big hole) and the second is his observation of the bleve of Car 8. I repeat that "bleve" is an acronym for Boiling Liquid Expanding Vapour Explosion. He radioed immediately to report it and finally reached both the London and Toronto dispatchers. By the time he had stopped his head end was at mileage 15.4 being 1.2 miles east of Mavis Road and the 32nd car which, of course, was uncoupled from the 33rd car was approximately 3,900 feet east of the resting place of Car 1 which was 250 feet east of Mavis Road. Krupa volunteered to go back to close the angle cock on the 32nd car so that the air pressure could be built up through the head end of the train permitting it to pull away. After he had done this, Pruss did pull away a distance but there then came the second explosion and at Krupa's request he pulled further to the Cooksville Station at mileage 14.2 and stopped. Krupa did some flagging for westbound trains and subsequently they proceeded with the 3 units and the 32 cars to the Lambton yard. They returned to London the next morning; they did not return to the scene.

Conductor Nichol as above reported was in the act of crossing from the north to the south side of the cupola when the train went into emergency. He took his consist list (in the emergency he forgot the Emergency Response Forms), his radio and some flagging equipment and ran west to Erindale Station Road. He placed some warning devices on the track and tried to keep people away from the train. He then ran back to Wolfedale where he showed his consist list to a fireman and a policeman. The latter took him to the temporary control centre where he informed a fire chief that there were 24 cars in the derailment and marked them off on the consist. Not unnaturally he was unable to identify the Chlorine car on the ground and he was not permitted to get the Emergency Response Forms until about 2:30 a.m. He too returned to London the next morning.

2. THE RAILWAY

As the transcript indicated one of the dispatchers on duty in London was Mervin Wallace but the chief night dispatcher was Bill Kent upon whom fell the duty of taking steps in the emergency. The railway provides a flow chart which instructs dispatchers whom to call. Among these are the local fire and police departments, the Bureau of

Explosives (an arm of the Association of American Railroads), the Superintendent and other officers of the railway, the Canadian Transport Commission and perhaps most important the appropriate parties for emergency response. All of these parties were indeed notified or at least an attempt was made at notification. Mr. Nutkins himself was notified about 0030 on 11 November and by 0130 was on his way to the scene. There he found Mr. L.A. Hill, the general manager of the region, and numerous officers of the Toronto Division. They were questioned by the fire and police departments on the location of the Chlorine car but could, like Nichol, reply only by giving its original position among the derailed cars. They were able to remove the rear 25 cars to Guelph Junction without difficulty. Of the remaining cars west of the derailment, 4 were partly or entirely derailed, and the rest were on the rails. By the afternoon of that day all of those cars had been removed to Guelph Junction or Streetsville. During the following days Mr.Nutkins supervised work crews in repairing the site and removing debris and cars when permitted to do so—sometimes there was work done so close to the scene as to cause some consternation among those seeking to prevent chemical injury. On Sunday November 18th, when the track had not been entirely cleared, a diversionary track or shoo-fly was built. On Monday Mr. Nutkins returned to London.

Messrs. Hill and Nutkins were by no means the only CP employees on hand. Indeed there were over 200, largely trackmen, carmen and signalmen from London, Toronto and Windsor. Among the officers in attendance were Mr. G.E. Lepage, the Supervisor of Dangerous Commodities, and Mr. R.S. Allison, Vice-President of the Eastern Region, and from Montreal Mr. W.W. Stinson, the Executive Vice-President of the railway.

Mr. Nutkins complained bitterly both at the time in a report to his superiors, and before the Inquiry in his evidence, of his exclusion, indeed the exclusion of all CP personnel from the decision-making process in the early stages. It seems that he and Mr. Hill were asked to participate in a meeting to be held on Tuesday and then denied access at the door. He stated that the railway had many contacts and much expertise that could have been available and by the exclusion was lost. I did not permit the Inquiry to delve into the matter deeply and no evidence was offered as to any particular benefit lost, but there is no question in my mind that if CP officials were excluded, it was a mistake.

Certainly the exclusion was not permanent. It was obvious from transcripts of command post proceedings that Mr. Allison was a part of the command team from Thursday, November 15th on.

Mr. Lepage, the Director of Dangerous Commodities for the Eastern Region, has a background as machinist, foreman and mechanical supervisor for CP Rail. In 1975 he was made Director of Dangerous Commodities with duties to attend derailments and guide and supervise if dangerous commodities are involved. As it happened he was on holiday in Ottawa on November 10-11. He was reached late Sunday morning and drove back to Toronto immediately, arriving at the scene about 9 p.m. that night after a detour (requested by his superior) to give a television interview. His principal task was to warn CP employees and others on the site of the potential dangers of the dangerous commodities involved. He readily admitted he was not an expert in the properties or control of dangerous commodities particularly Chlorine, but he did assist or offer to assist the members of the private response teams and his activities there are better left to be considered with the activities of those teams. Certainly he was not a member of the command post team.

3. THE MUNICIPAL EMERGENCY SERVICES - FIRE & POLICE

Both the fire department of the City of Mississauga and the Police Department of the Region of Peel were on the job and on the scene immediately after the derailment. The fire department set up hoses on both

sides of the track and manned them continuously until the fires were out and were available at all times thereafter. The police took charge of the scene to keep the citizens free of danger and executed the very difficult evacuation and re-entry programmes. While the authority and capacity of these departments may be within Item 6 of the terms of reference, I did not consider that the quality of their performance was within my mandate and I refused to issue subpoenae to the fire and police chiefs which subpoenae seemed to me directed to that assessment. I content myself with saying that I heard no complaint about the manner in which the police executed their difficult task, and the only complaint voiced about the firemen was that they were inclined to approach the fire too closely for their own safety. It is a transgression I find very easy to forgive.

4. THE PRIVATE SECTOR

The transportation of dangerous commodities by rail is big and necessary business. It is estimated that there may be as many as 300,000 different dangerous substances capable of transportation, but only some 3,500 are commercially significant and 30 constitute the bulk of

those transported. These include explosives, compressed gases, flammable—the word "inflammable" has fallen into disuse in North America, apparently because of confusion with "non-flammable"—liquids and solids, toxic substances and corrosives. Some, as we shall see, are much more dangerous than others but regardless of danger, many have great commercial use and most of these are transported by rail.

The dangerous commodities involved in the Mississauga derailment more or less in order of magnitude of danger were:

(a) Chlorine
(b) Propane
(c) Toluene
(d) Caustic Soda
(e) Styrene

Styrene, a solvent used in the manufacture of pharmaceuticals, plastics and automotive parts is not classified as a dangerous commodity in Canada although it is in the United States. The others, all classified as dangerous commodities, have many and valuable commercial uses including Chlorine for water purification and bleaching of pulp and paper, Propane as a fuel, Toluene in paints, fuels, clothing and furniture, and Caustic Sode in textiles, paints and disinfectants.

These products are not only needed but must be transported because they obviously cannot be manufactured

everywhere. Some suggestion was made that there could be a reduction in transportation by using the product where made or at least avoiding the transportation of chemicals from one place of manufacture to or close to and for use at another place of manufacture. It would not, in my view, be practical to attempt such a solution by legislation. Not only would it be an interference in a free market economy, but that very free market, if our theories are correct, should eventually produce the cheapest method of distribution which will involve the least transportation.

The problem that arises in the transportation of dangerous commodities is not just the danger. It is the ignorance of the layman in the properties of the commodity and in consequence his inability to control the escape of that commodity or to take appropriate protective action upon that escape. This deficiency can be corrected only to a limited extent. The municipal services can be educated (and indeed steps have been taken already by the railways, private industry and government to that end—the above mentioned Emergency Response Forms are an example) and I will recommend that such education extend to all railway employees concerned in the transportation of dangerous goods and all firemen through whose municipalities dangerous commodities may pass. But such education or training can

never be enough. Where a dangerous spill occurs there must be on the scene someone or some group capable and qualified to take the necessary action.

4.(a) CANADIAN CHEMICAL PRODUCERS ASSOCIATION AND TRANSPORTATION EMERGENCY ASSISTANCE PLAN (TEAP)

Private industry has recognized this need and government is recognizing it more and more. The Canadian Chemical Producers Association in 1972 established the Transportation Emergency Assistance Plan (TEAP) which operates Regional Control Centres located at the various companies in British Columbia, Alberta, Ontario and Quebec. Its purpose is to provide immediate expert advice to people at the scene and then to arrange for a shipper to provide more detailed assistance. It operates a 24-hour telephone service at the Regional Control Centres with a technical adviser who remains available until the shipper has taken over.

4.(b) THE CHLORINE INSTITUTE AND CHLOREP

Of a similar nature is, dealing with a particular industry, CHLOREP (The Chlorine Emergency Plan) established on a North American basis by the Chlorine Institute which

has its headquarters in New York and has amongst its members virtually all manufacturers of Chlorine in North America and many manufacturers from overseas as well. The Institute has many committees of which the important one for us is the Chlorep Committee established in 1972 which controls the Chlorep plan. By that plan the United States and Canada are divided into sections, each with at least on Chlorep team operating or prepared to operate on a 24-hour basis to handle real or threatened Chlorine leaks. These teams are located at the major manufacturers, one of whom is the Dow Chemical plant at Sarnia which was, as it happens, the shipper of the product in Car 7.

(i) DOW CHEMICAL OF CANADA LIMITED

It was the Dow number that was called by the London dispatcher on the morning of November 11. He called plant security at 0149 hours and plant security notified Mr. R.W. Johnson, the manager of the Product Services Department of Dow who has been the Emergency Response Coordinator of both the TEAP and CHLOREP plans for Dow since 1974. There was, of course, at Dow in existence a Chlorep team and Johnson alerted that team consisting of Mr. Ralph Jones as Captain, Mr. R. Robichaud experienced in firefighting, and Mr. D. Hamilton experienced in public relations. He also alerted Mr. Stuart T. Greenwood, the supervisor of the shipping department, who had had practical experience in a Chlorine spill at Loos, British

Columbia, in 1973, a derailment involving a puncture of a Chlorine car and consequent escape of gas, but without accompanying fire, and also at Youngstown, Florida, in 1978 where in another derailment a Chlorine car had been punctured but again without accompanying fire. The team with Greenwood in charge left Sarnia at 0330 and arrived at the scene at 0630 hours. Immediately on their arrival, they detected a smell of Chlorine but were unable to get to the car to determine the source of the leak. Indeed, even with the help of a helicopter tour over the site, they were unable that day to discover the exact location of the car itself.

Greenwood did notice that the firemen were much too close and suggested they move back. Generally speaking he was unable to take any corrective measures that day because of the intensity of the fire and the danger of further explosion. He was, however, asked by the Provincial Ministry of Environment officials to get information on the worst possible results of the escape of Chlorine. Knowing that the capacity of the car was 90 tons and the wind was 17 miles per hour, he sought and obtained from Johnson dispersal figures and safe evacuation areas which he communicated to the command post and upon which the evacuation orders were no doubt based. The figures were shown on Exhibit 186 and are to the effect that to avoid

long-term health hazards in the event of release of the full contents, it would be necessary to evacuate an area of 16.5 miles by 2 miles and in the event of a release of only 18,000 pounds, the evacuated area should be 3.5 miles by 1/2 mile. As will be seen the first figure appears to have been the basis for the evacuation ordered on Sunday, and the second for the reduced area on Tuesday. Greenwood also was informed that the Ministry was unable immediately to take Chlorine readings in the air and asked for and obtained two more men from Sarnia properly equipped for the purpose. As it happened the Ministry did have the necessary personnel and equipment available on Sunday and readings were taken by them throughout the week. I should say now that at no time were dangerous readings recorded anywhere in the area but that, of course, is not the whole story. It is not the present but the potential danger that must govern, when human lives are at stake.

Robichaud and Jones located the Chlorine car on Monday morning, and saw that it did indeed have a hole and a large one at that. The hole was 2 1/2 feet in diameter, the largest ever experienced, at least on this continent. Greenwood and his men examined the hole with protective equipment, took pictures of it with the assistance of Detective Boyd Brown, covered the hole with a tarpaulin and proceeded to a tank car manufacturer at Bronte, namely Procor Limited,

where a patch was prepared immediately. The fires were still burning that day and no attempt was made to apply the patch. Greenwood did, however, report to the Attorney General who was in charge of the command post that there was this large hole but added that there was not so much Chlorine as he had feared remaining in the car. He had determined this by measuring from the surface of the hole to the surface of the Chlorine remaining. His figure could not be exact, however, because ice had formed on top of the liquid Chlorine and the depth of that ice could not be calculated.

(ii) THE NATURE OF CHLORINE I pause here to say something about the nature of Chlorine and its manner of transportation. It is itself non-flammable but acts as a supporter of flame. At normal atmospheric pressure it boils at -30° F, but the greater the pressure, the higher the boiling point. It is loaded at 40° F, with a pressure of 50 pounds per square inch, mainly in liquid form, but with some in gas form to prevent damage on expansion of the liquid into gaseous form. If indeed the liquid does boil and convert into gas, it expands by a factor of 460. When there is a hole in a tank car inevitably there will be a decrease in pressure which lowers the boiling point, increases the volume and causes an escape of vapour. After that escape, however, an equilibrium is reached with some of the vapour being returned to liquid form and in the absence of any

heat source other than that provided by the atmosphere the rate of release would thereafter be very slow.

Another property of Chlorine should be mentioned. As I have said, it is not in itself flammable, but carbon steel containing Chlorine will have a reaction at 483° F, which reaction is known as a ferric chloride reaction whereby the steel will burn and disappear in a form of very fast oxidation.

Finally, water can have an effect on a Chlorine tank car. First it is inadvisable to water a tank car having a small hole because the combination of Chlorine and water will create an acid that corrodes and enlarges the hole. And in a very large hole such as existed in Mississauga, water may get in and form an ice layer (hydrate) on top of the liquid as it did in Mississauga. This may have detrimental and beneficial results. The latter comes about by the insulating effect of the ice layer and the former would be demonstrated if there were chinks in the ice layer allowing some gas (liquid converted by the heat of the layer) to escape. The ice layer is known as chlorine hydrate and was one of the unusual features and one of the complications as we shall see first in determining the amount of Chlorine remaining and second in predicting the danger in evacuating the Chlorine from the car.

(iii) THE EVACUATION OF THE CAR The fires were out in the early morning of Tuesday, the 13th, and Greenwood, with the Procor patch, proceeded to attempt to evacuate the car of its Chlorine. The first attempt consisted of patching and then pressuring the car and trying to pump out the Chlorine into a Chlorine truck standing by, somewhat in the manner of what had been done in Loos with a much smaller hole. Unfortunately when the pressure was applied, the patch did not hold. Greenwood and his team worked all Tuesday night to repair the patch—the decision to work all night was perhaps dictated by the intention of others to do work on a Propane car nearby the following morning and the desire not to be working in the vicinity at the time. The patch was repaired, or virtually so, by 0800 hours on Wednesday, but no further attempt was made at evacuation; instead the team retired to bed in exhaustion, having first asked Sarnia for more help.

That help came in the form of Mr. Fred Hamlin, the Chlor-Alkali production manager and a chemical engineer, and 2 other men (later a third) from Sarnia, as well as 3 technical personnel from Canadian Industries Limited (CIL). From the time of his arrival on the scene, Hamlin was in charge of the Dow operation.

By the time Hamlin arrived, the idea had occurred to attempt to vacuum out the Chlorine as opposed to pressurizing. This was performed with the liquid being removed first to a tank truck and then to a tank car and the Chlorine vapour being coincidentally neutralized in Caustic Soda. There was some delay because the command post was worried about the wind direction and the possibility of some disaster occurring in the course of the transfer. However, the evacuation of liquid did commence at 2315 hours on Thursday and was completed without incident in the early morning of Monday, November 19th, when the tank car was filled with water and the patch removed. The remaining evacuees in Mississauga were permitted to return home on Friday, November 16th, at which time the command post deemed that operation to be safe.

(iv) THE ALLEGED DEFICIENCIES OF DOW'S CHLOREP TEAM

A massive attack was launched upon the performance of the Dow team by counsel for CP Rail. As I understand the complaint it is as follows:

1. Dow sent to the scene an unqualified and inadequate team.

2. Greenwood and his crew did not know how to evacuate the Chlorine.

3. Greenwood and his crew did not know how much Chlorine remained in the tank car after the initial escape and did not know how to calculate it.

4. Greenwood and his crew gave improper and dangerous instructions to firemen to water the Chlorine car and indeed watered the car themselves.

5. Greenwood failed to take measures to vent the car at the beginning to protect against escape of Chlorine.

6. Greenwood (and Hamlin) gave poor advice to the command post team, particularly with respect to the rate of vapour and liquid evacuation, as to the method of evacuation and as to the dangers of release of gas consequent upon breaking of the ice.

7. Greenwood (and Hamlin) were parties to the concealing of information or the rendering of misinformation to the public.

There were many motions made before me in the course of the Inquiry and two of them, at least, bear upon this problem. The first was a motion by CP Rail to subpoena some of the persons in the command team to give evidence of the decision-making process. I rejected the application partly upon the ground that in my view it would result in a protracted delaying cross-examination on largely (to me) irrelevant matters, but partly also because in my view

it was the danger or properly apprehended danger with which the Inquiry should be concerned, not the validity of the action taken by the command team in response to that danger or apprehended danger. The second motion was one brought on behalf of Dow which asked, among other things, for an interpretation of Item 6 of the terms of reference as it affected the response by Dow's Chlorep team. I noted that I might not be able to report on the question at all but added that in my view the term "involves the action to be taken by the federal authorities to correct the situation arising upon an accident including the calling upon the private sector for assistance. That may embrace the capacity of the private sector to respond; and whether in the light of the Mississauga experience, the present system should be continued, discontinued or amended."

The Inquiry proceeded without the evidence of those in command at the command post and counsel argued knowing the limitation of my interpretation of Term 6. I was concerned with the danger or properly apprehended danger facing Mississauga, not with the validity of the reaction to that danger or the measures taken to combat it. I was concerned with the capacity of the private sector to respond and with the system of relying upon private response, not with the manner in which that response was executed. That, no doubt, will be a matter of great interest to others at another time.

That being so, I need not consider the facts behind the allegations in too great detail. However, a great deal of time was taken up with that detail in the Inquiry and much time was spent in argument in the course of the accusations against the team and in the course of the very vigorous and spirited defence of the team's conduct by counsel for Dow and counsel for the Attorney General, and perhaps I should express some view on the matter. I content myself with saying that I do not think the personal attacks on Greenwood and to a lesser extent on Hamlin and Johnson are justified. Perhaps in hindsight Johnson should have provided for a back-up team earlier and perhaps Greenwood should have asked for it earlier. Perhaps Johnson should have sent Hamlin at the beginning. Perhaps even in light of the magnitude of the disaster, a person of ultimate authority in the company should have been on the scene. Perhaps the knowledge of Greenwood was inadequate for the enormity of the task and perhaps again in hindsight he did not use the best methods at the beginning. But all of these men did the best they knew and their knowledge was better than that of anyone else on the scene. They all, and the other members of the team, worked very hard to correct a situation which was not of their own personal making and they gave the best advice of which they were capable. I may deal very little with some of the other allegations in the course of considering the actions of the command team. With regard

to the last enumerated alleged default, I must say now that I do not accept the allegations that any of these men were deliberately parties to a deception, either of the command team or of the public.

(v) THE POSITION OF DOW Having said that, however, I do not wish to be taken as entirely satisfied with the Chlorep plan of Dow. Nothing in the conduct of the company's affairs can be of greater public importance than their response to a Chlorine spill. It must be remembered that however good or bad that response may be, it is at the moment all we have. It is accordingly of vital importance that its response team be adequate to the task.

Dow has, as we have seen, a predetermined group of people who are designated as the Chlorep team and have computers to give dispersal data. Apparently Greenwood was given some practice training in patching cars and he had the practical training at Loos. Dow also has kits, supplies and equipment and has prepared a detailed, apparently complete Emergency Response System Guide for its employees. That document was filed on condition it not be made public and will be returned to Dow on the completion of this Report. I have examined it and find it replete with information where technical assistance can be obtained, but empty of technical assistance itself.

That is indeed my concern. The team was completely surprised and quite unprepared for a hole the size of the one that developed in Mississauga. It was not experienced in dealing with repair work in the presence of fire. Is the training of the Chlorep team—which is voluntary; the Chlorine Institute runs seminars but attendance is not required—sufficient? Is it sufficient to rely on the experience of the men designated, that experience being obtained in their ordinary jobs or should there be some specialized training in simulated disaster settings? Is it enough to have practical men only compose the Chlorep team in the first instance or should there be a technical man thoroughly knowledgeable of the properties of the particular chemical as part of the team from the first?

I pose these questions; I do not answer them. As will be seen I shall recommend that these problems be considered by a qualified person and that the plan of response be approved and the rules be established before any shipment be permitted.

(vi) THE CHLORINE INSTITUTE REPORTS I should here note the history of rail spills of Chlorine in North America as revealed in the Chlorine Institute Accident Reports issued for its members.

Labarre, Louisianna. The first in point of time was that at Labarre, Louisianna on January 31st, 1961, when a Chlorine tank car of the 105 series was punctured by a draw bar at the B end and the whole contents of the car apparently spilled into neighbouring ditches. The hole was stated to have an area of about 4 square feet. There were about 100 human casualties and 1 death. It was also stated to be the first known puncture in the 52 year history of Chlorine tank cars.

Newton, Alabama. The second spill was that at Newton, Alabama, in 1967, where a Chlorine car, one of 51 cars, derailed. The derailment produced a fire that raged for 20 hours and the Chlorine car suffered an 18 inch hole in the shell and a 6 inch hole in the B end, both believed to have been caused by ferric chloride reaction. When it finally became possible to approach the car, it was found that all the Chlorine had gone, believed to have been carried into the air by the conflagration and dissipated in the upper atmosphere. There were no casualties but 2,500 people were evacuated.

Corbin, Louisanna. The third spill was at Corbin, Louisianna, on December 11th, 1971, where a Chlorine car was derailed and suffered a blow from the coupler of the car ahead creating 2 small holes in the jacket, one of which cut a slit in the head of the tank 3/16th inch by 1/2 inch. From this hole

Chlorine was leaking and the leak could not be repaired. The Chlorine was transferred to an empty car and with the aid of some caustic soda neutralized. The Chlorine in the air never reached any dangerous levels and there were no casualties.

Loos, British Columbia. The fourth spill was that at Loos, B.C., on March 4th, 1973 which Greenwood attended. 24 cars including 4 Chlorine tank cars of a CN train were derailed. One of the Chlorine cars suffered 2 punctures, one 3 1/2 inches by 6 inches and one 6 inches by 4 1/2 inches. It appears that 17 of the 85 tons of Chlorine in the car escaped through boiling off, spillage and venting, and the remainder was pumped off, after patching, into a waiting tank car. There was only one minor casualty. The Institute in its report recommended that Emergency Kits should have pre-made patches, fasteners, pumps and other equipment. The Chlorep team did not arrive at Mississauga with a pre-made patch and Greenwood stated it would be useless because all patches had to be made to fit the configuration of the particular hole and the particular car. It must be recognized, of course, that no time was lost by any lack of equipment in the Chlorep team at Mississauga because the fire prohibited any repair work until Tuesday morning.

Youngstown, Florida. The last and most serious (before Mississauga) spill was at Youngstown, Florida, on February 26, 1978 at which as we have seen Greenwood also attended. 44 of 140 cars including 2 Chlorine cars derailed and 1 of these suffered an irregular shaped puncture about 3/4 of 1 square foot in size. About 50 tons of Chlorine was lost in the first few minutes. There was very little wind and the cloud drifted to a nearby highway killing 8 motorists and their passengers. Some 89 persons were hospitalized and hundreds affected. It was decided that the hole could not be patched and the remaining Chlorine was pumped out (and neutralized by Caustic Soda) into a large pit dug for the purpose.

4.(c) THE PROPANE RESPONSE

Whatever may or may not have been the defects in the Chlorine response, it at least was available and immediate. The same cannot be said for the response of the Propane industry generally. Propane constituted the second greatest danger at Mississauga and in fact caused by far the greatest damage to property. The Canadian Chemical Producers Association originally had a cooperative arrangement with the

Propane Gas Association but has ceased to make any claim to that arrangement because it is said that that latter Association does not maintain a 24-hour telephone. Indeed, it appears that Johnson of Dow in the early hours of Sunday tried to reach the Propane Gas Association through an intermediary but was unsuccessful.

It is to be remembered that 11 of the 24 cars derailed contained Propane and that 3 of these cars, numbers 8, 12 and 13, bleved within one-half hour of the derailment. Propane is one of the family of Liquified Petroleum Gases or LPG's. It is not only explosive but also flammable and indeed most of the fire at Mississauga was the result of the burning of Propane. Of the 8 tank cars containing Propane that did not bleve, 7 were either punctured or ruptured from within and their contents consumed in fire. One however (Car 23) was found still to contain a large part, if not all, of the Propane intact. As noted earlier there is no response organization for Propane and when Mr. Lepage arrived on the scene on Sunday night he asked that someone be obtained to help deal with the Propane problem. That someone turned out to be a team of 7 or 8 men under the leadership of Mr. David Johnson from Superior Propane, a company having a 24-hour telephone service, and one which, as it happened, was the consignee of bleved Car 12. Johnson appeared on the scene Sunday night but could do nothing until

the fires were out. He approved of the firemen's approach which was cooling the Propane cars and permitting the fires to burn themselves out. Like everyone else he found the firemen to be doing an excellent job. After the fires were out he, assisted by Lepage, supervised the washing out of all the burnt out cars to remove any vapour and the removal of the liquid from Car 23. This was partly accomplished on Tuesday and completed on Wednesday after the car had been righted. The whole operation was conducted under the protection of explosimeters, instruments that will tell of the imminence of explosion. There was also an interruption on Wednesday because of a suspected escape of Chlorine to which I will refer later, but generally speaking the clean-up of Propane was completed without incident. Nevertheless we must not forget the 3 explosions and the fires that raged for more than 48 hours. It is also imperative that the emergency telephone numbers onall Emergency Response Forms be operable on a 24-hour basis. Mr. Wilmer Karaskawich, the manager of the Dangerous Commodities Assessment of the RTC, in a survey conducted between January and October, 1979, found some of the emergency telephone numbers "not functional anymore".

5. THE PUBLIC RESPONSE

(a) THE COMMAND TEAM

I need hardly say that the accident at Mississauga was unlike any other. In the ordinary course an accident will be handled by the railway with perhaps a little help from the Bureau of Explosives of the Association of American Railroads and very occasionally from TEAP or CHLOREP or some such technical organization. But in Mississauga not only were there explosions and fires requiring immediate and continuous firefighting and police control, but the apprehended danger from the Chlorine resulted in the evacuation of nearly a quarter of a millon people. Inevitably the problem became a political one.

The evacuation of the residents is assuredly not among my terms of reference. Also as I have said I refused to subpoena witnesses where the evidence seemed to me to lead only to consideration of the propriety of the decisions made to evacuate them from or to return them to their homes. Still Term 6 does, at the very least, require some consideration of the corrective system in response to an accident and we have had, I think, more than enough evidence to enable me to express my views on how it worked at Mississauga and what could be done to improve it.

There was an immediate response from the City in the person of its Mayor, Hazel McCallion, and from the Province in the person of The Honourable Roy McMurtry, the Attorney General. Mr. McMurtry was (and is) also the Solicitor General and it was in that capacity as Chairman of the Cabinet Committee on Emergencies that he attended the scene and took command—I have no doubt whatever that he was in complete command from the moment he arrived, even though he did not conduct the matter like a military operation. His method was to discuss and obtain agreement, not to issue orders. Everyone at the command post referred to him by his senior title, viz. Attorney General, and I shall do the same.

Among those advising the Attorney General besides the Mayor, were members of the federal and provincial parliaments, the chiefs of fire and police, representatives of the provincial Ministries of the Environment, Health and Labour, the Canadian Transport Commission, Messrs. Greenwood and Hamlin of Dow, Mr. Johnson of Superior Propane, two university professors, and from Thursday, November 15 on, Mr. Allison and others of CP Rail. From this team there issued the orders to evacuate the populace and to return them to their homes, to commence or delay the evacuation of Chlorine and to permit the clean up of the CP right of way. The team also

issued press releases to inform the public, particularly the people of Mississauga of progress, and dealt with a host of other problems that arose during the fateful week. So far as I can determine there was no dissent from the decisions made and the orders issued.

The major problem at all times and the only real problem after the fires were out on Tuesday morning, was the danger to the public posed by the escape or possible escape of Chlorine. What was needed to know was the amount of Chlorine remaining in the car, the rate at which it was escaping, and what the risks were of a greater escape in any effort to evacuate it.

Stangely enough no exact figure could be given of the amount of Chlorine in the car after the initial escape. It appears that the bleve of Car 8—and perhaps the other bleves as well—sucked up much of the Chlorine out of the tank and lifted it into the sky where it was dissipated more or less harmlessly. Greenwood was able to measure to the hydrate level on Monday and reached the conclusion that there was 2 to 3 feet (including hydrate) remaining which, taking into account the total depth of the tank (102 inches) he estimated would leave about 20 tons of Chlorine still in the tank. Later this estimate was revised downward, perhaps after the frost level could be determined, because documents were

circulated at the command post showing that ice (hydrate) was 6 to 12 inches thick and there remained in the car "about 10 tons of liquid Chlorine". More sophisticated methods of determining the quantity were tried throughout the week by x-rays, thermovision and gamma ray. The latter achieved the best results, but none was really satisfactory. The difficulty is that the industry has traditionally used only one method and that is weight, a method that was impossible at Mississauga because the car could not be lifted without running the risk of a sudden escape of Chlorine from the disabled car. By Wednesday (after the patch was on) Greenwood told the command post that there was a "controlled situation", but he could not guarantee that something might not happen to the ice which might cause the release of gas which might in turn destroy the patch.

Hamlin in evidence estimated that there was probably 20,000 pounds left after the initial escape, that about 5,000 pounds was lost until Thursday and that the remaining 15,000 pounds or 7 1/2 tons were vacuumed out between Thursday and the following Monday. Much of the Chlorine was neutralized in the vacuuming process so that the figures of weight of the product transferred to the truck and car (negligible) are unreliable. Hamlin further estimated that there was a loss of about 50 pounds per hour from Monday to Thursday by vapourization and that evacuation after Thursday of both

liquid and vapour was at the rate of about 200 pounds per hour.

(b) WATER ON THE CHLORINE CAR

I should mention here an incident (the same one as referred to in Item 4 of the indictment, supra, against the CHLOREP team) that caused some temporary concern at the command post. Late Wednesday morning a puff of vapour was seen by several witnesses to come from the general direction of the Chlorine car and was assumed by many to be Chlorine. I may say I am far from certain that it was. In any event, it caused a temporary halt in the evacuation of Propane from Car 23 and considerable recriminations at the command post and at the site. It happened while Greenwood and most of his team were asleep and when he was informed of it he blamed it on the inadvertent or ill-advised watering of the Chlorine car, perhaps in the course of the Propane operation. Some of the firemen suggested that it was Greenwood himself who had ordered and arranged a steady stream of water directed towards the area of the patch. Greenwood and others in turn testified that no water was arranged by them to fall upon the patch and the only hoses in the area were sprays to disperse escaping Chlorine. I doubt very much that Greenwood would have

ordered the placing of hoses where water could have entered the car, and I doubt that any of the firemen would have done so against his orders. Whatever happened was a misunderstanding only, but in any event, in my opinion, was of little or no importance in the final analysis. A great deal of water must have fallen on the unprotected hole in the initial firefighting. It is doubtful that that water caused any harm. The hole was so large that the water was unlikely to cause any expansion and the only certain result, i.e. the formation of hydrate, appears to have acted as a seal to prevent or at least inhibit the further escape of Chlorine. As to the alleged additional water entering the car on Wednesday morning, as I say, I am not sure there was any. I am also not sure that there was an escape of Chlorine resulting therefrom and if there was there is absolutely no evidence that it caused any harm to anyone. The only problem with it is that it seems to have caused some alarm at the command post and perhaps affected their view of the danger of the situation.

(c) THE DECISIONS OF THE COMMAND TEAM

As I have said, I do not consider that I have been asked to judge the validity of the team's decisions and I do not intend to do so. All I can say is that they

clearly had a very difficult problem. They obviously had no desire to keep people out of their homes any longer than necessary and the Chlorine readings showed that there was no immediate danger. No one, however, could tell them exactly how much Chlorine remained—all estimates given were of an amount that if it all escaped could be catastrophic—and no one could guarantee that the vacuuming process could be conducted without some danger in light of the hydrate and the unknown condition of the car. As a matter of interest, the examination of the car by the Ontario Research Foundation revealed a dent with a crack in it at the bottom of the A end of the car.

Even in the hindsight of the 127 days of the hearing with much of the evidence and argument dealing exhaustively with the danger presented by the Chlorine car, I am happy that the decisions were theirs, not mine.

VI. THE TANK CARS

Tank cars for the transportation of dangerous commodities by rail have been with us for more than 100 years. At first, they were wooden barrels on flat cars, then they became metal cars of wrought iron and later of steel. Until the turn of the century the capacity did not exceed 10,000 gallons, but in this century they have become much larger. Indeed for a time there seemed no limit to the increase in size but finally it had to be brought under control because of the effect on track. In Canada it is provided—see CTC Regulation 79.13 that after 1970 no tank car shall exceed 27,500 gallons capacity or 263,000 pounds gross weight. Also in recent years special types of cars have developed for special types of dangerous commodities.

1. DEVELOPMENT AND OWNERSHIP

At first also the tank cars were owned by the railways but gradually the manufacturers and the shippers have taken over, generally with the shippers as lessees. The dangerous commodities carried in Train 54 were in cars of the 105 series for Chlorine, the 111 series for Toluene, Caustic Soda and Styrene (the latter not technically a dangerous commodity), and the 112 and 114 series for Propane.

Of the particular cars, Cars 1 and 13 were owned by North American Car Corporation and leased by Shell Oil, No. 7 was owned by Canadian General Transit Company and leased by Dow, Nos. 8 and 12 were owned by Union Tank Car Company and leased by Imperial Oil and Shell Canada respectively.

2. DESIGN AND THE RETROFIT PROGRAMME

The design of these tank cars has for many years been regulated, at first only by the Association of American Railroads, but latterly also by government, the Department of Transportation in the United States and the Canadian Transport Commission in Canada. It is sufficient for now to say that by regulation all tank cars in use in Canada must comply with CTC regulations which in turn are generally speaking in accord with the specifications for manufacture established by the AAR. Indeed the Red Book requires that designs, materials and construction be submitted to and approved by the AAR Tank Car Committee.

There are, of course, innumerable features of design in all these cars that relate to safety, but the only ones I think we need deal with are (a) roller bearings and plain bearings, (b) shelf couplers, (c) head shields, (d) thermal protection, (e) bottom fittings, and (f) safety valves. I shall deal with each mainly to show the purpose

of the improvement and the state of the retrofit programme. The term "retrofit" is used in railway circles to denote a programme for improvement of a tank car already manufactured. Sometimes, as we shall see, it is under the auspices of the AAR, and sometimes it has the force of law.

(a) Roller Bearings and Plain Bearings.

Journal bearings, as I have indicated, are a part of the running gear of the railway car and are by no means peculiar to tank cars. Roller bearings have been in existence since about 1950 and in 1966 the AAR required all new 100 ton cars to be fitted with roller bearings and in 1967 the requirement was extended to all new tank cars. In Canada all cars now manufactured have roller bearings, but there never has been any requirement of law providing for the conversion of plain bearings to roller bearings, although it would now appear that most tank cars and something just under 50 per cent of the railways' fleet (mainly box cars) are so equipped. As we learned, there were only 7 of the 69 cars on the C&O's Local 4 having plain bearings and of the cars derailed those so limited were Cars 2 and 16 (box cars) 9(Styrene) and unfortunately Car 1.

(b) Shelf Couplers.

The double shelf coupler is a device designed

to prevent the vertical displacement of the coupler on the uncoupling of a car and thus reduce the danger of puncture to the head of an adjacent car. It is now required by law on all 112 and 114 cars—see CTC Regulation, 22 January 1979. The AAR has decreed that all new cars must be so equipped and in the United States the D.O.T. has proposed that all 105 cars be likewise equipped after December 31, 1981 and all other tank cars after December 31, 1984. There is no real argument against the merit of these couplers but I understand that a double shelf coupler on a dangerous commodity car will protect it regardless of the type of coupler in an adjoining car. Consequently, for my purposes, I need not consider in this connection the state of the fleet generally. Neither Cars 1 nor 7 had double shelf couplers and for neither was it required.

(c) and (d) Head Shields and Thermal Protection. The 112 and 114 cars were not originally required to have head shields to protect the cars from puncture or thermal protection to protect against excessive heat caused by fire. Now under CTC regulation all such cars are required to be so protected (the requirement for thermal protection relates only to cars loaded with flammable gas) by June 30, 1981. The precise nature of the protection is set out in the Regulation. Car no. 8 had completed the retrofit in this regard by the time of the derailment. Cars 12

and 13 had not. In the United States there is a proposed ruling that the same should apply to 105 cars, but unlike the shelf coupler there is still debate on the subject and no formal rule has yet been made. The difference appears to be that 105's have always been insulated (to prevent the atmospheric temperature from affecting the contents) and some 105's already have some additional head thickness and it is not clear that the proposed head shield and thermal protection would provide any greater protection. There are at present tests going on in the United States aimed, in part, at determining this matter. There is no Canadian authority considering the question at the moment. There does not appear to be any formal proposal either in Canada or the United States for the retrofitting of 111 cars some of which are insulated and some not and which can and do carry flammable commodities, although not LPG's.

(e) Bottom Fittings.

Bottom fittings are for ease of loading and have never been permitted on 105's or 112's but were permitted on early 114's and have always been permitted on 111's. The difficulty with them is that they tend to sheer off in a derailment thus causing the release of their contents. Every one of the 111 cars involved in this derailment had bottom outlets and every one except Car 24 which remained upright with its rear truck still on the rails suffered damage to the bottom outlets and the release of all their contents. The AAR rule now requires bottom

outlet protection for all new cars, retrofitting of all 114 cars by December, 1984, and of 111 cars,according to the commodities carried,for periods up to 1989. There is no formal regulation either in Canada or the United States.

(f) Safety Valves.

Tank cars which carry compressed gases such as Chlorine or Propane are equipped with "safety valves" set to release into the atmosphere any excess gas when the pressure reaches a certain point. There is no retrofit programme under way or contemplated nor has anyone suggested that the valves do not satisfactorily perform the task assigned. To me, however, they do not do the job that I would have expected of them. They are designed apparently to work only in normal or relatively normal conditions. In a conflagration such as Mississauga they cannot operate to prevent a bleve and Greenwood discovered that the safety valve had not activated on Car 7 notwithstanding that the car probably ruptured from excessive heat and the ferric chloride reaction.

3. THE CHLORINE CAR

The full title of the car is DOT 105A500W Non-Coiled Insulated 90 ton Chlorine Car. As its name implies, it is specifically designed for the transportation

by rail of Chlorine. The DOT stands for the U.S. Department of Transportation, the 105 was successor to the class V tank car first manufactured in 1918 which was designed for the transportation of Chlorine and was insulated and of especially heavy construction. The 105 number was adopted when the Interstate Commerce Commission in the U.S. took over control of the specifications for tank cars. The DOT is in this regard the successor to the I.C.C. and corresponds to the CTC in Canada.

The A means nothing—its sole purpose is to keep the numbers apart. The number "500" denotes the pressure to which the tank has been tested on inside pressure. The tank will not rupture until the pressure gets to 2 1/2 times the 500 mark or 1250 pounds per square inch, and the safety valve is set to start to discharge at three-quarters the 500 mark or 375 pounds per square inch. The W indicates that the cars were fusion welded. As we shall see all tank cars must, by CTC regulation, be manufactured in accordance with tank car specifications of the AAR Tank Car Committee. These specifications are developed after consultation among the AAR, the Chlorine Institute and the railways and it was certainly not demonstrated that there are improvements available other than those under way or considered in the retrofit programmes, supra. The steel could be thicker but the thicker it is the heavier it will become and the load

of product will be reduced. Any increase in thickness will not apparently give proportionately greater protection.

In any event the documents of manufacture by the Hawker-Siddeley plant at Trenton, Nova Scotia, of the Chlorine car were examined in detail by Mr. E.L. Kunz, an independent expert retained by the Commission and found to conform to CTC specifications in every respect. Moreover the tank car itself was subjected to intensive tests, both non-destructive and destructive by the Ontario Research Foundation under the supervision of Mr. G.R. Wood and its reports studied on behalf of the Commission by Professor R.W. Smith of the Metallurgical Engineering Department of Queen's University, and found to have been manufactured in accordance with specifications and without defect of material. The examination of the area of the hole in the car did not disclose whether the hole came about by a puncture or by wasting of the steel in the ferric chloride reaction. There were indications of loss of metal by corrosion in the area of the hole and of a dent in the area (separate from the dent referred to supra, p. 92) caused by impact with an object. Quite possibly the hole was caused in part by a puncture and in part by the ferric chloride reaction.

4. THE BLEVED PROPANE CARS

Mr. Kunz also examined the manufacturing

documents for Cars 8, 12 and 13 and could find no significant discrepancies. As I have indicated above, Cars 12 and 13 had not been retrofitted for head shields and thermal protection, but the time had not yet run.

5. THE TOLUENE CAR

It was the Toluene car that caused the derailment and the most intensive examination was made of it. The car type is 111A100W1. It suffered impact damage and a minor explosion about 0930 Sunday morning which may have been caused by a build up of vapour in the tank or by thermal shock when the hot metal was sprayed with water in the ccurse of dousing a fire in Car 2.

(a) Manufacture

First of all, Mr. Kunz examined the manufacturing documents of this car as well. It was manufactured by Hawker-Siddeley in 1967 and again he found it to be in accordance with specifications. Again the destructive and non-destructive tests were made (this time many of the parts to be tested were as noted earlier to be found distributed along the right of way) and again no significant defects were discovered.

(b) Loading

The car was owned by North American Car Corporation and leased to Shell Canada in 1970 and used as a general purpose tank car. It had been used in 1978 in the Chicoutimi-

Chibougamau area of Quebec on Canadian National and throughout most of 1979 on the Sarnia to Toronto run via the C&O and CP Rail. For the final fateful trip it was loaded by Shell personnel at Sarnia. There appears to have been a slight error in the loading in that it was loaded to 5 inches outage—outage is the space in the tank to allow for expansion—when the required outage would have been closer to 5 1/2 inches. However this was not of consequence in the derailment. The load weight was well within the limits.

(c) The repack and the lubricator pads.

The problem with which we were most concerned in Car 1 was not in its manufacture or in its loading. It arose out of a repacking performed by C&O at Sarnia on July 30, 1979 and concerned the lubricator pads in the plain bearing journal boxes.

Although the car was owned by North American and leased to Shell, in the normal course repairs are performed by the railways as needed and billed to the owner under AAR rules. On the 29th of July, 1979, Car 1 was in the C&O yard at Sarnia, having been "shopped" for a broken hand rail. The repairs were done by C&O employees George Keyes and Frank Fichter. They have no precise memory of the matter, but it appears from the records that they took the occasion, the car being empty, to repack the journal

boxes. Under Rule 25A 1 of the Field Manual of the AAR Interchange Rules a car's plain bearing boxes must be repacked whenever they are on a repair track or empty in transportation yards and a certain time has passed. In this case the last packing stencilled on the car was "2-12-77" and the appropriate interval was 29 months. Under the rules again, on repacking new lubricator pads must be installed and again according to the records they were installed on this occasion in each of the 8 journal boxes.

The journal boxes were for this car size 6 inch by 11 inch and lubricator pads designed for those boxes are called 6 by 11 pads. They are indeed not of those dimensions but of necessity smaller to fit into the journal boxes, and can according to the make vary in the case of 6 by 11 pads from 9 3/4 inches to 10 3/4 inches in length for the whole pad including the 2 lips and from 7 1/2 inches to just under 9 inches in length for the core. The pad is composed of a cotton fabric exterior including at each end a lip which is a reinforcing tape. The cotton fabric serves to transfer oil to the surface of the journal in a wicking fashion from the bottom of the journal box. The interior of the pad (core) acts to some extent as an oil reservoir but its main function is for resiliency to maintain pressure or contact between the pad and the journal surface.

We must now go back to the debris of Car 1 as found on the ground near Mavis Road. One 6 1/2 inch by 12 inch lubricator believed to be from journal box L1 was found at Burnhamthorpe Road. Two 6 1/2 inch by 12 inch lubricators were found in place in the L3 and L4 journal boxes, and two 6 inch by 11 inch lubricators were found in place in the R3 and R4 journal boxes.

We return to the Sarnia yard. Lubricators must be soaked in oil before installation and for the purpose the C&O kept 3 bins, A, B and C. In A bin were stored the 6 by 11 lubricators, in B the 5 1/2 by 10 lubricators, and in C the 5 by 9 lubricators. Unfortunately there were only 3 bins, but there were more than 3 sizes of lubricators, one being 6 1/2 by 12 inches, which was not in great demand but was used occasionally. The dates of manufacture of the 12 inch lubricators found corresponded with times at which lubricators were delivered to the C&O and although it is possible that new lubricators could have been installed (trackside) by some other carrier between July and November, it is probable that Keyes and Fichter mistakenly installed 12 inch lubricators in the L1, L3 and L4 journal boxes. The burning question however is what they installed in the R1 box. It might have been a 12 inch as in L1, L3 and L4, or it might just as well have been an 11 inch as in the R3 and R4. I simply cannot say and I don't see how anyone

will ever know. The pad itself which would have been our proof disappeared in flame sometime before the train reached Burnhamthorpe Road.

Does it matter? Again I don't know the answer. We had the benefit of the evidence of two expert and impressive witnesses who gave diametrically opposed views. Mr. Henry Wintringham, the general manager of Southland Manufacturing Company of Norfolk, Virginia, who developed the Southland lubricator in the United States and the Eureka in Canada, said that in his view size is important and a pad too large is apt to be cut by the collar (the ridge at the extremity) of the journal which might cause pieces of the pad to be drawn up onto the journal and create an area of lack of lubrication and eventually a hot box. He examined the remains of what was believed to be the L1 pad and thought there were signs of collar cutting.

Mr. James Hennessy, the President of Hennessy Products Corporation of Chambersburg, Pennsylvania, who developed the Oilwell and Pluswell pads, was much less concerned about an "over-sized" pad. He said it was most unlikely for a pad to be cut by a normal smooth collar even if pad and collar did come in contact. In any event he said the only result would be lint which would cause no problem. He could see no signs of collar cutting in the remains of the L1 pad.

One would assume that it is better in putting a lubricator into a journal to put in the size of the lubricator for that size of journal. The AAR permits the use of 5 by 9 inch lubricators in 4 1/2 by 8 inch journal boxes but is silent on any other substitution. It seems that the AAR would not consider the installation of "wrong" size lubricators to be "wrong repair" justifying a debit charge against the repairer. It also appears from a survey conducted by the C&O that the installation of "wrong" size pads while not common is not unknown and such pads continue to lubricate satisfactorily for years and indeed the pads in L3 and L4 on Car 1 were apparently lubricating satisfactorily at the time of the derailment.

The AAR in its quarterly hot box reports list as one of the causes "lubricator-wrong size" but it has very small incidence indeed.

In summary I cannot say that a 12 inch lubricator pad was installed in the R1 journal box of Car 1 on July 30, 1979. Nor can I say that if it were it would have or even might have caused or contributed to the hot box. What I can say, I think, is this. Until it is established conclusively that a "wrong" size pad will do no harm, it is incumbent on the C&O to maintain a system of separation of pads so that such a pad is unlikely to be installed.

VII. GOVERNMENT OF THE RAILWAYS

1. THE CANADIAN TRANSPORT COMMISSION

(a) HISTORY

The history of the railway regulatory bodies pre-dates Confederation. The Board of Railway Commissioners was established in 1851 initially to supervise construction of a line through Upper and Lower Canada and connecting with Nova Scotia and New Brunswick, but it was shortly thereafter expanded to acquire powers of supervision including the prevention of accidents.

The first Railway Act was enacted almost immediately after Confederation and the regulation of railways was by it consigned to the Railway Committee of the Privy Council and there it remained until 1903 when the Board of Railway Commissioners was resurrected with powers on pricing, construction, operation and safety.

The powers and duties of the Board after 1903 expanded to have jurisdiction over telegraph and telephones and culminated in the enactment of the Transport Act of 1938 with the inclusion (temporarily) under its jurisdiction of air and water transport; it was renamed the Board of Transport Commissioners.

There were several revisions to the Board's jurisdiction in the interim but the next major development was the enactment of the National Transportation Act of

1967 which set up a single authority to regulate all methods of transportation and named that authority the Canadian Transport Commission. Within this Commission were established 5 modal committees for air, pipeline, motor vehicle, water and railway transport. The latter was (and is) called the Railway Transport Committee. Under the Act the committees have power to exercise all the powers of the Commission except regulation-making and even there, in practice, the committees perform the initiating function.

(b) JURISDICTION OF THE CTC AND RTC

The jurisdiction of the Commission and its committee in the government supervision and investigation of the railways is almost limitless. It has control over the operation, the fares, the construction and abandonment of lines, the construction and maintenance of stations and other facilities. Our main concern is with operation and here the important statutory provisions appear to be Sections 227, 228 and 296(1) of the Railway Act and Section 3 of the National Transportation Act. These sections are as follows:

Railway Act:

227. (1) The Commission may make orders and regulations

(a) limiting the rate of speed at which railway trains and locomotives may be run in any city, town or village, or in any class of cities, towns or villages; and the Commission may, if it thinks fit, limit certain rates of speed within certain described portions of any city, town or village, and different rates of speed in other portions thereof;

(b) with respect to the use of a whistle within any city, town or village, or any portion thereof;

(c) with respect to the method and means of passing from one car to another, either inside or overhead, and for the safety of railway employees while passing from one car to another;

(d) for the coupling of cars;

(e) requiring proper shelter to be provided for all railway employees when on duty;

(f) with respect to the use on any engine of nettings, screens, gates and other devices, and the use on any engine or car of any appliances and precautions, that may be deemed by the Commission necessary and most suitable to prevent, as far as possible, fires from being started or occurring upon, along, or near the right-of-way of the railway;

(g) with respect to the rolling stock, apparatus, cattle-guards, appliances, signals, methods, devices, structures and works, including light, heat and power lines or wires to be used upon the railway, so as to provide means for the due protection of property, the employees of the company, and the public and all persons travelling on Her Majesty's service;

(h) with respect to the length of sections required to be kept in repair by employees of the company, and with respect to the number of employees required for each section, so as to ensure safety to the public and to employees;

(i) designating the number of men to be employed upon trains, with a view to the safety of the public and of employees;

(j) limiting or regulating the hours of duty of any employees or class or classes of employees, with a view to the safety of the public and of employees;

(k) providing that a specified kind of fuel or a specified kind of power or method or means of propulsion shall be used on any or all locomotives and trains in any district; and

(l) generally providing for the protection of property, and the protection, safety, accommodation and comfort of the public, and of the employees of the company, in the running and operating of trains and the speed thereof, or the use of engines, by the company on or in connection with the railway.

(2) Any orders or regulations under this section may be made applicable during or after the construction of the railway, or during such time, and in such manner, as the Commission deems proper.

228. The Commission shall endeavour to provide for uniformity in the construction of rolling stock to be used upon the railway, and for uniformity of rules for the operation and running of trains.

296.(1) The company shall not carry any goods of an explosive or dangerous nature except in conformity with the regulations made by the Commission in that behalf.

National Transportation Act:

3. It is hereby declared that an economic, efficient and adequate transportation system making the best use of all available modes of transportation at the lowest total cost is essential to protect the interests of the users of transportation and to maintain the economic well-being and growth of Canada, and that these objectives are most likely to be achieved when all modes of transport are able to compete under conditions ensuring that having due regard to national policy and to legal and constitutional requirements

> (a) regulation of all modes of transport will not be of such a nature as to restrict the ability of any mode of transport to compete freely with any other modes of transport;
>
> (b) each mode of transport, so far as practicable, bears a fair proportion of the real costs of the resources, facilities and services provided that mode of transport at public expense;
>
> (c) each mode of transport, so far as practicable, receives compensation for the resources, facilities and services that it is required to provide as an imposed public duty; and
>
> (d) each mode of transport, so far as practicable, carries traffic to or from any point in Canada under tolls and conditions that do not constitute
>
> (i) an unfair disadvantage in respect of any such traffic beyond that disadvantage inherent in the location or volume of the traffic, the scale of operation connected therewith or the type of traffic or service involved, or
>
> (ii) an undue obstacle to the interchange of commodities between points in Canada or unreasonable discouragement to the development of primary or secondary industries or to export trade in or from any region of Canada or to the movement of commodities through Canadian ports;
>
> and this Act is enacted in accordance with and for the attainment of so much of these objectives as fall within the purview of subject-matters under the jurisdiction of Parliament relating to transportation.

I think the first thing we should notice is that while the CTC has the power (and the duty) to guard the public's safety, it is also under an obligation to consider the economic realities of the situation and the competitive

positions of the railways vis-a-vis other modes of transport. I am not at all sure that my concern extends beyond safety, but I mention the conflicting concerns of the CTC so that it will be understood that when I describe their activities (or lack of activities) in certain areas, I understand their problem, or if you will, their dilemma.

It was, of course under section 228 of the Railway Act that the Uniform Code of Operating Rules was issued. The control of the carriage of dangerous commodities is much less direct. It will be seen that the Railway Act, s. 227(1)(l) provides for "...safety...in the running and operating of trains" and this would not cover the regulation of shippers and manufacturers, but s. 296 of the Act comes partly to the rescue. It is pursuant to this section, with the additional help of the National Transportation Act, s. 46(1)(a) giving the CTC power to regulate with respect to any matter that is sanctioned, required to be done, or prohibited by the Railway Act, that the regulations for the transportation of dangerous commodities by rail (the Red Book) are made.

(c) THE RED BOOK

The Red Book is an outgrowth of the regulations

first published by the Bureau of Explosives of the Association of American Railroads. These regulations were adopted and made law in 1911 in the United States by the Interstate Commerce Commission and as we have seen that latter organization has given way in this field to the Department of Transportation. The present regulations are now published in the United States as Title 49 of the United States Code of Federal Regulations.

The Board of Railway Commissioners issued its first regulations in 1909. The Red Book in its present consolidation is known formally as CTC General Order No. 1974-1-Rail and was, as one might suspect, published in 1974.

There are some distinctions between the Red Book and Title 49, e.g. the Emergency Response Forms referred to earlier which are required in Canada but not in the United States, but generally speaking the regulations are identical. This has its advantage because there is a tremendous amount of international rail traffic and it enables both countries to have an international acceptance clause—see Red Book 73.8 and 74.505. The difficulty, if it is one, is that it follows almost inevitably that the initiative in the field lies with the AAR. While Canadian railways and indeed Canadian manufacturers and shippers are members or associate members of that organization, there is no contribution to its deliberations on behalf of the Canadian public.

The Red Book—which is exceedingly difficult to comprehend—is divided into parts. In one part is a list of dangerous commodities, in others there are regulations applying to shippers, carriers and tank car manufacturers. The scheme is that the tank car will be manufactured according to the specifications and will be shipped, loaded, marked and labelled according to the regulations in that regard. If they are not, then the carrier must not accept them (Railway Act, s. 296). After acceptance by the carrier, the dangerous commodities will be carried in accordance with the Red Book's regulations for that carriage.

(d) THE INVESTIGATORY PROCESS

One of the great tools in control of the operation of railways is the investigation of accidents. Section 225 of the Railway Act requires all accidents involving injury or more than trivial property damage to be reported to the CTC. There is a wide discretion to the Commission as to its reaction. It may do essentially nothing relying upon the Railway's report. It may cause an investigation to be conducted by one of its officers or it may hold a full scale inquiry. I am going to deal with some of these investigations but before doing so, it is

desirable to consider and emphasize three matters of vital importance to this Inquiry. They are roller bearings, hot box detectors and marshalling.

(i) ROLLER BEARINGS

We must never forget that this accident was caused (I am not here referring to the contributing factors) by a hot box in a plain or friction bearing journal. As I have pointed out, roller bearings have been known since the early fifties and have been compulsory (by AAR rule) on all new tank cars since 1967. While a roller bearing journal failure is certainly not unknown and is harder to detect visually, it is vastly less likely to occur than is a plain bearing journal failure.

(ii) HOT BOX DETECTORS

Hot box detectors are a device designed to warn of the existence of a hot box before there is a burn-off and derailment. The general principle is the detection and recording of extraordinary heat and they are placed at locations where no heat will be generated by other factors, e.g. brakes on grades or switches, etc. Some of the hot box detectors, for example, those now used by Canadian National,

are recorded in a central location and some as now used by CP Rail are recorded on a screen at trackside and read by the crew. There are some train-mounted hot box detectors that we have heard about but they don't yet seem to have found favour.

Those hot box detectors that have been installed by the railways appear to have been effective. The only problem is that there does not seem to be unanimity of opinion on their spacing. In the United States, some railroads have set them apart by only 20 miles. In Canada the CN seems to think 30 miles is enough. If the hot box at Mississauga started at or after Guelph Junction it would seem that a 20 mile interval is safer.

(iii) MARSHALLING

The marshalling of a train is the arranging in the yard of cars in their proper order. Often cars must be placed in a certain order for ease of setting-off or delivery, but that is not our problem. Our problems relate to the Red Book marshalling requirements when dangerous commodities are being carried.

The Red Book requires first that dangerous commodity cars must be placarded, that there be controls over the switching of such cars and that many of the more dangerous commodity cars be placed in a special order on the train. The object is to keep particularly dangerous cars away from the head or tail end and to keep certain dangerous commodity cars away from others. Prior to Mississauga however there was nothing to prohibit a Chlorine car being marshalled next to a Propane car or any other LPG tank car.

(e) THE GENERAL SAFETY INQUIRY OF 1971

During the 1960s, the RTC's figures disclosed an alarming increase in the number of derailments. There also were 3 serious accidents in 1970 in Ontario which caused much public concern and resulted in public inquiries by the RTC. The first was a derailment at Cobourg of 25 cars of CP Rail caused by a roller bearing failure, the second was a derailment of 14 cars of CN at Port Hope caused by a plain bearing failure, and the third was a collision between a CN passenger train and a track motor car near Brockville.

As a result of the worsening situation and the evidence adduced at the public hearings, it was decided to hold a General Safety Inquiry with the following terms of reference:

1. Rule instruction and examination procedures.
2. Supervision of train operations.
3. Track motor car operation where there is centralized traffic control and where there is not centralized traffic control.
4. Use of radio as a means of communication and its maintenance.
5. Procedures followed by railway companies when accidents occur including accidents involving dangerous commodities.
6. Instructions given to train crews and wrecking crews respecting the transportation and handling of dangerous commodities by rail.
7. Maintenance and inspection of roller bearing and solid bearing rolling stock (including locomotives) and the structure and design of cars and equipment.
8. Location of maintenance and inspection staff.
9. Rolling stock inspection procedure (including locomotives) at major terminals, at intermediate points and while en route.
10. Standards and procedures of maintenance and operation of all types of railway signalling installations.
11. Standards and procedures of maintenance of track and structures.
12. Allocation of staff, materials and equipment for adequate inspection and maintenance of track, structures and signals.
13. Need for revision of railway companies' own rules and instructions to their employees.
14. Extent of research and development by railway companies respecting safety in all aspects of railway transportation.
15. Revision of C.T.C. General Orders, staff and safety function.

I set out these terms of reference in full because of their remarkable similarity to the problems that affected us in this Inquiry.

The General Safety Inquiry occupied 36 days; evidence was presented on hot box detectors, journal bearings and dangerous commodities. During the hearing, there appear to have been 4 train accidents involving dangerous commodities which particularly alarmed the Committee. As it expressed the problem in its initial report:

> " These accidents raise certain urgent and critical questions for the Inquiry. With dangerous commodities creating such hazards was the regulatory authority in Canada being confronted with a new dimension in destructiveness and danger to life and limb? The answer to this question certainly appears to be affirmative. If so, what were the reasons for this other than the obvious factor that modern industrial technology is producing larger quantities of dangerous materials having a greater destructive potential per ton or per car than ever before? Is for example new railway technology increasing the hazards? Are railway practices and rules for dangerous commodities many of which date back 20 or 30 years adequate to meet the increased hazards? Are these possibly now inadequate rules at least being properly applied by railway personnel? Is there sufficient enforcement? How much research into the causes of and the prevention of such destruction is being done?
>
> Throughout the Inquiry these questions and many others like them kept recurring. However as the Inquiry progressed the panel was increasingly of the view that more detailed information was required than a public hearing could provide. It was also felt that action needed to be taken urgently and that this work should commence as soon as the public hearings ended.

> It was proposed that a Task Force on the Carriage by Rail of Dangerous Commodities be created. This was immediately and enthusiastically seconded by the railways. The proposal was accepted and the committee addressed itself to its implementation.
>
> The Task Force consists of the Committee, the CNR, CP Rail and the Canadian Railway Labour Association. Its terms of reference are simple: to review the hazards attendant on the carriage of dangerous commodities by rail and to recommend to the committee such measures as will achieve the highest level of safety compatible with economy of operation and expeditious movement of goods."

This Task Force was duly established together with a consulting pool with representatives from industry and the tank car lessors, shippers and others concerned. The Task Force was divided into groups which reported to the Task Force which in turn reported to the Committee. It expired in 1975 but its work seems to have been taken over by the Dangerous Commodities Technical Committee and the Railway Safety Advisory Committee or by the combination of both.

The important thing to me, however, is not the organization of the committees studying the questions but what was studied. In this connection the initial report of 1973 was silent on roller bearings, hot box detectors and marshalling, although all 3 subjects were the object of much testimony. The Inquiry promised future reports and one such report was forthcoming entitled the Third Report of the General Safety Inquiry, released in December, 1973, and

contained a recommendation with respect to hot box detectors as follows:

> " The Railway Transport Committee and its staff intensify their study of derailments on account of burnt-off journals in all railways coming under the jurisdiction of the Canadian Transport Commission so that the Committee can make a better evaluation and determination of the most effective and efficient methods of reducing the number of such derailments and thus improve the safety of operation of trains."

It is a well intentioned recommendation but in my respectful view absolutely meaningless.

(f) INITIATIVES OF THE CTC

There have been other initiatives of the CTC since the General Safety Inquiry, notably a vigorous improvement in track standards and maintenance undertaken by the railways after a not-too-veiled threat contained in the Third Report to reduce the weight of car loads if something was not done about the state of the tracks. In 1974 there were a number of amendments to the Red Book including the provisions for the Emergency Response Form. The Commission apparently encouraged the railways in providing refresher courses for their employees in the Red Book and in preparing emergency response plans for their dispatchers.

The Task Force ran a seminar for shippers and firemen and the CTC is currently involved in preparing air brake regulations and standards of visual acuity requirements for enginemen.

(g) OTHER INVESTIGATIONS

The CTC has continued its investigatory work most notably an inquiry into the derailment of a coal train in British Columbia in November, 1977, which contained a recommendation for the installation of an event recorder in all locomotives, which I am informed is about to be implemented. The CTC has also very recently investigated a Canadian National derailment in Manitoba (The McGregor Derailment) and in its recommendations has called upon CN to submit a report containing plans for improvement of its safety procedures.

(h) MONITORING OF TRAIN OPERATIONS

One of the most important safety programmes devised by the CTC is its monitoring of train operations to determine the state of compliance with regulations and indeed the state of the railways generally. This programme has only recently been instigated but it has already elicited some interesting statistics. For example, some 27 per cent

of all cars inspected have been found to be defective in some particular. Many of these defects may not be dangerous and many may have been discovered by CTC inspectors just before they would have been discovered by railway carmen. Nevertheless the figure seems disproportionately large and one figure, namely 34 per cent of cars leaving repair shops having defects seems positively alarming.

(i) THE SHOW CAUSE SUMMONS AND THE MARSHALLING ORDER

After the Mississauga incident (at which as I have stated there were in attendance at one time or another, the President, the Chairman of the Rail Safety Advisory Committee, and many officers) the CTC issued a "show cause summons" directed to CN, CP and the Railway Association of Canada with respect to a proposed order requiring 6 cars with roller bearings between the locomotive and the dangerous commodity cars and failing that a maximum speed of 25 miles per hour. It was dissuaded however from implementing the order by the protests of the railways that it would cause additional switching and that it would adversely affect parties not notified of the proposal, e.g. shippers and owners of tank cars. Instead there was issued a marshalling order to the effect that shipments of Chlorine, anhydrous ammonia and sulphur dioxide be separated by 5 non-placarded cars from shipments of cars containing flammable compressed gases. This may be a sensible

order, but I have already noted (ante, p. 88) that it was perhaps the proximity of the Chlorine car to the bleved Propane cars that carried the Chlorine more or less harmlessly into the air and in any event the order could be only fairly effective when one appreciates that a Propane car is capable of bleveing 2222 feet.

(j) CTC's INACTION

For all these initiatives and for its work in other fields, the CTC is entitled to commendation. At the same time we must appreciate that in the matters with which we are concerned almost all of which were in the terms of reference of the General Safety Inquiry, its decision - perhaps deliberately made - has been to do nothing.

On hot box detectors at the General Safety Inquiry the CN reported themselves in favour and undertaking a vast programme of installation. CP Rail which was testing the machines was very dubious of their merits and was afraid that if the detectors were in place the crew might become too relaxed in their running inspections. The CTC took no action. CP Rail has since become a convert and has very recently installed hot box detectors on the London Division. At the time of Mississauga, however, there was only one on the Windsor Subdivision and none on the Galt Subdivision.

On roller bearings the Inquiry received a report from both railways as to their programmes and was apparently content. In any event no order was made and the railways fleets still have more than one-half of all cars equipped with plain bearings.

On speed the CTC has the authority to regulate but virtually does none. The railways have authority in the absence of CTC orders to set speed limits and have taken full advantage of it.

(k) THE QUESTION OF FUNDING

The reason for this inactivity, if such it can be called, is twofold. First there is a lack of money and manpower. In this connection a submission has, I understand, gone into Treasury Board seeking provision for more salaries to expand the accident investigation, inspection, planning and standards development programmes including the engaging of specially qualified officers to go into shippers and manufacturers' plants and railway yards throughout Canada to ensure compliance with Red Book regulations. I have no knowledge of the priorities and I do not wish to intrude upon Treasury Board decisions. But surely at the very least the CTC should have the funds to find answers not dependent on information or advice supplied

by the railways. The railways are answerable to their shareholders; the CTC is answerable to the public.

(1) THE CONSIDERATION OF ECONOMICS AND THE BURDEN OF PROOF

The other reason is philosophical. It was very clear from the evidence of Mr. David Jones, the former chairman, and Mr. John Gray, the present chairman of the RTC, that there is an ingrained reluctance to take any action involving expenditure or loss to the railways without a complete investigation of the amount of that expenditure or loss and an assurance that the benefit to be gained will fully compensate for that loss.

It is not a philosophy that I fully share. I cannot understand how the CTC could accept the railways' own programmes for conversion to roller bearings and for installation of hot box detectors when both are universally accepted as desirable improvements and when at least in the case of hot box detectors the programmes were quite different. I cannot understand how the Commission could leave to the railways the regulation of the speed and length of trains. A long, fast train is a profitable one; it is not necessarily a safe one. I accept, of course, that in the course of natural justice one does not normally

make an order affecting another's rights or pocket book without giving that other a chance to be heard. But there may come a time, where the safety of the citizen is concerned, when the onus shifts. In such case the burden of proof may (perhaps should) fall upon him who creates the risk.

2. TRANSPORTATION OF DANGEROUS GOODS ACT

This Act was passed by the Federal Parliament in July of 1980 and was proclaimed on the 1st November, 1980. Its stated purpose is to promote public safety in the transportation of dangerous goods and so a consideration of that statute is central to the solution of the problems that arose in Mississauga.

I should just pause to mention here that the authors of the statute preferred "goods" to "commodities" while the authors of the Red Book clearly had the opposite preference. No doubt "commodities" came from U.S. practice, where indeed the object of the legislation is now often referred to as "hazardous materials". For what it's worth, I express a personal uninformed opinion in favour of "goods". I also prefer "dangerous" to "hazardous". It seems more comprehensive and less affected.

The Act contains provisions to classify all dangerous goods into nine classes, to create offences and penalties for breach of the Act, to provide for inspectors to enforce the Act, to impose duties to report dangerous occurrences and most important to enable the Governor-in-Council to make regulations respecting all aspects of the transportation of dangerous goods.

Two rather important provisions are s. 17 which empowers an inspector to "request" any other person whom he deems to be competent to take emergency measures (s.14(5) appears to make failure to comply with a reasonable request an offence), and s. 26 which authorizes the Minister either alone or in cooperation with others to engage in technical research.

The regulations under the Act have been drafted but to date the concern is more with safety standards than with safety procedures. Also as I understand it (almost all our information on the proposed course came from Mr. Duncan Ellison, the very dedicated Director of the Transportation of Dangerous Goods Branch, Transport Canada) it is contemplated that the CTC will initiate the drafting of the rules with respect to dangerous goods. Those that have general application to railway operations may continue to be promulgated under the Railway Act. Those that relate only to the carriage of dangerous goods will be promulgated under the new Act.

The draftsmen of the Act, as I have said, fully recognize the constitutional problems and provision is made in the Act for federal-provincial agreements to implement the Act's intention. Mr. Ellison recognizes that emergency response is generally speaking a provincial matter but it is his intention that the federal inspectors will provide guidance where required. Of particular importance is the intention to expand the present federal response centre known as CANUTEC which is available on a 24-hour basis so that it is equipped to provide that guidance.

The enactment of the Transportation of Dangerous Goods Act is obviously a great advance in the field, but there are still drawbacks to overcome. There is still no compulsory provision for an adequate private response. The meat of the Act is in the regulations and these regulations are not yet promulgated. No doubt the responsible officials are now working on it and perhaps some of the recommendations in this report will help in the task.

The Act can only work if the inspectors under it are capable of doing the job assigned. It is contemplated that there will be different kinds of inspectors for different tasks, some with great proficiency in the handling of dangerous goods, some with less, some under permanent employment, some only coincidentally with their regular

employment which might be in the police or fire departments of the nation. Their training is essential and provision is made in s. 21 to make regulations prescribing their training and qualifications.

The new Act may have other imperfections not now apparent, but it has provided us with the machinery we need to establish within the limits of our constitution a workable system for the transportation of dangerous goods.

3. THE AMERICAN EXPERIENCE

(a) THE ASSOCIATION OF AMERICAN RAILROADS

We have already heard about the Association of American Railroads and their work, particularly the work of their Tank Car Committee throughout this century in the development of the modern tank car.

(b) THE BUREAU OF EXPLOSIVES

The Bureau of Explosives is a constituent part of the AAR designed (to quote from its introductory pamphlet) "to promote the safe handling and transportation of hazardous materials and to serve as a central agency for collection, analysis and dissemination of information

on these materials and to provide emergency assistance to its members."

On behalf of its members who are railways, manufacturers and shippers, the Bureau carries on regular inspections for compliance with the regulations and gives technical assistance. For our purposes, however, its important services are (1) as an advisor on tank car specifications, and (2) to assist the railways on a dangerous goods spill. The Red Book provides innumerable references to Bureau of Explosives standards and requirements of submissions not only to the CTC but to the Bureau of Explosives as well. Indeed the Red Book provides that the plants of shippers shall be open to representatives of the Bureau of Explosives, a provision of dubious constitutional validity but one against which the shippers are unlikely to rebel. To a large extent the CTC has delegated the regulation of the control of dangerous goods to the Bureau.

To a large extent also the railways are dependent on the Bureau for assistance in a dangerous goods accident. Emergency aid is available on a 24-hour basis, and the Bureau has published a comprehensive booklet entitled "Emergency Handling of Hazardous Materials" which is a constant companion of some railway officers and crews.

The CP Rail flow chart requires the Chief Train Dispatcher to call the Bureau of Explosives inspector even before notifying his own superintendent and on the morning of November 11, 1979, Kent of London did in fact notify the appropriate inspector, one Alvin Deckert, about 0100 hours. Deckert, who was in Montreal at the time, arrived at the scene about 10 a.m. and remained on or near the site the rest of the week. He gave as much assistance as he could but, of course, the real expertise was provided by Johnson of Superior Propane and the Chlorep team of Dow.

(c) THE NATIONAL TRANSPORTATION SAFETY BOARD

The control of railways in the United States is under the Department of Transportation and its component the Federal Railway Administration. I have, of course, made no study of its operations generally even so far as those operations relate to safety. Certainly I do not intend to make invidious comparison between the governing bodies of the two nations. In fact the evidence would appear to demand an inference very favourable to Canada. A study for the U.S. government indicates that our safety record is better than theirs and figures supplied by CP Rail indicate that that company has had rather consistently over the past several years the best accident rate among major railroads in North America.

The U.S. government emanation that I do wish to refer to is the National Transportation Safety Board which has published reports on all major rail accidents and has, from time to time, undertaken special studies and made specific recommendations. I cannot, of course, accept the facts set out in the reports nor slavishly follow the recommendations. But for an appreciation of the problems the reports are invaluable.

(i) CRESCENT CITY

Of the many reports of specific accidents, I make mention of only the derailment at Crescent City, Illinois, on the 21st June, 1970, and I mention it because of the many similarities in that derailment to that at Mississauga. The Crescent City derailment involved 15 cars of a 109 car train, 9 of which derailed cars were loaded with LPGs. One of these cars was punctured and the leaking propane ignited, resulting in a series of explosions, many injuries and much damage.

The Board found the derailment caused by a hot box and that the heat generated from the fire from the initial puncture caused the other cars to rupture and explode. The safety valves were useless to prevent the

explosion although the firemen on duty had mistakenly believed that so long as the valves were working the tanks would not rupture.

The fire of the hot box had been observed by a witness some 7 miles back from the derailment, but during that stretch there were no curves and the Board attached no blame to the crew for failing to inspect and discover the hot box which was on the 20th car from the head end of the train. The Board noted that while hot boxes were becoming less frequent, their detection before burn-off was not improving. It attributed this to a reduction in smoke from a burning hot box resulting from the new and improved lubricator pads, to fewer employees along the tracks to note the hot box and warn the crew, and to complacency among crews.

The Board further noted the difficulty of the firemen in locating the dangerous commodities and deprecated the close proximity to each other of LPG cars, the speed of the train, and the lack of insulation and centre sills of the tank cars.

The Board recommended inter alia acceleration of installation of hot box detectors, an expansion of education for railway and firefighting personnel, research

in tank car design, and strict enforcement of running, standing and walking inspections.

Of the many general reports of the National Safety Transportation Board, I would mention only 3.

(ii) SAFETY EFFECTIVENESS EVALUATION

First and perhaps most important is a report dated June 23, 1978 on hearings held by the Board in April of 1978 on "Safety Effectiveness Evaluations". The Board noted that tank cars had got bigger but not safer. It noted also that the design of 112A and 114A series cars (which were much bigger than the 105s) was approved without consideration at least by any federal agency of safety, that although the Department of Transportation had issued regulations requiring retrofit of the cars for shelf couplers, head shields and thermal protection, the time limit for compliance was unnecessarily long and there was no apparent sense of urgency in the industry to comply earlier. The cost to the industry of the retrofit was in the opinion of the Board easily overcome by the savings in larger tank cars. There was inadequate provision for emergency response and the communication of post-accident lessons was ineffective.

The Board recommended immediate installation of head shields and double shelf couplers, installation of thermal protection by December 31, 1980, and made many recommendations for improved emergency response. It also recommended establishing priorities for track upgrading and consideration of a "National Rail Hazardous Material Routing System" with a view to the least population exposure.

(iii) TANK CAR SAFEGUARDS

In another special report dated March 8, 1980 on the Accident Performance of Tank Car Safeguards following a derailment of a chemical train in Texas, the Board recommended that the requirement of double shelf couplers be extended to all tank cars transporting hazardous materials, that the requirement for head shields and thermal protection be extended to 105 cars and that it be considered whether it should also be extended to 111 cars when carrying toxic materials. It further recommended the protection of top fittings and bottom outlets and that tests be conducted to determine if marshalling could reduce the severity of collisions.

(iv) NON-COMPLIANCE WITH HAZARDOUS MATERIALS SAFETY REGULATIONS

Finally in a report dated August 3, 1979 the

Board investigated the "Non-compliance with Hazardous Material Safety Regulations" particularly in the area of packaging, labelling, record-keeping and quantity limits and found that the main reason for non-compliance was non-awareness of the regulations induced largely by the complexity and incomprehensibility of those regulations as published.