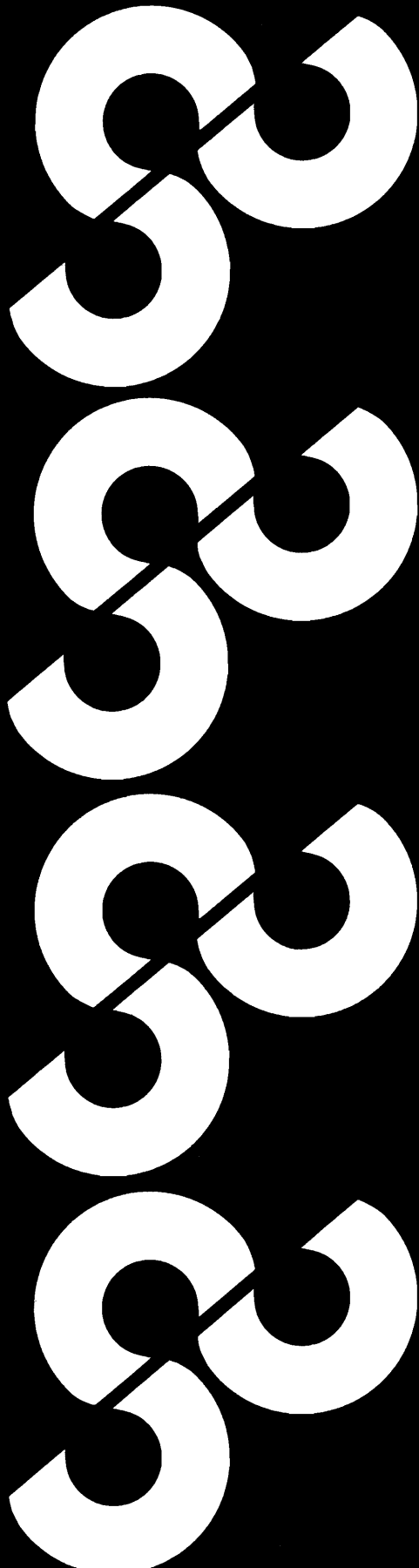


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Science Council  
Canada  
Report No. 28

October 1977

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CANADA INSTITUTE FOR S.T.I.  
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OTTAWA  
INSTITUT CANADIEN DE L'I.S.



# Policies and Poisons

The Containment of Long-term  
Hazards to Human Health in the  
Environment and in the Workplace

**ANALYZED**

Science Council of Canada,  
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K1P 5P4

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Available by mail from

Printing and Publishing  
Supply and Services Canada,  
Ottawa, Canada K1A 0S9

or through your bookseller.

Catalogue No. SS22-1977/28  
ISBN 0-660-01434-3

Price: Canada: \$2.00  
Other countries: \$2.40

Price subject to change without notice

Printed by Thorn Press Ltd., Don Mills, Ont.  
OHO25-7-0004

October 1977

The Honourable J. J. Buchanan, PC, MP,  
Minister of State for Science and Technology,  
House of Commons,  
Ottawa, Canada.

Dear Minister Buchanan,

In accordance with Section 13 of the Science Council of Canada Act, I take pleasure in forwarding to you the Council's Report No. 28, *Policies and Poisons: The Containment of Long-term Hazards to Human Health in the Environment and in the Workplace*.

Yours Sincerely,

Josef Kates,  
Chairman,  
Science Council of Canada

13 September 1977

Dr. Josef Kates,  
Chairman,  
Science Council of Canada

Dear Dr. Kates:

This report on "Policies and Poisons" recommends changes in the procedures which were designed to protect Canadians from long-term, low-level exposure to environmental and occupational hazards.

The Committee responsible for its preparation consisted of a representative body of expert knowledge. It has proved advantageous to have viewed the problems we considered from many differing perspectives. I wish, here, to acknowledge my gratitude to all members of the committee and staff. This report could not have been written without their contributions.

There are three points which may be lost in the detail of the report, but which I feel I should stress to you in this letter.

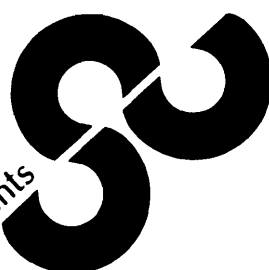
Firstly, I think it necessary to emphasize that the six particular hazards we have considered in detail constitute but a very small fraction of such materials to which human exposure is dangerous. Also, they are not necessarily the six most dangerous or difficult materials which our society handles. For tactical reasons the six hazards we chose were studied as separate cause and effect models. This is a reflection of how most research vis-à-vis exposure to these types of hazards is currently carried out. However, it is becoming increasingly apparent that a level of exposure to a substance may be free of risk under one set of circumstances but not under another. Permissible levels of exposure have been derived for toxic substances on an isolated basis. The impact of collective exposure to the broad spectrum of toxic substances at or below the permissible levels at which each is viewed as safe demands serious consideration. This will be a most difficult chore since, as yet, we have had little success in defining the effects of 'so-called' isolated exposure to low levels of individual contaminants.

Secondly, I wish to stress the fact that chronic incapacity causes a heavy and immeasurable burden of misery. Some of us may be so far removed from any hazardous environment in our daily lives that we forget that even if the percentage incidence of these conditions is low, if you happen to be the individual involved, as far as you are concerned, it is 100 per cent. This is true of disablement from asbestos, or mercury, or silica, or for that matter, from many other hazards. The only proper goal for a society such as ours is to attempt to eliminate all such misery.

Finally, I feel that, in view of the preceding, we must develop a preventive rather than simply a reactive strategy as regards hazardous substances. For far too long the cost to human life and health of industrial technologies has either been hidden or generally ignored. It is the hope of our committee that, as a result of the work we have completed, these costs will be counted whenever a new technology is being considered for development and exploitation.

Yours sincerely,

David V. Bates  
Chairman,  
Science Council Committee on Policies and Poisons



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## **Prologue**

Our study of the regulation and control of hazards has been guided by a number of principles which the Science Council feels must underlie the decision making and control program which we recommend. These principles may be of interest to others – and may even stimulate some discussion or controversy – and hence form part of this Report.

### *Statement of Principles*

**Exposures.** All exposures of living things to harmful pollutants should be as low as practicable.

**Hazards.** The hazards associated with exposure to any substance or process should be assessed prior to the exposure.

It follows that prior to a substance or process being marketed, research should be instituted with the aim of protecting human life and health. The scale of the research should be commensurate with the nature of the pollutant, e.g., quantities processed and released, toxicity, or persistence. The scale of the research should also be related to the social and economic importance of the pollutant.

**Risk assessment.** This involves relating the hazard of exposure to the probability of exposures reaching certain levels. It is the responsibility of the regulatory process to demonstrate to the public that adequate risk assessments have been carried out and to inform each exposed population of the risks of the exposure it receives. It should be the right of everyone to accept or reject risks and thus to participate in selecting acceptable levels of exposure.

**Protection.** Responsibility for protection against known and understood risks to an individual lies partly with the individual. He or she must be assisted by protective facilities and procedures, designed during the planning and instituted during the conduct of any operation. In the long term protection can be assisted by supporting new technologies, processes and products that minimize exposures.

**Standards.** As soon as risks are recognized they must be subjected to regulation by laws and practices. To achieve this there must be protective standards for all hazards, even suspected hazards, and they must be subject to change as new information becomes available.

A standard should be the reflection of an acceptable risk, and the public should be informed that most exposures to the levels prescribed by a standard, whether a Maximum Permissible Level or a Threshold Limit Value, involve some risk.

Standards should be measurable, achievable, enforceable, and used to ensure protection and the development of technology for monitoring, abatement and substitution.

Standards should be as uniform as possible throughout all economic and political communities. In Canada, provincial standards should not be less stringent than minimum federal standards and Canadian standards should not be different from other national or international standards without justification.



**Workplaces.** They should not cause disability or disease to their occupants; in fact, they should promote physical and psychological health.

Ideally, people at work should not be subjected to greater risk than those outside the workplace. An acceptable risk may, however, be perceived differently for, on the one hand, a population with good health surveillance (workers) and, on the other hand, a general population that includes children, pregnant women, the aged and diseased.

There should be compensation and, if needed, rehabilitation of those who suffer injury or ill-health from conditions in the workplace, but reparations should not be a substitute for the best possible standards of protection.

Occupational histories and records of exposure to pollutants should be included in all routine medical records of individuals. They are an important resource for epidemiological enquiry, which is required if public protection is to be of high order.

# I. General Background

## **Introduction**

1. At its meeting in Winnipeg in October 1975, the Science Council approved a recommendation that a study be made of the decision-making processes in Canada that are designed to protect the public and the workforce from health hazards to which they might be exposed. A committee was brought together to design and superintend the study and a press conference was held in Montreal in March 1976 to announce that the study would take place and to solicit views upon it.
2. The very considerable public interest aroused by the announcement of the study strongly supported the view expressed within the Science Council that the public is concerned about the adequacy of Canadian procedures in respect of certain environmental and occupational hazards. At the press conference, the Canadian Medical Association, the Chemical Institute of Canada, the Canadian Public Health Association, the Royal Society of Canada, the Scientific, Engineering and Technological Community of Canada (SCITEC), together with a number of representatives from the trade union movement, strongly supported the undertaking of the study. As a result of the discussion, the committee added mercury to the other hazards that it proposed to study.
3. There are two very good reasons why the Science Council should address itself to the issues discussed in this Report. First, a fundamental step in the consideration of any hazard is the assessment of risk associated with it, and scientific evidence is central to this. The ability to assess risk in Canada is therefore of direct concern to the Science Council. Second, although the determination of when a risk is acceptable is a judgement that society has to make for itself, it necessarily involves the relationship between the scientific community and society as a whole.
4. The purpose of the study is to examine the decision-making process in Canada as it applies to a number of environmental and occupational hazards and to make recommendations to improve the decision-making process and to diminish not only those hazards now recognized as important but those which may only be recognized at some future date.

## **The Process of the Study**

5. We decided to study six hazards in depth – lead, asbestos, radiation, vinyl chloride, mercury, and oxides of nitrogen. We felt that if we looked at the major dimensions of these hazards and came to understand the jurisdictional and administrative problems that are related directly to them, we would be in a good position to draft recommendations with some confidence that whatever mechanisms we might devise could be useful in the control of many future or different hazards.
6. In our initial discussions, other materials or chemicals, such as arsenic, benzpyrene, silica, dioxin, or food additives, were considered suitable for inclusion. However, we concluded that, if we could satisfactorily understand the six we have listed, problems relating to the remainder could probably also be understood since each appears typical of a wider class of hazard.
7. Many people unknowingly come into contact with these contaminants. Vinyl chloride is primarily an occupational hazard; lead, asbestos, radiation, and mercury are both occupational and environmental hazards.

Oxides of nitrogen, is a hazard in certain very particular industrial and agricultural settings, but the primary concern is with the low-level, long-term exposure of city populations as a consequence of air pollution. Thus, the six hazards range from being primarily occupational to being primarily environmental.

8. We recognize the close links between concern for the general environment and for human welfare. In this Report we have confined our attention to environmental and occupational issues that have a direct, though long term, impact on human health for the following reasons:

- These issues are complex and in themselves necessitate long term management policies.
- There is an urgent need to establish effective labour-management collaboration in the containment of certain hazards.
- Specific environmental issues, particularly as they involve the need to protect the natural environment, are the subject of widespread general attention, but a focussed examination of a range of long-term human health hazards has not, to our knowledge, been attempted in Canada.

9. The Science Council began by commissioning background papers on the technical and medical aspects of each of the hazards. We also commissioned a paper on the legal framework of control of the six hazards in Canada. A separate case study was commissioned on the legal jurisdictions in Quebec, not only because there are differences between the law in Quebec and the rest of Canada, but also because major exposures to two of the hazards, vinyl chloride and asbestos, have occurred with some prominence in that province. We also commissioned a study of the decision-making processes that had affected the present status of these six hazards in Canada, with an examination of the roles played by the public, the government, the academic community, industry, and the labour unions in the various stages of decision making. Finally, we commissioned a study of the decision-making process vis-à-vis the regulation of hazardous substances in the United States, the United Kingdom and Sweden – three countries with which Canadians often compare themselves.

10. When these studies were completed, the committee joined with medical, technical, legal and political science consultants to plan a series of workshops to examine each of the six hazards in detail. During a three-month period, one-day workshops were held on each of the hazards. We brought together experts to act as resource persons, spokespersons for relevant industries and for the trade unions involved, representatives of any specially affected groups (particularly native Indians in respect of mercury), and federal and provincial government officials with differing responsibilities in the fields of occupational and environment health. Each workshop consisted of approximately forty people. The proceedings of all these discussions were taped and summarized. These workshops provided reviews of each hazard that proved to be of great value when we drafted recommendations.

11. During the course of the study it became apparent that the general problem of public involvement in decision making was sufficiently complex and important to merit special attention. Since January 1976, we have closely followed the material being published on this issue on both sides of the Atlantic. In order to educate ourselves further, we held a final workshop in February 1977 to bring together experts from the United Kingdom and the United States who have had personal experience of providing for public parti-

cipation in decisions.

12. We will publish as background material overviews of each of the hazards we have studied, together with the background papers that form the general basis for our proposals.

13. There are at least three factors that have already profoundly influenced our ability to detect the consequences of environmental influences on people: firstly, major advances in chemical and physical analytical technology; secondly, a greatly improved ability to diagnose clinical abnormality at an early stage; and thirdly, the development of powerful methods of information storage and retrieval. We have no doubt that a general knowledge of these advances has played a part in precipitating public demand that all of these tools be used to detect adverse environmental influences wherever they occur.

## II. Principal Lessons from Each of the Six Hazards Studied

## Asbestos

### Preamble

14. Asbestos refers to a group of hydrated silicate minerals that separate readily into fibres. The chrysotile asbestos fibres most common in Canada are curved in appearance and occur in open bundles that split into sub-microscopic fibrils of 20-24 nanometres ( $10^{-9}$  m) in diameter. There is no technique that is wholly adequate or that has been universally used for the identification and quantitative determination of asbestos fibre in fine dust.

15. The world's first asbestos mine opened in the province of Quebec in 1876. In 1947, Canada was mining and milling 66 per cent of the world's asbestos. In 1972, world production and consumption was approximately 3.5 million metric tons. Canadian production of asbestos was 800 000 metric tons in 1950; by 1974 this had more than doubled and now exceeds 1.6 million metric tons per annum. Commercial applications of asbestos fibre are very numerous and include asbestos cement, floor covering, friction products (e.g., brake linings), and asbestos textiles.

16. Asbestos is both an occupational and an environmental hazard and may indeed be a consumer hazard. Asbestos fibres once inhaled cause changes in lung cells and the cells of the lung lining. This was first suggested in 1907. The risk associated with the inhalation of asbestos fibres is now well known. The presence of high concentrations of asbestos in water and beverages poses, as yet, an unknown risk.

17. Inhaled asbestos may cause three separately identifiable conditions. It may give rise to a diffuse change within the lung; it may predispose to lung cancer, particularly in conjunction with cigarette smoking; and, more rarely, it may cause a tumour of the lung lining. Any individual who lives in the vicinity of asbestos mining or who works with asbestos in any form is at risk.

18. Government actions, within Canada, have taken a variety of forms: adoption of occupational guidelines or threshold limit values, air quality emission standards to take effect in 1978, consumer protection prohibitions, and establishing expert committees and task forces. Mines and industries have been temporarily shut-down. Industries themselves have installed control technology to reduce emissions both within and outside the plant and have made available protective equipment to be used by their workforce. The Canada Safety Council has recently issued an educational pamphlet on asbestos. Organized labour has publicized the hazardous conditions within the workplace through strikes and collective bargaining demands, has precipitated government action and, where possible, has participated in such initiatives.

### Lessons

19. • Asbestos illustrates the difficulty of effective measurement of exposure levels because of methodological problems entailed by the membrane filter method currently in use. These contribute to the difficulty of defining a "standard."

• Among its other undesirable effects, asbestos may cause a fatal tumour of the lining of the lung (mesothelioma) that often occurs many years after exposure. It may result from a relatively low level of dust concentration over a relatively short span of time.

• The effects of exposure to asbestos on the lung may be of such a general

nature that precise attributability of early signs or symptoms is difficult.

- Asbestos illustrates the tragedy that can occur when clear-cut, early-warning signs are ignored.
- Asbestos illustrates the problem that arises when the interpretation of scientific evidence on disease incidence is conflicting.
- Asbestos is widely used in a variety of secondary industries, e.g., insulation and construction, and illustrates the importance of protection of those who may be unaware they are handling a hazardous material.
- Although the degree of hazard varies considerably among different dust types, including asbestos, any unnecessary individual exposure to dust of any kind – grain dust, cement dust, silica dust, etc. – is to be scrupulously avoided.

## **Lead**

### **Preamble**

Lead, a naturally occurring heavy metal, is widely distributed in nature, though the proportion of lead present in the earth's crust is relatively small. Lead can undergo both physical and chemical transformation in the environment and is readily accumulated in plant and animal tissue.

21. World production of lead ore, in 1972, was over 3 million metric tons. Canada ranks second in world production of ore, accounting for 15 per cent of the total. Canada ranks sixth as a producer of refined lead. World production of primary lead increased 98 per cent between 1950 and 1969. Average Canadian consumption of primary lead ore and secondary lead averaged 100 000 metric tons between 1970 and 1973. The recycling of lead represents a major potential source of lead pollution. Lead, both inorganic and organic, is widely used in the industrial-chemical, transportation, construction, and communications industries. Lead oxides are used in storage batteries and lead pigments in paints. Other lead chemicals are employed in the manufacture of plastics. Tetraethyl lead is used as an anti-knock agent in gasoline; atmospheric release from this source alone in Canada in 1972 was estimated at 3000 metric tons. It has been estimated that in 1970 total Canadian lead emissions approached 17 000 metric tons.

22. Lead has been recognized as an occupational, environmental and consumer hazard since ancient times. It is a cumulative poison and very toxic to living organisms. For lead, the critical organs are the bone marrow, the nervous system and the kidney. Lead poisoning of adults predominantly affects the digestive system through peripheral nervous system malfunctions, while in children lead usually affects the central nervous system, especially the brain. Behavioural defects, including mental retardation, hyperactivity and acute aggressiveness, have been attributed to chronic exposure to low concentrations of lead. Of all the elements that are of environmental concern, the concentrations of lead frequently found in humans most closely approach those levels generally agreed to be toxic.

23. Government actions within Canada have taken a variety of forms: drinking water standards, maximum permissible levels of lead in commercially-available foods, consumer protection prohibitions on, for example, paint and toys, occupational guidelines or threshold limit values, emission and ambient air quality standards, and establishment of expert committees and task forces. The major mining, smelting and manufacturing industries have installed control technology to reduce emissions both within and outside



their operations and have made available protective equipment to be used by their workforce. Organized labour and public safety groups have publicized the hazardous conditions to which people are subjected through collective bargaining demands and prosecution of polluters, and have thereby precipitated government action at both the provincial and federal levels.

### **Lessons**

24. • Lead is a long-recognized hazard for which new biological effects are being described at lower concentrations than we previously considered dangerous.

• Lead is both an occupational and an environmental hazard. A clear definition of the relationship between blood levels and possible adverse consequences is clearly needed for all populations at risk.

• The Council's lead case study illustrates that, as perception of a hazard is refined, awareness of subtle psycho-social effects increases.

• Like asbestos, lead is a potential "take home" hazard that may extend from the worker to his or her family unless special precautions are taken.

• A particular problem is encountered in small industries employing a small number of workers engaged in recycling lead.

## **Mercury**

### **Preamble**

25. Mercury is an ubiquitous, naturally-occurring heavy metal that can undergo a variety of physical and chemical transformations. Inorganic mercury can be transformed into organic forms through bacterial action in nature. These naturally persistent forms can both accumulate and concentrate in plant and animal tissue.

26. World production of metallic mercury in 1969 was 10 236 metric tons, while world consumption to date is in excess of 10 000 metric tons and forecast to increase at 1.5 per cent per annum. Both inorganic and organic forms of mercury are extensively used in the industrial-chemical, agricultural-chemical and manufacturing sectors of the Canadian economy. It is estimated that there are approximately 3000 commercial applications of mercury. Global mercury pollution of the biosphere exceeds 7000 metric tons each year. Man-induced emissions are more than double those attributable to the natural processes of weathering of rocks, soil erosion, etc.

27. Mercury is an occupational, environmental and consumer hazard. That it is an occupational hazard was first recorded by Pliny in the first century AD. An organic form, methyl mercury, is a cumulative poison and is the most toxic form. In Iraq and Japan, accidental, acute, high-dose exposure has been shown to cause irreversible neurological disorder, kidney and liver dysfunction, teratogenic and mutagenic effects, and even death. Of more relevance to Canada, chronic, low-dose exposure has been shown to cause neurological abnormalities.<sup>1</sup>

28. Government actions, within Canada, have taken a variety of forms: a ban on mercurial fungicides and pesticides, the setting of maximum permissible levels for mercury in commercially available foods, a ban on commercial (but not sports) fishing in mercury-contaminated waters, the conduct of pilot health surveys of populations at risk, and the establishment of expert committees and task forces. Industries have closed down, converted to mercury-

free technologies and/or been compelled to reduce mercury discharge to the environment. Native groups have publicized the dangers of methyl mercury exposure, precipitated government action and, where possible, participated in such initiatives.

### Lessons

29. • The exposure of native people to methyl mercury through eating fish caught in water contaminated by industrial mercury represents a serious long-term hazard to the people involved. The reaction time of different levels of government and scientists in Canada to this hazard has been unduly slow, and there has been a real difficulty in getting access to pertinent data.<sup>2</sup> The mercury case provides us with an unequivocal example of intra-jurisdictional confusion and lack of coordinated action. Not only has the public been at a loss to assign precise fault (accountability), but government departments themselves have had difficulty inducing one another to act.

- The clinical definition of early damage from methyl mercury is difficult; much more clinical investigation and scientific study is required before the earliest definition of clinical damage can be defined with sufficient precision to command general acceptance.

- There are grounds for anxiety that, when continued for some years, the burning of coal (a source of acid rain) and the industrial use of mercury and its compounds may give rise to air pollution and the deposition of mercury on large areas of land. By rainout and surface water transport from the whole watershed, this may give rise to significant mercury pollution of water bodies.

- It is now clear that inorganic mercury, once released into the air, can be transported great distances and be deposited with acid rain in distant regions where methylation readily occurs because of high acidity. It is now realized that acidification of fresh water increases the rate at which methyl mercury is formed. Thus, mercury contamination illustrates the interaction of environmental factors with man-induced activities to produce a higher level of risk.

- In respect of mercury, the scientific community was asked to prove damage before action was taken, whereas more commonly, the demonstration of the existence of a hazard has provoked action, for example, with vinyl chloride.

## Oxides of Nitrogen

### Preamble

30. Oxides of nitrogen are primarily an environmental hazard, involving a large sector of the population, especially in urban centres. The major source of oxides of nitrogen in the atmosphere is the combustion of fossil fuels. Present ambient levels from industrial and automotive emissions are two orders of magnitude greater than normal background levels. We may be facing a doubling of  $\text{NO}_x$  emissions in the next 15 years.

31.  $\text{NO}_2$  is biologically the most hazardous oxide of nitrogen. In the atmosphere, more often than not, it is formed by the photochemical conversion of NO.  $\text{NO}_x$  may occur at levels sufficient to produce pulmonary disorders. Chronic low levels, to which most people are exposed, have not yet been shown to be especially harmful. An incremental increase of chronic exposure, however, might well lead to an increase in pulmonary disease in the general populace. Those weakened by illness, asthma sufferers and young children are

likely to be the most vulnerable to the adverse health effects of  $\text{NO}_x$ . The important secondary consequence of  $\text{NO}_x$  emission is the formation of secondary photochemical pollutants, of which ozone is the most important, as a result of combined  $\text{NO}_x$  and hydrocarbon air pollution. The smoking of nitrate-treated cigarettes may expose the smoker to  $\text{NO}_2$  concentrations of up to 250 parts per million (ppm).

32. Acute exposures to oxides of nitrogen were first noted in 1956 among welders, silo fillers and underground miners. Pulmonary edema and bronchiolitis obliterans resulted. In some cases complete recovery was possible with appropriate therapy.

33. Within Canada, standards on automotive emissions have been established for  $\text{NO}_x$  at 3.1 g/mile; the Air Quality Objectives under the Clean Air Act establish for  $\text{NO}_2$  a maximum desirable level of up to  $60 \mu\text{g}/\text{m}^3$  (0.03 ppm.) and a maximum acceptable level of  $100 \mu\text{g}/\text{m}^3$  (0.05 ppm.) both averaged for 1 year. The National Air Pollution Surveillance Network provides good coverage except in the immediate vicinity of industrial pollution. The values and objectives set by the Federal-Provincial Committee on Air Pollution seem reasonable. There is a lack of adequate control technologies for  $\text{NO}_x$  emissions and a paucity of information regarding chronic low-level exposures. There is uncertainty as to what action should occur and who is responsible when standards or "objectives" are exceeded.

### Lessons

34. • Oxides of nitrogen represent a subtle environmental problem by virtue of the fact that all urban populations are exposed to oxides of nitrogen at varying concentrations. Sources of emission are multiple, leading to difficulties in jurisdictional definition.

- If the results of animal experiments of exposure to very low levels of oxides of nitrogen are representative of what may occur in the human population, the earliest evidence of the effects of oxides of nitrogen would be an increase in respiratory disease, morbidity and possibly mortality. It is very unlikely that such a statistical increase would be attributed to oxides of nitrogen levels; it would not be very hard to prove that such an increase had, in fact, been attributable to increased levels of oxides of nitrogen exposure.
- The containment of the hazard in occupational settings depends on a good knowledge of situations in which oxides of nitrogen may be generated and of the precautions to be taken to avoid exposure (for example, in silo fillers' disease and in welding in closed environments).
- Not enough is known of possible synergisms between oxides of nitrogen and other materials to which the general population is exposed.
- The complex relationship between ambient air concentrations and "controlled" rates of emission complicates the process of public protection.

### Radiation

#### Preamble

35. Canadians are exposed daily to radiation, both man-made and natural. Growth of the nuclear industry will place more members of the public at risk of radiation exposure. Nuclear radiation is emitted during processes of change in an atomic nucleus.

36. Radiation can irradiate the body externally. The dose can be con-

trolled by limiting exposure time or by use of shielding material. The general populace receives most of its external radiation from the natural background (about 100 millirems/person/year). The medical and dental use of x-rays account for 35 to 70 additional millirems, whereas exposure from the nuclear industry is about 2 millirems. However, routine exposure by a worker in the nuclear industry is certainly much higher. Internal radiation results from the intake of radionuclides in air, water and food chains. The first of these poses a special problem for uranium miners. Nuclear accidents, nuclear waste management and spent fuel recycling pose potential risks, which include, of course, the risk of nuclear war.

37. The risk of injury from ionizing radiation was recognized shortly after its discovery in 1895. A continued growing awareness of the radiation hazard and its association with cancers, leukemia and genetic changes resulted in the creation of the International Committee on Radiological Protection (ICRP), consisting of a panel of experts on radiation effects.

38. Since the 1940s the ICRP has issued guidelines on the “maximum permissible” radiation exposure to the body, to organs and to the extremities. Most countries have adopted standards at least as stringent as those proposed by the ICRP. Canada’s present standards, adopted by the Atomic Energy Control Board, are shown in Table 1.

Table 1—Standards for Radiation Exposure in Canada, 1977 (in rems/year)		
	Atomic Radiation Worker	Public
whole body, gonads		
bone marrow	5	0.5
bone, skin, thyroid	30	3
tissues of hand, feet, ankles, forearms	75	7.5
other single organ or tissue	15	1.5

39. Public concern about radiation arose first in connection with radioactive fallout from nuclear weapons testing. It appears that the major problems occur during the mining and milling of uranium and during the disposal of radioactive wastes.

**Lessons**

40. ● Protection against the biological effects of ionizing radiation is designed to eliminate early acute effects and reduce the risk of late and delayed effects (mutations and cancer) to acceptable levels. For the latter, it is assumed that there is no “threshold dose”, i.e., a dose below which there are no effects.
- Canadian standards and their recognition have been greatly influenced by the adoption of international standards for limiting radiation exposure.
  - Radiation exposure at low levels may produce lung tumours histologically identical to those that are not a consequence of radiation exposure.
  - The pulmonary carcinogenic risk is increased by cigarette smoking.
  - The present radiation doses from diagnostic medical x-rays constitute a major source of population exposure and one that is poorly controlled.
  - The regulation of radiation exposure from the nuclear fuel cycle has been predominantly a federal responsibility. There is no evidence to indicate that

this has *of itself* ensured the best attainable control of this radiation hazard.

## Vinyl Chloride

### Preamble

41. Vinyl chloride monomer (VCM), a relatively simple synthetic organic chemical, is polymerized industrially to produce polyvinyl chloride (PVC), a resin used in the fabrication of a wide variety of plastic products. Since its development during the Second World War, the worldwide manufacture of PVC has grown rapidly and presently exceeds 8 billion t (18 billion pounds).

42. For a long time it has been known that exposure to VCM causes specific occupational diseases, such as acroosteolysis, Raynaud's syndrome, sclero-dermiform lesions and liver function abnormality, in workers exposed to levels up to 3000 ppm. It was not until December 1973 that a B.F. Goodrich report dramatically revealed that three of their workers had died of a rare liver cancer known as angiosarcoma. Further research revealed 48 victims throughout the world, ten of whom were in Canada. VCM was identified as the causative agent. Recent research by Dr. P. L. Viola, Università Degli, Rome, and Dr. C. Maltoni, Institute of Oncology and Tumour Centre, Bologna, Italy, has confirmed the carcinogenicity of VCM.

43. The B.F. Goodrich announcement precipitated a flurry of publicity the media and quick cooperative action by industry, government and labour. More stringent standards were set, abatement and monitoring technologies were developed and applied, and a variety of biomedical and technical research programs were initiated. Environment Canada is establishing an emission rate standard for VCM and PVC plants. Currently, provincial exposure limits to VCM vary from 1 ppm to 10 ppm averaged over 8 hours.

### Lessons

44. ● If vinyl chloride had not caused a very specific histological tumour (angiosarcoma of the liver) its recognition as a carcinogen might have been delayed for a long time. As a matter of fact, up until 1973 most toxicologists considered vinyl chloride to be relatively safe.

- Vinyl chloride is an example of a carcinogenic material that came into large scale production before its carcinogenicity was recognized.

- Although it is probably premature to describe the control of the vinyl chloride hazard as a "success story," it is clear that prompt action by industry with the cooperation of an informed workforce has been effective in limiting vinyl chloride exposure.

- In respect of vinyl chloride, information exchange between the industry and academic scientists worked well, possibly because the industry commissioned significant scientific research.

- The short-term remedy in the workplace (i.e., better ventilation) may increase the release of the material to the environment.

- There is a need for methods of long-term follow-up if affected individuals who have left the industry are to be recognized fifteen or twenty years after their exposures occurred.

### General Lessons

45. The following represents principal lessons that are common to all six case studies.

- A degree of uncertainty in assessing the risk associated with long-term, low-level exposure to hazards cannot be overcome.
- Moral and ethical considerations preclude human experimentation, and the extrapolation from animal studies to human experience has limited and uncertain applicability.
- Knowledge of dose-response relationships is incomplete, especially at low exposure levels. To a large extent this may be attributed to:
  - lack of appropriate and systematic research
  - lack of trained research personnel
  - lack of facilities for gathering pertinent information
  - lack of systems for medical-occupational record linkage
  - lack of research on individual susceptibility.
- Identification of populations exposed to hazards and thereby at risk has been incomplete. Monitoring physiological indicators of deleterious effects has been generally neglected. Systematic follow-up of persons previously exposed is lacking.
- All six hazards are characterized by deleterious effects resulting from chronic low-level exposure. The implications of this for the regulatory process are significant, since the process has in some cases been devised only to deal with hazards associated with acute exposure. We are only now reacting to the insidious chronic effects of hazardous substances and have yet to learn how to anticipate them.
- Except in the case of radiation, officials with regulatory responsibility have not been assisted by any agency in Canada established to assess the nature and degree of exposure risk.
- Containing a hazard by means of the regulatory process presents different problems relative to controlling a large number of small industries, compared with very large industries. In the case of small industries, resources may be limited and they may be widely dispersed. A very large industry may exert considerable pressure against regulatory enforcement.
- The Canadian regulatory process is characterized by a lack of openness in information gathering, in information access and availability, and in decision making and determining accountability.
- There is no single way to control dangerous contaminants in the work place. Sometimes a solution can be found through the use of a less hazardous substitute, sometimes in the design of a new plant or the selection of equipment to avoid or minimise the exposure of workers to the contaminant. Where such methods of control cannot be used, or would take time to implement, personal precautions, changes in routine, or detailed working rules may be needed to protect workers from the contaminant. These measures might be implemented most effectively through labour-management cooperation.
- There is a lack of uniformity between the provinces in respect of standards. As well, many standards appear to have been selected in an *ad hoc* and arbitrary fashion.
- There is a lack of clear definition of responsibilities between different departments within the provinces.
- There is a lack of clear definition of responsibilities between federal and provincial governments.
- To date we lack sufficient Canadian-trained occupational and environmental health personnel; we do not yet have enough specialized educational programs for their initial training and necessary continuing education.

## III. Statement of the Problem

46. The problem of the control of environmental or occupational risk necessarily involves an attempt to assess the magnitude of a specific risk in relation to many different ordinary risks that we have to accept as a necessary part of life. Recently, this problem has been the object of a great deal of public attention. The differences between risks become important when one attempts to determine who should decide the level of risk for different categories of the population.

47. The growing international literature on this topic broadly categorizes risks as follows: a) voluntary risks, b) risks that can be modified by the risk-takers' behaviour, c) risks that are taken involuntarily, d) risks taken in ignorance of the hazard, e) risks in which there can be no direct awareness of the level of risk though there is a general awareness of the existence of a hazard, for example, in a low-level radiation exposure, f) short-term hazards as opposed to long-term risks, where the consequences of exposure may only be seen years after the exposure has ended, as in the case of asbestos or vinyl chloride exposure, g) a category of special hazards where the individual involved may not be in a position to assess the benefit or the damage of a procedure, for example, in psycho-surgery and the medicinal use of drugs.

48. The attempt to place any given risk in some kind of general perspective has been the subject of much international consideration. A recent example of this endeavour is given in the Sixth Report of the Royal Commission on Environmental Pollution in the United Kingdom,<sup>3</sup> in which the comparative risks of a variety of different activities are listed as a basis of comparison with the risks which were the immediate concern of the Report. (See Table 2.)

**Table 2—Comparative Risks of Selected Activities**

Risks	Activity
1/400	smoking (10 cigarettes a day)
1/2000	all accidents
1/8000	traffic accidents
1/30 000	work in industry
1/500 000	natural disasters
1/1 000 000	driving 80.5 km <sup>a</sup>
1/2 000 000	being struck by lightning

*Note:* The risk is expressed as probability of death for an individual for a year of exposure and orders of magnitude only are given.

<sup>a</sup>This risk is conveniently expressed in the form indicated rather than in terms of a year of exposure.

*Source:* United Kingdom, Royal Commission of Environmental Pollution, Sir Brian Flowers, *Sixth Report, Nuclear Power and the Environment*, HMSO, London, 1976, Table 8, p. 77.

49. Dr. Chauncy Starr brought a new dimension to this kind of comparative work. He assessed the public acceptability of risks associated with technological development, and concluded,

“a) That the public is willing to accept voluntary risks roughly a thousand times greater than those represented by involuntary exposure; b) That the statistical risks set by disease appear to be some kind of psychological yardstick for establishing the level of acceptability of other risks; c) That the acceptability of risk appears to be crudely proportional to the cube of the benefits (real and imagined); d) That the social acceptability of risk is directly influenced by public aware-



ness of the benefits of an activity; e) That levels of risks judged acceptable appear to be inversely related to the number of people participating in an activity.”<sup>4</sup>

50. Risk and risk perceptions are not absolute, but tend to be judged in relation to an individual's personal experience and his or her environment. A major difficulty with most risk-benefit analyses appears to be a lack of consideration of how risks and benefits are distributed among various social sectors. It seems that those at greatest health risk are often not those who derive major benefits. Since this is a characteristic of our socio-economic system, it is often neglected by those engaged in risk-benefit analyses. As well, it is obvious that risks and benefits cannot be measured with the same currency.

51. A number of writers have stressed the fact that public appreciation of risk is influenced by the level of publicity given to particular events. Thus there is much more public concern over a single accident which results in the immediate death of 50 people, than in 50 single accidents in different locations, each involving the death of one person. The general difficulty of becoming as concerned about a very long-term risk, such as cigarette smoking, as about short-term risks is within the experience of many of us.

52. Public perception of what constitutes an acceptable risk is in fact capricious and it is often inconsistent. Nor is it surprising that concern over occupational risks involving relatively few people would be absent in societies beset with the severe human problems of malnutrition or uncontrolled tuberculosis.

53. Contemporary interest in risk emphasizes the importance of trying to keep a sense of proportion in discussions of comparative risk. An important concept in this respect has been an evolving new definition of “safety.” The view advocated by William W. Lowrance undoubtedly marked an important step forward in this matter.

“Safety is not measured. Risks are measured. Only when those risks are weighed on the balance of social values can safety be judged: a thing is safe if its attendant risks are judged to be acceptable. Determining safety, then, involves two extremely different kinds of activity...: measuring risk — measuring the probability and severity of harm — is an empirical, scientific activity; judging safety — judging the acceptability of risk — is a normative political activity. Although the difference between the two would seem obvious, it is all too often forgotten, ignored, or obscured. This failing is often the cause of the disputes that hit the front pages.”<sup>5</sup>

54. We believe that the two activities outlined by William Lowrance are not only often confused, but give rise to justified public concern about what appear to be important differences between scientists in these matters. Specifically, it is often stated that scientists of repute are diametrically opposed in their positions on some particular hazard. More often the question at issue cannot be resolved on the basis of scientific experiment; it necessarily implies a judgement of the acceptability of the risk and, to some extent, of its magnitude. It is clear that such judgements cannot be the exclusive prerogative of scientists.

55. A number of writers have pointed out that there is an important area of decision making in which, by its very nature, *there can be no scientific certainty*, although the question deals with matters that have a major scientific or technological component. Alvin Weinberg, for example, called problems where objective proof or certainty is unattainable “trans-science.”<sup>6</sup> For

example, oxides of nitrogen – a common constituent of urban air pollution to which most of us are now exposed if we live in a city with more than 200 000 people – are believed on experimental grounds to exert some adverse effect on the lungs of animals at concentrations of approximately 1 ppm. Those experiments involve microscopic study of the lung after controlled exposures and cannot be replicated in people. We have limited epidemiological data on human beings to suggest what levels of oxides of nitrogen should be considered the maximum permissible for the general urban population. It is easy to see that such a “standard” is bound to be a matter of opinion. Two scientists who agreed on the validity of all the scientific papers in front of them and who agreed on the strength and weaknesses of the animal and human data can nevertheless very properly disagree if asked to write down a single number which in their opinion adequately expresses the risk of exposure. Thus, trying to determine the maximum permissible concentration to which the general population should be exposed becomes a complex matter. Differences of opinion do not represent a failure of the scientific process, but rather the inevitable limitation of the kinds of experiment that can be conducted, and the uncertainty with which one may try to arrive at an agreed safety factor to protect small children or elderly people from adverse health effects. Setting a standard is analogous to the formulation of the “best available hypothesis” – one of the essential components of the scientific method.

56. There are, of course, often genuine disagreements on the validity of factual information. The interim report of the Task Force of the Presidential Advisory Group on Anticipated Advances in Science and Technology in the United States, for example, noted: “There are many cases in which technical experts disagree on scientific facts that are relevant to important public decisions. Nuclear power, disturbances of the ozone layer and food additives are recent examples. As a result, there is a pressing need to find better methods to solve the factual disputes to provide a sounder basis for public decisions.”<sup>7</sup> An article in *Science*, “The Science Court Experiment”, describes the way in which a science court might operate to resolve some of the questions. There is a similar “pressing need” in problems that are distinctively Canadian.

57. The measurement of risk, then, is quite properly a scientific activity. A comparison of health statistics from different occupational groups, comparisons of hospital admissions in the same city on days with different levels of air pollution, detailed animal experiments to identify the mode of action of a particular hazard – all of these are matters that are primarily scientific. This type of information must be summarized and debated before whatever body is charged with setting regulations concerning maximum permissible exposure.

58. The ways in which a risk is detected and appreciated are diverse. In some cases, there may be a slow unfolding of medical and toxicological information on a world-wide basis, as for asbestos. The experimentation that led to the recognition that vinyl chloride in low concentration was likely to be a human carcinogen, on the other hand, was quickly followed by the detection of cases of a rare liver tumor attributable to it.

59. Perception of hazards is continuously being refined and extended. The question of whether low levels of lead in the blood of a pregnant woman might affect the mental and cerebral development of the child, for instance, has only recently been studied.

60. A recent paper by Jacqueline K. Korn expands:

“The significance of the history of plumbism up to this point is that an ancient disease once considered acceptable has been re-evaluated and become a serious medical, human, and social problem. This change of focus is based on new scientific data which have changed our perceptions of the earlier manifestations of lead poisoning and created new attitudes toward the effect of lead poisoning on the health of industrial workers and the general population exposed to lead.

“The new uses of lead, new ability to make more accurate measurements, advances in biochemical science, and new attitudes towards the public health have all meshed to challenge the traditional concept of lead poisoning. In the dialogue that has been initiated between those who see a threat and those who do not, the concept of health risk and even the concept of disease itself are undergoing redefinition.”<sup>8</sup>

61. The general effect on the lung of asbestos was identified in 1937, but it is only in the last ten years that it has been shown that in some individuals very low levels of asbestos exposure may lead to the development of a specific malignant tumour arising in the fibrous lining of the lung. The perception of risk involves not only public information dealing with the statistics of poisoning, but also the perception of the nature of the hazard by the scientific community and the dissemination of relevant information to those most concerned or affected.

62. It is clear that the more specific and the more readily identifiable the effect of a hazard, the quicker will be the recognition of the causal relationship. Had vinyl chloride produced a lung tumor indistinguishable from other lung tumours, we would probably still not be aware that it is a carcinogen. It is sobering to reflect that there may be other substances just as dangerous as vinyl chloride, but about which we are unaware precisely because the effects they produce are not specific.

63. The decision as to what level of risk is acceptable is necessarily a task for a group of people with a wider perspective than those involved with a regulatory agency and with the scientific and technological aspects of the hazards. Views on the acceptability of a particular risk, if they are to command respect, must reflect a broad and deep contact with public opinion, as well as thorough knowledge of relevant technical innovation. Sir Brian Flowers, former Chairman of the U.K. Royal Commission on Environmental Pollution, told a workshop of the Science Council, in February 1977, that although the technical basis for the Sixth Report on Nuclear Power in the Environment<sup>9</sup> contained no scientific or technical matters of which he had not been previously aware, the hearing of this evidence by the Royal Commission which included members drawn from different sectors of society, had changed his own view of the acceptability of the hazards of rapid development of certain types of nuclear technology. The Science Council emphasizes that judgement of the acceptability of risk, especially if made on behalf of those who may be exposed to it by those who are not, is a complex process.

64. Discussion of the scientific background must take place in an open forum. This forum should include those particularly affected by a hazard, labour and management in the occupational context, and all affected parties in the environmental context.

65. A desirable process for assessing the acceptability of risks would include: a willingness to be accountable for all decisions leading to the adoption or non-adoption of recommended maximum permissible levels of exposure; decisions made by a body with members from different sectors of society; structured opportunities for public participation, a process whereby

new scientific evidence can be quickly reviewed, and previous standards reconsidered; and a system able to respond quickly to newly-perceived hazards.

66. The Royal Commission on Electric Power Planning in Ontario, under the chairmanship of Professor Arthur Porter, embodied for the first time in Canada some of these characteristics. The Royal Commission was able to employ consultants to evaluate and criticize, in a public forum, the briefs submitted to the Royal Commission by major agencies such as Ontario Hydro.

67. In summary, therefore, the first task must be to establish a method by which a modern community may examine hazards and their concomitant risks. Only then can it come to general conclusions respecting appropriate and inappropriate levels of exposure to these hazards, bearing in mind the circumstances of exposure, the size and type of population at risk, the scientific evidence that lies behind the appreciation of the hazard, the means available to lessen the risk, and local and national impact. Once that process has been established, the very difficult questions of monitoring the hazard and identifying actions required to contain it become the next major concern.

68. We emphasize that three basic conditions must be observed if the process of containment is to work satisfactorily. Firstly, where the exposure levels in the workplace cannot be modified by equipment design and modification, the efficacy of the protection system critically depends on consultation and collaboration between management of a company and its employees. Such consultation can only be achieved if there is a dedication to a policy of openness. There must also be a serious attempt to inform all those involved in the manufacturing process about the nature of the hazard and the protective measures that have and must be taken to deal with it. This important aspect of any control strategy has been emphasized by the Report of the Royal Commission on the Health and Safety of Workers in Mines in Ontario. Secondly, the responsibilities of different levels of government must be openly and realistically defined so that there is less ambiguity about where these responsibilities lie, thereby ensuring greater public accountability. The question of the disposal of radioactive waste in Port Hope, Ontario, the lead problem in Ontario, and the occurrence of mercury poisoning among native people in northern Canada as a result of fish contaminated with methyl mercury are examples of a problem compounded by confusion about where responsibility really lies. The unfolding of these events, and some which have yet to be fully documented, seems to have followed a sequence. The media publish an account of the problem with some magnification of the severity and extent of it; the first response of public officials in some instances is to deny that there is a problem; then they deny that there is a problem of any severity; and then they devote a great deal of energy to establishing that some department or jurisdiction other than their own was primarily or jointly responsible. In some instances, there has been an effort by participants in the dispute to discredit the evidence and/or those who have produced it. This spectacle of official confusion with initial denial followed by later general corroboration of the initial report leads the public to believe that the matter is not being treated openly. This suspicion (usually justified) necessarily fosters the belief that the actual problem is probably much more extensive than was initially reported in the media (a belief that may or may not be justified). At this point in the discussion, the actual scientific data, if they

exist, tend to be neglected by all parties concerned. Thirdly, in all cases there needs to be dedication by everyone concerned to ensure that the highest possible level of protection is attained. No formal institutional arrangements can work without such dedication.

69. We have therefore concluded that much of the recent concern expressed in Canada on many of these issues has been fuelled by an unfortunate lack of perception at senior levels of the inevitable consequences of repetitive attempts to cover up what is quite genuinely a matter of serious concern. The recommendations in this Report are designed to help to rectify this situation.

70. The Science Council **recommends:**

A) That a National Advisory Council on Occupational and Environmental Health (NACOE) be established by statute, with the following mandate:

1. to designate hazards and be responsible that assessments of risks are undertaken and published in respect of any hazard it may designate
2. to be responsible for publishing recommended standards of maximum permissible exposure levels for Canada.

B) That NACOE be established as a schedule B Crown Corporation reporting to Parliament through the Minister of National Health and Welfare. (See Appendix B.)

C) That NACOE have a full-time chairman and secretariat for the discharge of its responsibilities.

D) That NACOE have the capability of contracting for review of scientific evidence and technical methodology to be prepared by the National Research Council, the Medical Research Council, the Canadian Institute for Scientific and Technical Information (CISTI), universities, private organizations and industry, and other government agencies.

E) That NACOE be able to support and fund committees formed to advise it on such matters as environmental carcinogens and the health impact of new chemical compounds.

F) That NACOE be able to contract for the establishment of reference laboratories in respect of specific requirements not met by existing resources, for example, a pathology laboratory to standardize tissue analysis in Canada.

G) That NACOE be required to receive public briefs and submissions and when requested to hold review sessions in public when it has announced its intention to publish a recommended standard. It shall be permitted to publish its recommended interim standard in matters of urgency when it considers this necessary.

H) That the membership of NACOE include representatives from labour unions, industrial management, the scientific and medical communities, and the general community, bearing in mind the need for a balanced regional distribution. Each member should serve for a three-year period, renewable once only.

I) That NACOE, when it deems it appropriate or necessary, assist public interest or citizens' groups to make public input into its deliberations by making information available and by the provision of funds and/or other resources. To this end NACOE should develop criteria for the selection of such groups.

J) That NACOE work closely with the Atomic Energy Control Board as regards radiation health hazards connected in any way with the nuclear energy industries. As for the medical use of x-rays, we **recommend** that NACOE together with the Radiation Protection Branch of the Department

of National Health and Welfare and the Canadian Association of Radiologists establish guidelines for the more judicious use of x-rays in terms of both patient and employee protection, and the means of monitoring such use.

K) That NACOEH serve an educational and advisory function for relevant parliamentary and legislative standing committees.

71. NACOEH's secretariat could draw upon existing expertise located in various government departments and agencies concerned with environmental and human health.

72. We recognize that the role we project for NACOEH will necessitate modification and readjustment of the existing mandates and responsibilities of some agencies in government departments. These changes and redefinitions are necessary if the decision-making process is to be altered so that it may be equal to the future demands that will be made on it.

## IV. The Process of Risk Assessment

73. Having recommended the establishment of a National Advisory Council on Occupational and Environmental Health (NACOEH), the Science Council feels that it should discuss in some detail the process of risk assessment NACOEH would supervise.

### Information Base

74. The first task in the assessment of risk is the provision of the best possible information base. This necessarily includes: knowledge of the exposure to the hazard (This includes information on the properties and characteristics of a substance, its possible environmental and biological transformation, its production, use, and disposal, the levels likely to be encountered in the workplace and the environment generally, and the population groups exposed.); information concerning the effects on health (This includes the acute effects of poisoning, the more subtle sub-clinical effects, and the nature and probability of long-term effects.); information on technical and economic options for control; a study of morbidity statistics and analysis of record linkage and epidemiological information; and consideration of the necessary warning systems, both anticipatory and reactive.

### Information Exchange

75. In the medical field, there is a need for better information exchange. The identification of the specific angiosarcoma of the liver attributable to vinyl chloride was greatly facilitated by the independent action of Dr. M. J. Phillips, Professor of Pathology at the University of Toronto, who had a particular interest in liver tumours. We have noted that the Department of National Health and Welfare took no steps to ensure that pathologists across the country were aware of this unusual tumour, and alerted to its possible cause and occurrence. We find it surprising that the Department of National Health and Welfare should be quick to take initiative in respect of food and drug problems and think it normal to send a letter to all practicing physicians in Canada concerning such matters, but should not have considered it to be within its normal sphere of responsibility to alert all pathologists about recently published information on a liver tumour attributable to a chemical substance that many Canadians were handling.

76. As a means of improving information exchange, we **recommend** that NACOEH require and request the Canadian Institute of Scientific and Technical Information (CISTI) to assemble the scientific papers relating to a specific hazard and that it have available to it the funds required to annotate this bibliography to enable all members of the community to have access to the scientific literature that bears on their specific problems.

77. We have studied the role of the National Research Council Associate Committee on Scientific Criteria for Environmental Quality, which provides scientific background for the decision making of the Department of the Environment and other departments. The present arrangement suffers from a number of major difficulties, of which two are of very considerable importance. The first is the lack of any close liaison between those who are seeking the scientific background on the one hand, and the committee which may be in a position to marshal it on the other. The second has been the expectation that compilation of the scientific background to complex issues can, for the



most part, be done as an unpaid service by academic scientists and others. Economical though such a policy may be, it does not permit the quick preparation of material on topics of immediate importance; it certainly cannot be relied upon in the future as a main information input system.

## Research Base

78. It is essential that those responsible for the risk assessment process be capable of identifying research needs in relation to hazards and materials of specific importance to Canada. Such a capability requires adequate knowledge of the present research base if work done elsewhere is not to be needlessly duplicated; it requires close liaison between bodies capable of initiating new work on hazards, with NACOEH responsible for the assessment process. We feel that the most effective way of ensuring this linkage is by contract funding from NACOEH to NRC, MRC, the Department of National Health and Welfare, and other government departments and agencies for specific studies and enquiries. We recognize that to accomplish this it may be necessary to modify the existing mandate of these agencies.

79. Accordingly, we **recommend** that the National Research Council Associate Committee on Scientific Criteria for Environmental Quality be developed as an arm of NACOEH on environmental and occupational hazards. Its task would be to administer contract research proposals coming from the Council and to ensure the scientific quality of the review of scientific knowledge that is produced by this process. We regard it as important that NACOEH should have the capability of deciding on which problems research endeavour in Canada should be focussed. This can be best achieved by placing the research contract capability with NACOEH. Close working relations of the agency responsible for developing standards of exposure and the scientific community are difficult to achieve, but the scientific community and the public interest would be best served by this process.

80. We have reviewed carefully the proposed mandate for the Centre of Occupational Safety and Health under the aegis of the federal Department of Labour. We recognize that some of the tasks we are proposing for NACOEH might fall within the range of study of such a Centre. However we feel that the mandate of the Centre as currently proposed is too narrow, and its task seems too limited for what is now required in the Canadian context. We believe that there must be a requirement that NACOEH address itself directly to recommending maximal permissible levels of exposure in *both* the environmental and occupational fields. The Centre is not envisaged as having this joint responsibility. The process of risk assessment must, in our view, be conducted in an open and accessible way; the initial proposals for the Centre do not indicate that this has been regarded as essential.

81. We do not feel that existing structures can be modified to meet this need. It is clear for example, that the Canadian Environmental Advisory Council was structured to be purely advisory to Environment Canada. The responsibilities which we recommend for NACOEH are not those which could appropriately be placed within the Canadian Environmental Advisory Council.

82. We also anticipate that NACOEH should be able to establish reference laboratories which, for example, might improve greatly the diagnostic capability available to the country as a whole. With respect to human tissue, such

a laboratory might provide a very high standard of diagnostic reference capability, and we anticipate that the establishment of such laboratories on a contract basis might greatly improve the medical capability, and perhaps most particularly, the analytical capability of the country as a whole. In the case of containment and monitoring, such a laboratory might provide the basis for innovative techniques, which under appropriate arrangements could be transferred to relevant industries.

### **Scientific Controversy**

83. We have stressed that NACOEH will have to make judgments in areas in which there is no scientific certainty. This can best be done in our view if there is openness of information development and exchange and an openness of process, whereby different interpretations of scientific evidence can be publicly discussed or new scientific evidence can be placed in the public domain. Where interim standards are promulgated without public enquiry, there should be provision for an appeal process.

84. The concept of the “science court” which is being developed in the United States does not appear to be wholly appropriate to the kind of decision making we have in mind, and we feel that a less formal process, such as that adopted by the standing Royal Commission on Environmental Pollution in Britain might be more efficient and more appropriate. Nevertheless, the experimentation with such a concept in the United States should be followed carefully as it may provide a model which could be adopted or modified later. We do envisage that NACOEH will function, on some occasions, in much the same way as a “science court” is expected to operate.

## V. Medical Record System

85. There is an urgent need to design a medical record system in Canada that will permit the linkage of individual diagnosis with occupational and environmental history.<sup>10</sup> We do not believe that such a system would represent any major infringement of privacy; its adoption is urgently indicated if the public is to be protected in the future against carcinogens which may only be manifest many years after the exposure experience has occurred. As Sir Richard Doll states in a recent article:

"The concept of linking records by computer has given rise to anxiety lest they are used to the detriment of the individual, as has happened when personal records have been linked by credit organizations in the U.S.A., and some doctors have been worried by the apparent loss of confidentiality. Confidentiality can, however, be protected in a computer much more easily than in a standard case note, and I know of no instance where the provision of personal information to a *bona fide* medical research worker has been abused. It is, of course, for the public to decide; but in my experience, most people understand that we cannot protect them against disease unless we are allowed the necessary tools. Record linkage of the type required is, moreover, not expensive when the essential records have been made for other purposes, as they now all are — the only defect of the present system being the records are not organized in a way that enables them to be used to detect hazards to health."<sup>11</sup>

86. We believe that the public would fully support such a record system in Canada, and we do not believe that medical confidentiality would be in any way compromised by its adoption. Details of one possible system have been recommended by H. B. Newcombe.<sup>12</sup>

87. We **recommend** that a medical record system be designed and proposed by the Department of National Health and Welfare. As an essential first step, this must include standardizing nationally the collection of pertinent medical and occupational information, as well as standardizing an appropriate code for computer inputs. With the cooperation of provincial departments of Health and Labour, the various Workmen's Compensation Boards, and industry, the standardized procedures could be used to link medical and occupational records province wide, to start with, and then nation wide. Once its feasibility is demonstrated, this system should be established in Canada to permit the linkage between occupational exposure to materials and subsequent cause of death to be studied on a continuing basis.

88. We **recommend** that agencies having responsibility for surveillance and competent responsible persons who wish to conduct epidemiological research have statutory right of access to the proposed medical record system.

## VI. The Process of Determination of Acceptable Risk

89. We have noted in paragraphs 53 and 54 that determining with as much accuracy as possible the risk involved in any human activity or in exposure to any chemical is a process distinct from decisions as to what level of risk might be acceptable. We have argued that the two steps should be considered by the same Council, but the two aspects of the decision-making process involve different processes. Risk assessment involves consideration of all the scientific evidence relating to a hazard. Determination of acceptable risk involves a judgement of the social acceptability of a given level of risk. The latter responsibility, in our opinion, is best discharged in two ways: the Council of NACOEH should be broadly representative of different sectors of the community; and the hearing of evidence should be public, with encouragement of those with and without expert knowledge to participate.

90. We recognize that these provisions will slow down the decision-making process and necessarily add to its cost. These objections, in our view, have to be regarded as secondary to the prime requirement that the public and particularly those exposed to the hazards will have more confidence in the equity and wisdom of the conclusions reached.

91. We have concluded that in Canada at the present time it would be desirable for a single institution to have responsibility for assessing the level of risk, for making recommendations on acceptable risks, both for the general population in environmental terms and for the working population in relation to specific industrial hazards. This will avoid an otherwise very burdensome and unnecessary duplication of work, since many of the traditional occupational hazards are also environmental hazards. There are, of course, hazards to which the working population may be exposed but which do not involve the general population; and there are some hazards of immediate concern in terms of population exposure which are not major problems in any occupational setting. However, a single institution could best consider the levels of exposure or of accumulation of materials within the body which would be considered acceptable for an ordinary population; it might specify levels in certain population groups in terms of specific hazards, as for example the maximum lead level that might be considered acceptable in a pregnant woman. It would also specify the maximal acceptable level for a person exposed to the same material in the working environment under close medical surveillance.

92. The process of coming to a decision on whether a certain risk level should be considered acceptable or not must involve consideration of the following factors: general information about the hazard and the economic factors concerned with its control, and an assessment of the benefit to society from the processes that produce hazards. *The final decision of a "best judgement process" is best left to a group of individuals of varied background as to whether the risk involved in any particular hazard should or should not be considered acceptable.*

93. We wish to emphasize that the assessment of the acceptability of risk is necessarily a complex process. There may be uncertainty about the actual degree of risk; there may be a willingness on the part of some individuals to accept a degree of risk that might normally be judged "unacceptable" if the alternative is unemployment or social deprivation; and it is a common feature of all of us to act as if we will be personally immune from the statistical inference. (Indeed, an assumption of our own personal immunity from common hazards may be a necessary feature of a determination to survive.)

For these reasons, the composition of the Council of NACOEH that we are proposing is an important issue. We **recommend** that NACOEH be drawn from different sectors of the community and have a rotating membership.

94. It is an essential condition of the process of deciding upon the acceptability of risk that there be openness in the decision-making process, so that individuals can participate in decisions on their own exposure level. We envisage the Council holding hearings into particular problems and inviting submissions from a variety of sectors of the population. In Appendix A we reproduce a letter circulated by the National Research Council of the United States in January 1977, which represents an interesting prototype of one way the Council we are proposing might operate.

95. The Council would also provide a forum in which scientists who have prepared material for the Council could attend and speak, and before which the chairman of a committee that might have put together a specialized report could answer questions concerning it. All such dialogue should, in our opinion, be in the public domain. There would however be no necessity that all the deliberations of the Council be made in public, although all of its recommendations would.

96. We believe that it is wise to separate the process of risk assessment and risk adjudication from the process of establishment of statutory and mandatory standards, and from the complex tasks of enforcement and compliance. It seems to us that an essential first step to improve the present Canadian decision-making process is to establish the risk assessment procedure in an open forum for both environmental and occupational hazards, and to regard this decision-making process as necessarily separate from the work of those agencies which should have the responsibility of regulation and enforcement.

## VII. Regulation, Enforcement and Compliance



97. In the previous section we emphasized the necessity for a new body in Canada responsible for recommending acceptable exposure levels in the occupational and general environments. We believe that the establishment of such a body is a necessary first step to improve the risk assessment and adjudication capability of Canada in relation to these important questions.

98. It is a simpler task to identify the necessity for such a body and to indicate in broad terms the way it should function, than it is to determine how the general recommendations of NACOEH ought to be implemented and how the working population and the population as a whole can and should be protected against major hazards. We have reviewed the existing jurisdictional complexity in Canada and conclude that the confusion between jurisdictions has led in the past to difficulty in identifying with precision the department or body actually responsible for any existent situation. The report on lead to the Government of Ontario made this point very forcefully:

“In view of the plethora of bodies and legislation involved it is not surprising that there should be some confusion in the field. Co-ordination of the efforts of so many in such a wide-ranging field as that of the control of industrial poisons is obviously difficult. We have noted faults in the course of our inquiries, which stem from either lack of co-ordination or, more frequently, from uncertainty as to who is responsible or empowered to take action in a particular situation. The prime fault is that there is, at present, no one minister fully responsible for all matters involving the health of the people. An important problem may fall within the sphere of activity of several ministers, each responsible for one or another part of it, but none with the authority to bring the parts together in order that the whole may be tackled effectively.”<sup>13</sup>

We do not feel that overlapping jurisdictions are the problem. On the contrary they may, in fact, cover the cracks that often appear between distinct jurisdictions. Accountability is a problem, however, and jurisdictional responsibility should be clearly defined so that the public can appreciate “who is responsible for what.” While this does not, of itself, guarantee effective regulation and control of the type of hazards under consideration, its absence makes the effective control of chemical hazards difficult and undermines the credibility of the process.

99. Similar jurisdictional problems have been identified in respect of mercury pollution in the Canadian North. Was the identification, control and amelioration of this problem the responsibility of the Department of National Health and Welfare, of Environment Canada, of the provincial Departments of Health, of the Department of Indian Affairs and Northern Development, or all of these? One can foresee similar jurisdictional complexities in respect of arsenic contamination arising both from emissions into the air and from the underground storage of material. We understand that the lack of clear jurisdictional divisions has led to some of the neglect of and confusion concerning responsibility for regulating the uranium industry in Ontario. This was a finding of the Royal Commission on the Health and Safety of Workers in Mines: “Indeed at times it has not been clear whether initiative was considered to rest with industry or the responsible ministry. Staff in the Ministry of Health and the Workmen’s Compensation Board have worked, and continue to work, with inadequate resources to assist in illuminating problems outside their jurisdiction. In this sense there is compelling need for new clarity in roles within the responsibility system, especially when there is growing awareness of an evident threat to the lives of workers.”<sup>14</sup>

100. We have studied two broad philosophies that exist in relation to these problems. The first is the approach adopted by Britain, which in general has not favoured the establishment of statutory exposure levels either for the working or the general environment, and instead has relied on a judgement based on "the best practicable means" with monitoring and measurement by a factory inspectorate. The tradition of keeping confidential the actual measurements being made in any occupational environment, on the basis that unless this was done the mutual confidence between the inspectorate and the industry would be destroyed, has recently been questioned and is probably no longer an acceptable policy. In contrast, the United States has moved toward the establishment of definitive standards, both for the general public and the workforce, establishing these through the Occupational Safety and Health Agency for occupational exposures, and the Environmental Protection Agency for general environmental hazards. The enforcement of such standards has depended on processes of law, and this procedure has led to increasing litigation during the past 5 years.

101. We have been impressed by the testimony of the individuals most affected by the major occupational hazards we have studied, to the effect that there is no reason why they should have any confidence in a system of "guidelines" or of "non-enforceable standards." It seems clear that for some major hazards, for example, asbestos, lead, vinyl chloride, and radiation, the level of exposure, measured as precisely as is possible with modern technology, must be controlled by enforceable regulations. We **recommend** that it be a task of NACOEH to evaluate and recommend which hazards should be subjected to regulatory control. By this, we mean the establishment of statutory standards to regulate, not "guidelines" where appropriate scientific evidence exists to support such regulation. In our view guidelines are appropriate to assist industry and labour to institute those practices which are needed to minimize exposure to a hazard.

102. We are very conscious of the difficulties of control in the occupational field.<sup>15</sup> These relate mainly to the need for unambiguous demarcation of the provincial and federal responsibilities. Moreover, without a close working collaboration between management and labour, without a well-informed workforce and without a real dedication of both workers and management to the protection of health, statutory regulation would still be largely ineffective. This point has been made forcefully by the Royal Commission on the Health and Safety of Workers in Mines:

"Within the internal responsibility-system at the company level, which is the key to the quality of the over-all control of occupational hazards, there has been in many companies an inadequate opportunity for workers to contribute their insight to the assessment of work conditions and to the basis on which management makes decisions on issues of health and safety.

"The Commission has carefully defined a framework for the operation of joint labour-management health and safety committees as bodies contributive to the formulation and review of sound managerial policies and practices. In addition the Commission has recommended the introduction of a system of worker-auditors to provide to management and to the mines inspectorate a new dimension in the auditing of work conditions based on the insight of experienced workers.

"Within a context whereby workers, other than in the personal act of work, can fulfill a proper responsibility to contribute to the resolution of problems of health and safety, the Commission earnestly hopes

that a new measure of labour-management co-operation can emerge.

"The Commission believes that a part of the wide variation in accident frequencies among different companies is related to the quality of human relations that exist within them, relations in which both management and the collective bargaining unit (where such exists) play crucial roles. A well-founded internal responsibility-system in which labour and management co-operate to control occupational hazards ought to exhibit a high measure of self-regulation for which mines inspection and openly reported environmental and epidemiological reviews can provide the necessary external evaluation."<sup>16</sup>

103. The problem, then, is to suggest ways in which the actual regulation and enforcement process might be restructured so that it can operate more effectively. This is the aim of the recommendations which follow.

104. It is clearly within the powers of both levels of government to establish statutory levels, but we **recommend** that it would be best if the responsibility for the establishment of statutory levels of exposure rested with the provincial governments, by agreement between both levels of government.

105. The provincial governments, having considered the advice of NACOEH, would be responsible for legislation and for detailed enforcement and compliance. We expect that the provincial governments may be encouraged to legislate health and safety committees of labour and management through whom their own inspectorate could work, as implemented in Saskatchewan and proposed in Ontario Bill 139. As a first step, relevant federal and provincial Crown corporations and agencies should provide leadership by establishing such committees to serve as an example for private enterprise. We urge that information on exposure levels and on the results of measurements taken in hazardous environments should be made available on enquiry, and available without any constraints to the working men and women involved.

106. The role of federal government departments should be to assist in coordinating the work of the provincial governments, to discuss necessary standards and legislation in terms of environmental hazards and to recommend maximal permissible exposure levels where a need is perceived (as anticipated in the Environmental Contaminants Act).<sup>17</sup>

107. In relation to occupational health risks, the responsibility of the federal government should be to legislate for those industries that come under the Canada Labour Code, as well as for its own activities.

108. The Environmental Contaminants Act (Bill C-25) was proclaimed 1 April 1976 and permits the Ministers of the Environment and National Health and Welfare to control the use and distribution of newly manufactured chemical compounds. It provides the Ministers with powers to gather information about substances dangerous to human health in the environment. The U.S. Toxic Substances Control Act has a similar intent. The Canadian Act does not require any public or general involvement in the decision-making process, although the Ministers, at their discretion, may arrange for public hearings. They may establish specific advisory committees to:

"review any data. . ."

"receive representations from interested parties or concerned members of the public and to advise the Minister of the Environment and the Minister of National Health and Welfare respecting measures to control the presence in the environment of any substance or class of substances."

"make public its reports and recommendations with the reasons therefor."<sup>18</sup>

However, there is no requirement for a Minister to establish any advisory committee.

109. We recognize that this Act represents a useful step forward; the Act might have facilitated quick action to contain the hazard of vinyl chloride once this had been recognized. But we find it difficult to determine whether this Act will apply to the occupational environment. If it applies only to the general public environment, it is doubtful that vinyl chloride would have been considered a significant hazard. The degree to which the asbestos, mercury or lead hazards fall within the provisions of the Act is also unclear.

110. We note the following wording in the Act. "The report of a Board shall, within thirty days after its receipt by the Minister of the Environment and the Minister of Health and Welfare, be made public unless the Board states in writing that it believes the public interest would be better served by withholding publication, in which case the Minister of the Environment and the Minister of National Health and Welfare may decide whether the report, either in whole or in part, should be made public." (Section 6(5)) This does not indicate that the government has an appreciation of the importance of openness in the decision-making process.

111. We recognize that there will be resistance to the idea of careful measurement and policing of hazards, but it is fair to say that there has, in Canada, been sufficient adverse experience with more permissive methods of control to propose that a new approach must be made. The ideal form of control is unquestionably routine self-compliance with established standards, subject to an open process of inspection and enforcement. We have been impressed with the performance of the polyvinyl chloride industry in this regard.

112. Because of the importance of information flow, we **recommend** that the federal Department of Labour and NACOEH, working together with the provincial Departments of Labour, establish a budget specifically for the purpose of providing background educational material to the workforce and to management in specific industries to encourage an understanding of the nature of hazards and of the ways in which they can be avoided.

113. We also **recommend** that the provincial governments establish, after consultation with the federal government and with NACOEH, those hazards for which more specific regulation of exposure levels is required, and for which constant and detailed monitoring of existing conditions is mandatory. Any industry handling designated hazards should be required to ensure adequate and effective communication to their work force and to provide close medical surveillance.

114. We have noted, both from the Comité d'étude sur la salubrité dans l'industrie de l'amiante, in Quebec, and from the Royal Commission on the Health and Safety of workers in Mines, in Ontario, that the role of the medical profession in insisting on better protection for the workforce exposed to asbestos and silica dust has been less than distinguished in the recent past. Many people believe that the reasons for this is that physicians are wholly employed by company management and that independent medical advice is therefore not available within the workplace. We have observed during the last few months an increasing tendency for workers in major industries involved with hazards to seek their own medical opinion from consultants outside the plant, and even from outside Canada. We regard this breakdown of confidence as particularly unfortunate, but easily understand-

able. It must be publicly understood that a company doctor should be professionally responsible and independent of that company so that public pressure can be brought to bear on recalcitrant company doctors.

115. There seems to be a clear need for the establishment of a strong and independent medical presence at both provincial and federal levels. Occupational and environmental health divisions exist, but their work could be greatly improved if there were clear jurisdictional demarcation of responsibilities. We suggest that for specific hazards of major importance the occupational and environmental health divisions of the federal and provincial governments should be given a specific responsibility and right of access to information. The importance of this provision lies in the fact that in some instances it is possible to diminish the level of a substance in the workplace by increasing its general dispersal to the outside environment; this may be, and usually is, a highly undesirable solution.

116. In a later section we deal with the labour implications to improve the present situation. It is our opinion that a major reinforcement of well-trained medical personnel, as well as the establishment of new training programs for industrial hygienists and industrial nurses, is an important component in the improvement of the present situation.

117. We **recommend** that Workmen's Compensation Boards be obliged to publish: statistical breakdowns of claims for work-related diseases; diagnostic criteria used in identifying work-related diseases; and the criteria or rules used when adjudicating claims for compensation. This would be of immeasurable help in surveys of work-related diseases and would help to provide a better informed basis for appealing a Board's decision.

118. We wish to emphasize that in the case of medical injury, there is a great deal of work to be done in Canada to ensure some uniformity of diagnostic criteria among different provinces. There would seem to be no reason for different diagnostic criteria in relation to early asbestosis between provinces. Yet there has been no major attempt to standardize the diagnostic criteria or the measurements that may be used to assist the Workmen's Compensation Board in its decisions about disability. Where uniform diagnostic norms have been adopted, care must be taken in the medico-legal use of these norms to ensure that the decisions resulting from them comply with the law in each province. We are concerned that the level of expertise in adjudication of some conditions may be weak in some provinces and strong in others, and we **recommend** that it be an important role for the federal government, through its Department of National Health and Welfare and Department of Labour, to facilitate some general uniformity of diagnostic standards for the country as a whole. There is no evidence that this has been considered an important task for these federal departments.

119. We are aware that some of the most serious and neglected health problems have arisen in various small companies employing only a dozen or so people. It is not, of course, reasonable to require such companies to employ full-time medical staff and it is difficult to ensure an adequate level of inspection without a very large army of inspectors, since such companies are very numerous. The solution to this problem, we believe, lies in designating certain processes or industries or the handling of certain materials, as activities requiring certain specific inspection and preventive measures. It would be foolhardy to make recommendations across the whole of industry, but it would be equally unwise to ignore the small company engaged in such hazard-

ous activities as sand blasting, or welding in a closed environment, or handling asbestos products, or disposing of used car batteries.

120. We therefore **recommend** that provincial governments designate certain industries involved in "high risk" activities as being in a special category and, when necessary, accept responsibility for the medical surveillance of workers in them and for the control of working conditions.

121. In the case of environmental standards, we have concluded that the promulgation of acceptable standards of exposure, both in terms of 24-hour exposures or average figures over a month or a year, in the case of common air pollutants, serves a useful purpose. We have noted that the federal Minister of the Environment has published standards for the whole of Canada which deal with such common air pollutants as sulphur dioxide, particulates, oxides of nitrogen, and oxidants. These guidelines are not statutorily enforceable, but provide a yardstick against which the regularly published measured levels of these pollutants in Canadian cities may be judged. It is not clear however what action is to be taken (and by whom) when levels are in excess of those thought to be desirable for the population as a whole. To date there has been no forum at which such matters could be discussed. The environmental and occupational advisory council which we have recommended would certainly provide such a forum.

122. The sources of urban air pollution are invariably multiple. Their control necessarily involves action by diverse groups within the community, and often simultaneous action by several government departments. So far, Canadians have been content to establish local provincial regulations dealing, for example, with the sulphur content of fuel oil, or to take advantage of the United States auto emission standards. Only Ontario has so far legislated emission standards for automobiles, but these standards are still really dependent on the standards that govern the United States automobile industry.

123. It is unclear what action should follow the publication of air pollution data from a province indicating that certain members of the public in that province are exposed to levels of pollutants higher than those designated by the federal Department of the Environment as the maximal permissible level. It is essential, if public confidence in the process of measurement and control is to be sustained, that it should be quite clear what action is to be taken, and by whom, when such standards are known to have been exceeded.

## VIII. Occupational Health

124. Anyone who skis in a rather remote area far from medical facilities is undertaking a higher risk, albeit knowingly and voluntarily, than someone who skis where medical facilities are readily available. Thus, the skier can reduce his or her risk by appropriate selection of where to ski. Workers, generally speaking, are not as free to choose where they work and thus to modify the occupational risks they take. However, occupational risks can be reduced if skilled medical personnel are nearby. This staff should have expert knowledge of occupational hazards and information on the details of the employees' past and current history of exposure. Unfortunately, more often than not, workers in Canada did not and do not have such attention paid to their occupational health needs.

125. We commend initiatives undertaken by the Department of National Health and Welfare to reassess its role in the arena of occupational health. An interim document written in January 1976 by Dr. David Chisholm, of that department, listed some major concerns:

"1. Canada lacks a national policy on occupational health, and appears to have a 'low profile' and a difficult-to-identify national program for occupational health.

"2. The Canada Labour (Safety) Code is the only significant federal legislation but is highly safety oriented, applies to about ten per cent of Canadians, and has failed to be accepted as the model or standard code.

"3. Workmen's compensation is inequitable amongst the provinces, a particular concern to employees under federal jurisdiction. Yet overall Canada's achievements in compensation are internationally recognized.

"4. Within the federal government, and within several provincial governments, a close working relationship has not been achieved, in part due to jurisdictional uncertainties or conflicts, and the plethora of legislation/regulations.

"5. A network of informational/resource centres has failed to materialize, as has a national centre, in spite of the considerable expertise that exists in Canada. In addition, no continuous information sharing program has been sustained with the ILO and WHO, nor established with the U.S. National Institute of Occupational Safety and Health (NIOSH) nor the Occupational Safety and Health Administration (OSHA), nor counterparts in other nations.

"6. Legislative Acts and regulations continue to be introduced. Compounding this is the rapid increase of community environmental legislation, frequently insufficiently coordinated with occupational legislation and vice versa.

"7. Canadian corporations with operations in more than one province, and/or the U.S.A. or other countries, must endeavour to abide by the variety of regulations and standards in use. In turn, foreign-based corporations face a similar problem when establishing Canadian operations. Where higher standards exist in another nation (e.g., certain OSHA standards in the United States), non-complying equipment and/or more hazardous processes could be transferred to jurisdictions with lower standards, resulting in the "exporting" of the potential for occupational disease and injury."<sup>19</sup>

126. We recommend,

- that provincial policies for occupational health be considered and implemented, and that they be instituted in an open and easily identifiable manner;
- that a higher priority be given than is now given, in the area of occupational health, to medical problems that stem from low-level, long-term exposure to hazards;
- that medical and other appropriate training schools give far more attention



to the training of both medical and paramedical practitioners in the general discipline of occupational health.

There are major deficiencies at the present time in the following general disciplines:

—career physicians who have had first-class basic preparation in occupational health. These individuals are particularly required in major resource industries handling hazardous materials, but they are also needed to inspect and advise small industries handling hazardous material.

—industrial hygienists with special skills in dust measurement and chemical analytical procedures for both the environment and the workplace

—industrial nurses who have had first class educational training in the nature of industrial hazards and in the measures taken to protect people from them.

—people trained in the science of toxicology in Canada. We hope that this development will be facilitated by the establishment of reference laboratories that develop special skills in complex analytical methods and that will be widely available for consultation purposes.

We believe that in the future Canada will need a much better workforce in all these areas than currently exists; urgent attention should be given to improving educational opportunities in these fields. One way would be to provide new scholarship programs. Development of personnel will require more multidisciplinary cooperation between schools of science, medicine, engineering, and law, than has generally existed in this country.

- that the Medical Research Council, through its granting program, fund biomedical research that is closely related to occupational health. As noted in paragraph 78 we anticipate that this may be achieved by contract funding from NACOEH to the Medical Research Council.
- that a national record linkage system be used to provide information to the pertinent medical practitioner about a worker's previous exposure to occupational hazards.

## IX. Summary of Principal Recommendations

We the Members of the Science Council of Canada **recommend:**

*(Paragraph 70)*

That a National Advisory Council on Occupational and Environmental Health (NACOEH) be established by statute, with the following mandate:

1. to designate hazards and be responsible that assessment of risks are undertaken and published in respect of any hazard it may designate
2. to be responsible for publishing recommended standards of maximum permissible exposure levels for Canada.

*(Paragraph 76)*

That NACOEH require and request the Canadian Institute of Scientific and Technical Information (CISTI) to assemble the scientific papers relating to a specific hazard and that it have available to it the funds required to annotate this bibliography to enable all members of the community to have access to the scientific literature that bears on their specific problems.

*(Paragraph 79)*

That the National Research Council Associate Committee on Scientific Criteria for Environmental Quality be developed as an arm of NACOEH on environmental and occupational hazards. Its task would be to administer contract research proposals coming from the Council and to ensure the scientific quality of the review of scientific knowledge that is produced by this process. We regard it as important that NACOEH should have the capability of deciding on which problems research endeavour in Canada should be focussed. This can be best achieved by placing the research contract capability with NACOEH. Close working relations of the agency responsible for developing standards of exposure and the scientific community are difficult to achieve, but the scientific community and the public interest would be best served by a process whereby specific contracts for studies or for major reviews of the literature are placed by NACOEH through the National Research Council, the Medical Research Council, and other appropriate agencies.

*(Paragraph 87)*

That a medical record system be designed and proposed by the Department of National Health and Welfare. As an essential first step, this must include standardizing nationally the collection of pertinent medical and occupational information, as well as standardizing an appropriate code for computer inputs. With the cooperation of provincial departments of Health and Labour, the various Workmen's Compensation Boards, and industry, the standardized procedures could be used to link medical and occupational records province wide, to start with, and then nation wide. Once its feasibility is demonstrated, this system should be established in Canada to permit the linkage between occupational exposure to materials and subsequent cause of death to be studied on a continuing basis.

*(Paragraph 88)*

That agencies having responsibility for surveillance and competent responsible persons who wish to conduct epidemiological research have statutory right of access to the proposed medical record system.

*(Paragraph 101)*

That it be a task of NACOEh to evaluate and recommend which hazards should be subjected to regulatory control. By this, we mean the establishment of statutory standards to regulate, not “guidelines” where appropriate scientific evidence exists to support such regulation. In our view guidelines are appropriate to assist industry and labour to institute those practices which are needed to minimize exposure to a hazard.

*(Paragraph 104)*

That it would be best if the responsibility for the establishment of statutory levels of exposure rested with the provincial governments, by agreement between both levels of government.

*(Paragraph 112)*

That the federal Department of Labour and NACOEh, working together with the provincial Departments of Labour, establish a budget specifically for the purpose of providing background educational material to the workforce and to management in specific industries to encourage an understanding of the nature of hazards and of the ways in which they can be avoided.

*(Paragraph 113)*

That the provincial governments establish, after consultation with the government and with NACOEh, those hazards for which more specific regulation of exposure levels is required, and for which constant and detailed monitoring of existing conditions is mandatory. Any industry handling designated hazards should be required to ensure adequate and effective communication to their work force and to provide close medical surveillance.

*(Paragraph 117)*

That Workmen’s Compensation Boards be obliged to publish: statistical breakdowns of claims for work related diseases; diagnostic criteria used in identifying work related diseases; and the criteria or rules used when adjudicating claims for compensation. This would be of immeasurable help in surveys of work-related diseases and would help to provide a better informed basis for appealing a Board’s decision.

*(Paragraph 118)*

That it be an important role for the federal government, through its Department of National Health and Welfare and Department of Labour, to facilitate

some general uniformity of diagnostic standards for the country as a **whole**.

*(Paragraph 120)*

That the provincial governments designate certain industries involved in “high risk” activities as being in a special category and, when necessary, accept responsibility for the medical surveillance of workers in them and for the control of working conditions.

*(Paragraph 126)*

- That provincial policies for occupational health be considered and implemented that and they be instituted in an open and easily identifiable manner.
- That a higher priority be given than is now given, in the area of occupational health, to the medical problems that stem from low-level, long-term exposure to hazards.
- That medical and other appropriate training schools give far more attention to the training of both medical and paramedical practitioners in the general discipline of occupational health.
- That the Medical Research Council, through its granting program, fund biomedical research that is closely related to occupational health. As noted in paragraph 78 we anticipate that this may be achieved by contract funding from NACOEH to the Medical Research Council.
- That a national record linkage system be used to provide information to the pertinent medical practitioner about a worker’s previous exposure to occupational hazards.

# Appendices

## **Appendix A — News Release**

### **NRC Seeking Public Input to a New Study**

#### **Scientific and Technical Assessments of Environmental Pollutants:**

##### **Mercury**

Public comments and suggestions are being solicited by the National Research Council's Panel on Mercury, which is operating under a parent Committee on Scientific and Technical Assessments of Environmental Pollutants. The study group composed of Frank M. D'Itri of Michigan State University, Anders W. Andren of the University of Wisconsin, Richard A. Doherty of the University of Rochester, and John M. Wood of the University of Minnesota has been empaneled by the NRC's Environmental Studies Board at the request of the U.S. Environmental Protection Agency. It will provide EPA with a report that reflects the panel's best assessment of the available scientific and technical knowledge on the environmental health and ecological effects of mercury. The report, scheduled for completion in the fall of 1977, will be used by EPA as a basis for preparing a Scientific and Technical Assessment Report. This in turn will be used as the scientific and technical basis for possible EPA regulatory action.

The report will emphasize assessments of ecological and health effects plus considerations of transport, transformation, and routes of exposure when such are important. Occupational exposure will be dealt with only as it is a factor to be considered in EPA regulatory activity (for example, if there is a cumulative exposure or synergistic interaction involving occupational exposures and environmental exposures). The report will be a critical assessment of existing knowledge which reaches judgments on controversial scientific issues, points to questions on which evidence is inconclusive, and identifies information needs, in order to provide a sounder basis for possible regulatory action by EPA.

Individuals and organizations interested in commenting on the panel's study are asked to submit written statements by February 9, to Adele L. King, Environmental Studies Board, National Academy of Sciences, 2101 Constitution Avenue, N.W., Washington, D.C. 20418. Arrangements can be made for appropriate parties to address the panel at one of its upcoming meetings. Requests to schedule a fifteen-minute presentation should be accompanied by an abstract of the presentation.

Further information describing the panel's charge and proposed course of study can be obtained by writing Ms. King at the above address.

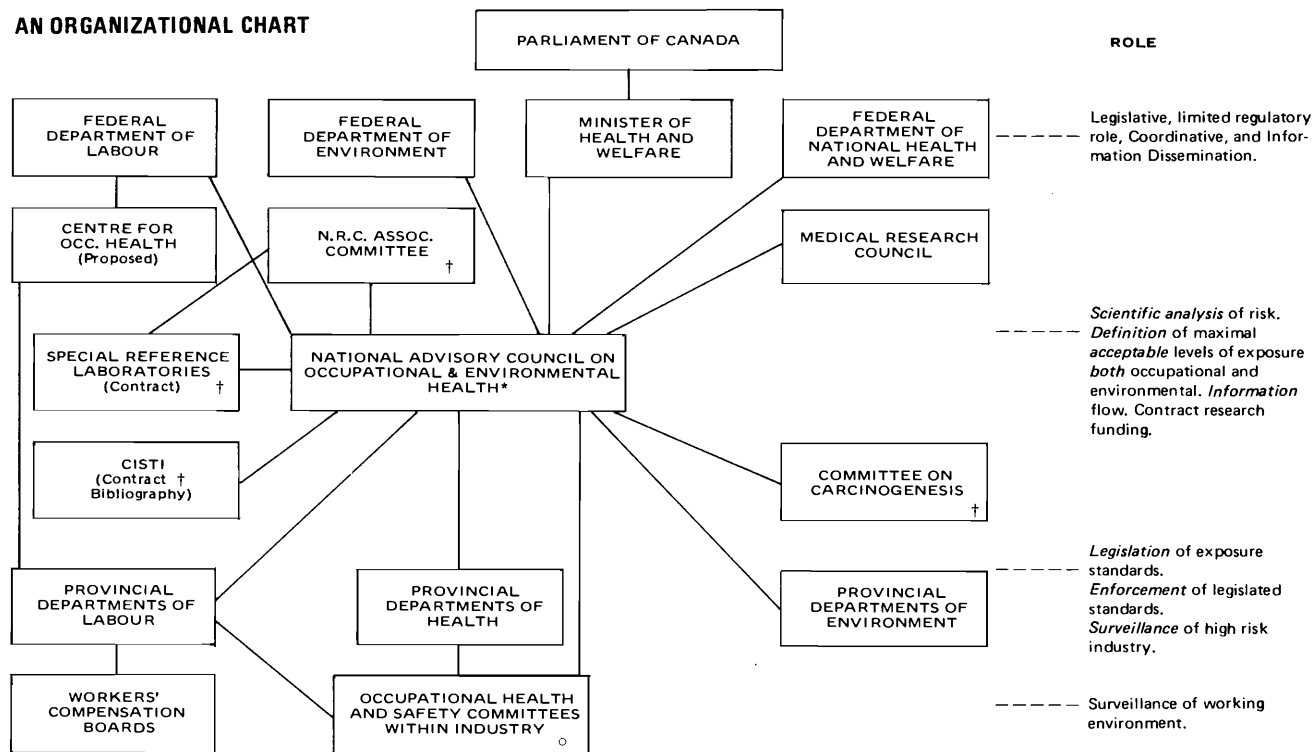
*Source:* U.S. National Research Council, Commission on Natural Resources, Environmental Studies Board, "NRC Seeking Public Input to a New Study: Scientific and Technical Assessments of Environmental Pollutants: Mercury," Environmental Studies Board, Washington, 13 January 1977.

## **Appendix B – A Proposed Organization of Government Agencies Concerned with Occupational and Environmental Health**

Throughout this report we have made reference to leading Governmental agencies and bodies whose mandates are concerned with Occupational and Environmental Health. Further we have proposed the creation of a National Advisory Council on Occupational and Environmental Health, and stipulated various duties for it. The following organizational chart illustrates NACOEH's position within the current organizational framework. It may serve to clarify the complementary roles of government departments and agencies with respect to NACOEH.



## AN ORGANIZATIONAL CHART



NOTES: \* — RECORDS OF NACOEH PUBLIC HEARINGS TO BE MADE AVAILABLE.

† — NACOEH MAY CONTRACT WORK TO BE DONE BY THESE COMMITTEES.

○ — FREE FLOW OF INFORMATION ENVISAGED FROM NACOEH TO ANY COMMITTEE AT THIS LEVEL. SEE SASKATCHEWAN AND ONTARIO LEGISLATION.

## Notes

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## Science Council Committee on the Study of Policies and Poisons

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The Committee wishes to acknowledge the contributions made to the study by the following consultants who provided background studies. The background studies are available on request from the Science Council.

- J. Arnold — Technical Aspects of Vinyl Chloride in the Environment
- R. Assad and  
G. S. Rajhans — Technical Aspects of Asbestos
- A. Barbeau — Early Detection of Chronic Organic Mercury Poisoning,  
(in C. T. Charlebois in this list)
- C. T. Charlebois — Three Perspectives on Mercury in Canada: Medical,  
Technical and Economic
- G. B. Doern — Regulatory Processes and Jurisdictional Issues in the  
Regulation of Hazardous Products in Canada
- R. T. Franson and  
A. R. Lucas — The Legal Control of Hazardous Products in Canada
- L. Giroux and  
P. Kenniff — Legal Aspects in Quebec
- J. F. Jaworski — Mercury: The Analytical Process, (in C. T. Charlebois  
in this list)
- R. E. Jervis — Lead as a Man-Made Hazard in Canada, Scientific  
Aspects  
— Radiation as a Man-Made Hazard, Scientific Aspects
- P. T. Macklem and  
L. Knight — Biological Effects of Exposure to Oxides of Nitrogen
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- D. MacKay — Technical Aspects of Oxides of Nitrogen
- R. Williams — Government Regulation of the Occupational and  
General Environment in the United Kingdom, the  
United States and Sweden

The Committee wishes to acknowledge with gratitude the assistance provided by those who participated in the Science Council workshops held in connection with this study and by the secretaries of the workshops who prepared overview articles on each contaminant. The articles are available on request from the Science Council.

*Asbestos* (27 September 1976)

D. V. Bates (Chairman), C. T. Charlebois (Secretary), R. Assad, W. A. Bardswich,  
R. Beaudry, B. Belovic, E. Boudreau, M. Brownstein, R. Caton, J. D. Christian,

G. B. Doern, P. Filteau, R. T. Franson, J. Gougoux, L. Juteau, P. Kenniff, L. J. Klump, G. Lagacé, M. Lesage, A. R. Lucas, C. Mainville, W. J. McCracken, G. Ostiguy, P. V. Pelnar, M. P. Perron, N. Plate, G. S. Rajhans, R. Sentes, J.-C. Simoneau, E. Somers, K. Valentine.

*Lead* (31 August 1976)

H. R. Robertson (Chairman), C. T. Charlebois (Secretary), T. D. Armstrong, S. Barton, L. Bithel, M. F. Bonnier, G. Brown, M. Brownstein, J. Cole, W. S. Cotton, G. B. Doern, R. T. Franson, K. Friberg, L. Giroux, J. Horn, J. Jaworski, R. E. Jervis, A. Johnson, M. Kacaba, J. Lees, C. Mainville, M. Marier, W. J. McCracken, M. F. Millson, R. Morgan, H. B. Newcombe, N. Schmitt, G. Schreiber, C. Smith, E. Somers, G. J. Stopps.

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*Oxides of Nitrogen* (28 September 1976)

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*Radiation* (1 September 1976)

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*Vinyl Chloride* (6 July 1976)

N. Reimer (Chairman), J. Basuk (Secretary), J. Arnold, P. Belanger, L. Bithel, D. A. Brooks, M. Brownstein, J. E. Brydon, J. H. Currie, F. Delorme, G. B. Doern, J. Duranceau, R. H. Elfstrom, G. G. Evans, R. T. Franson, L. Giroux, R. Hayter, P. Kenniff, A. R. Lucas, G. Markle, W. J. Martin, W. C. McCallum, W. J. McCracken, B. Munro, M. J. Phillips, S. Post, B. Punnett, D. B. Robinson, S. Sullivan, G. Thériault, P. Toft, H. B. Wallis.

*Public Policy Decision Making*, a special seminar held in conjunction with the 60th meeting of the Science Council (11 February 1977)

Principal speakers were: Sir Brian Flowers, Chairman of the U.K. Royal Commission on Environmental Pollution; Dr. Morton Corn, Past Director, U.S. Occupational Health and Safety Administration; Mr. K. L. Johnson, Acting Assistant Administrator, U.S. Environmental Protection Agency responsible for implementing the Toxic Substances Act.

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