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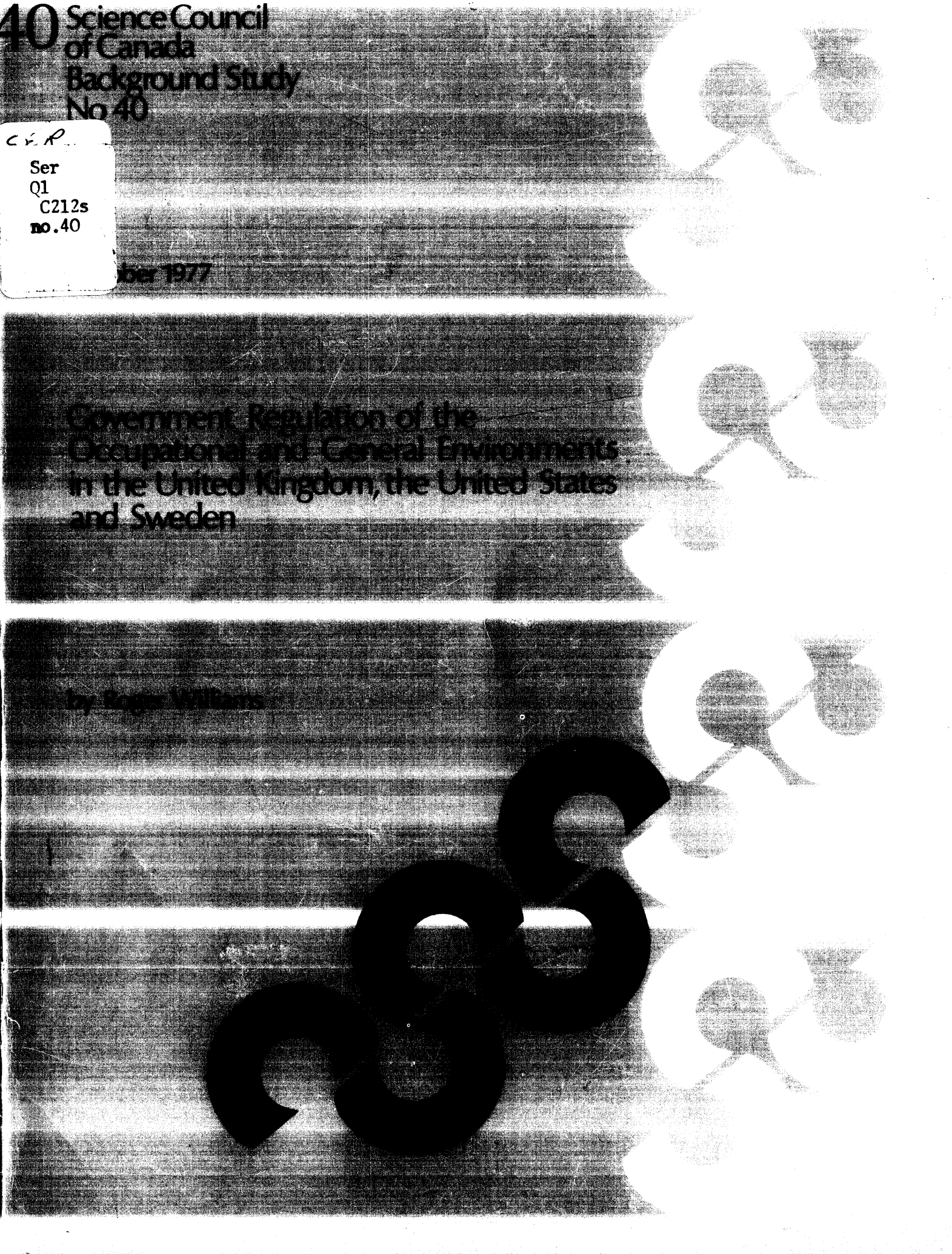
Government Regulation of the Occupational and General Environments in the United Kingdom, the United States and Sweden

by Roger Williams



GOVERNMENT REGULATION OF THE OCCUPATIONAL AND GENERAL ENVIRONMENTS IN THE UNITED KINGDOM, THE UNITED STATES AND SWEDEN

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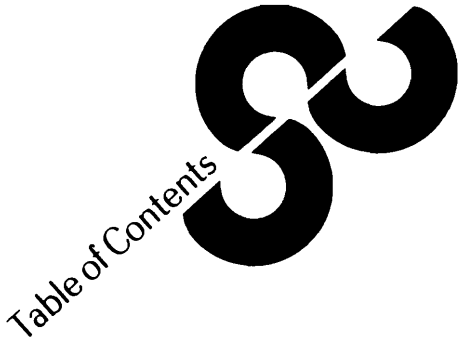

FOREWORD

The Background Study examines how the governments of the UK, USA and Sweden regulate and control exposure to human health hazards, both in the occupational and general environments. It is part of the background material which was commissioned during the course of a Science Council study dealing with this problem. It provides the reader with an indication of how these problems are perceived and dealt with elsewhere and enables comparisons to be made with the Canadian approach. Limitations of time and resources dictated that only these countries could be considered.

All three countries are highly industrialized, with the concomitant problems of industrial pollutants. Their governments differ in style and approach, reflecting the socio-political values indigenous to their societies. All three share similar concerns about exposure to industrial hazards. Sweden has long recognized a problem with mercury. All three are concerned with exposure to radiation as part of nuclear development. Vinyl chloride was recognized as an important occupational hazard in the UK and the USA; the UK has a long history of concern with asbestos. Air pollution has been a common problem. New, albeit differing, approaches to controlling the ever-increasing plethora of chemicals entering the environment have been instituted by their governments. These are but a few examples of the commonality of problems and approaches.

This Background Study is being published to provide members of the interested public and students of international affairs with a pertinent reference. It is one of a series that, we hope, will shed light on the problems associated with exposure to long-term human hazards.

As with all background studies, the analysis and conclusions are those of the author and do not necessarily reflect the views of the Science Council of Canada.

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CHAPTER I - SOME GENERAL OBSERVATIONS

The practical difficulties involved in producing this study can be usefully illustrated by means of two quotations from official sources, one referring to the general environment, the other to the occupational one.

1. "We had hoped to be able to make some comparison of the effectiveness of the system of control of air pollution in the UK with that in other countries but we have been surprised to find that the necessary information is not readily available... We recommend that the Department of the Environment should initiate such a study, possibly through an international organisation such as OECD".
   5th Report of the UK Royal Commission on Environmental Pollution, Cmnd 6371, para 141, January 1976.

2. "The Commission observes that it is difficult, and in certain cases impossible, to compare the limit value lists of different countries. On the other hand, the international exchange of information is of great value to work on the definition of limit values".
   Summary of the Final Report by the Commission on the Work Environment (SOU 1976:1)
   Stockholm 1976, p. 465

The present study is concerned, in other words, with what one Commission found to be impossible to do for air pollution in the general environment, and the other found to be partly impossible to do for hazards in the occupational environment. It is hoped that it will be judged with this two-fold complexity in mind.

It would really be impossible in a study of the present kind and length to review in detail, let alone analyze, the political, legal and technical features of standard-setting and regulation in respect of six deliberately very different hazards in two environments and three countries, at the same time trying to give a reasonable picture of each country's general approach. The aim instead in this study has been to throw as much light as possible on the philosophy and practicalities of environmental and occupational regulation in general in these countries, and to do this in part by making particular reference to the six selected hazards with which the main

Science Council study deals. The boundaries of the study were in principle incapable of being precisely defined, and in practice were determined by continuing subjective judgements as to what was important, and by time.

It has not been possible to treat the countries concerned in an exactly similar, comparative, fashion - their differences are simply too great to permit this. Nor has it been possible to deal equally with each of the six hazards, both because the countries themselves have not dealt equally with them, and because the information to hand tends to be different in kind and unequal in amount. Radiation, asbestos, lead and vinyl chloride (in about that order) would have been fully deserving of comparative studies of their own; mercury and oxides of nitrogen only a little less so. In some cases (asbestos[1], mercury[2], radiation[3]) comparative studies of one sort or another have in fact been undertaken in recent years.

It is noticeable that, of the six selected hazards, mercury and NO_x are currently of greater environmental than occupationalsign ifi-cance; for vinyl chloride the reverse is true; and asbestos and lead are major hazards in both contexts. Radiation is really in a class apart. One might perhaps say in this case, although not all nuclear critics would agree, that the hazards are mainly occupational, unless and until the possibilities of accident or deliberate disruption are allowed for, in which case the risks become environmental, and catastrophically so.

In the remainder of this section a few general points and conclusions which emerged in the preparation of the study are itemized. They should be regarded as indicative rather than exhaustive.

Continuity of Hazard

It is administratively convenient to distinguish between the general and occupational environments, and most countries do this. A further subdivision of the former into air, water and land follows naturally. In reality, of course, the occupational and general environments are quite closely related, and air, water and land pollution are certainly so. Thus, methods to reduce contamination of the workplace can easily increase the pollution of the immediate outside environment, or a contaminant may be carried home in workclothes. Similarly, spraying or washing of stack gases to reduce atmospheric emissions produces polluted water, and this must either be released or else be allowed to settle and evaporate, in which case a solid waste results. This in turn, unless it is converted by a suitable process into a harmless form, must be land-dumped. And land-dumping

has tended to be the least well-regulated form of pollution in most countries.

It is also taken for granted that the level of risk from a specific hazard must necessarily be higher in the occupational context than in the general environment. But how much higher is it acceptable or accepted that such a risk should be? And how far can the extra risk be offset by more meticulous handling and by enhanced medical surveillance, for example? In this respect, the nuclear industry, even in the United States, has a much better record than the chemical industry, and the nuclear industry in Britain has been especially good. The conclusion to this is that while administrative divisions must be made, they should not be rigid, so that hazards can be tackled as best befits their nature, and not simply as a consequence of the context in which they happen to arise. One might add that as well as the occupational and general environments there is also the micro-environment of indoors, the environment in which one can encounter asbestos from air-ducts, noxious sprays, insecticide strips, etc. This probably deserves substantially more attention than it has received.

Quality Standards vs Emission Limits

Environmental hazards of the kind discussed here can be regulated in essentially two ways; via general quality standards or via specific emission standards. The latter is a prerequisite of the former, whether or not general quality standards have been established.

Each approach has its advantages and drawbacks. General objectives, if they can be achieved, give better assurance that an acceptable level of health and environmental safety is being attained within a given region. On the other hand, it is difficult to avoid the element of arbitrariness which general restrictions cause to be placed on particular sources of pollution. If these restrictions, on the other hand, are determined by the application of specific emission standards, it is in principle possible to be both more just and more rigorous in their establishment and in their enforcement. There are, after all, a limited number of types of stationary sources of pollution, and mobile sources can be handled centrally by placing responsibility on their manufacturers. In this case, however, there is no guarantee that uniform general standards will be attained, rather the reverse in fact, unless the emission standards are adjusted to reflect local circumstances, but in that case national or regional uniformity and fairness may be lost.

It should be noted that there is considerable debate about what international commercial practice really requires in terms of harmonized environmental policies and harmonized standards. One OECD comment is worth quoting, more for the exceptions it allows than for the rule:[4]

> "It would seem undesirable as a general rule to harmonize emission and process standards internationally, especially as their nature requires them to be varied according to area".

The exception made by this OECD report is for persistent toxic chemicals.

Emission Standards vs Best Practical Means (BPM)

A major issue in relation to emission controls is whether more or less rigid standards are or are not better than an approach based on the lines of "best practicable means/best available technology" (bpm/bat). Rigid standards have the appeal that they are clear and unequivocal, so that the general and affected publics can be in no doubt about the frequency and seriousness of violations, or about the determination and ability of the control authority to deal promptly and effectively with such violations. Further, if they are national standards, there is a sense of uniformity which might appear commercially fair, and which might also give the impression that the country is concerned as a whole to respond to the best international practice. On the other hand, such standards cannot easily accommodate to local circumstances, so that they may prove to be too tough for some situations, too soft for others. Then again, they may require an essentially arbitrary allocation of restrictions among different types of sources of pollution, and they may come to be regarded as objectively "safe" and "acceptable" limits. They also almost inevitably mean more direct conflict with industry. Conflict can also arise with bpm, but is usually then much less severe and continuous. Rigid standards may in addition have economic and other consequences which are not fully revealed until they are actually in force. If they are then weakened to allow for these consequences, the authority of the control body is diminished, the law may be brought into disrepute, and the public may be left feeling cheated.

Bpm too is not without its problems, in particular, the uncomfortable feeling can arise that it is only a convenient disguise for collusion between the control body and those nominally being controlled. But if the possibility of this can be demonstrably removed, bpm does have the advantages that it can be highly sensitive to local conditions and to technological development. It is also

comprehensive enough to ensure that every aspect of an industrial activity can be included and reviewed. It can also distinguish between accidental and systematic failures of control arrangements. Bpm is evidently quite unsuitable when the consequences of failure, whether accidental or systematic, are catastrophic or very severe, e.g. as with major radiation incidents. It is also inappropriate when there is no fundamental difficulty in the way of establishing uniform conditions - the situation which most usually applies to the occupational situation.

If the bpm approach is adopted, every element of it evidently needs to be publicly justified and subjected to regular review, and pressure should always be exerted by the responsible authority to improve it. This is very much easier said than done: what really is technically possible at any given time, who shall say what is possible at reasonable cost, and for how long is a given bpm to be technically, legally, and economically justified? In using the bpm approach it is also easy to see that there can be a real difficulty in determining whether a specific unsatisfactory level of pollution is due to an inadequate bpm, or to a sound bpm inadequately enforced.

Bpm can, it should be noted, contain specific emission guidelines/objectives/limits, as appropriate. A recent OECD publication has in fact suggested that "it has come to be recognized that the two approaches are not in conflict but can be complementary", citing Australia as an example of a country which has managed this with respect to air pollution.

Radiation Standards

It is very apparent that radiation standards in the three countries considered in this study, and indeed in most others, are on a quite different basis from those for any other hazard. This is because, for more than fifty years, radiation has been well understood to present a hazard different both in kind and in gravity from that resulting from any other chemical or physical source - though it has recently come to be understood that the dangers of certain chemicals with cmt potential may not be all that different in seriousness from the dangers of radiation.

The special dangers of radiation having been recognized everywhere, the creation of an international mechanism for coping with them was an unusually straightforward development. Thus it is that the International Commission on Radiological Protection (ICRP) enjoys unique prestige, its reports and recommendations forming the basis of radiobiological standards throughout the world. Naturally,

the enforcement of radiation standards can differ quite widely from country to country, and the ICRP standards themselves may be revised from time to time. But in the case of this hazard at least, there is an international guideline which reflects the majority professional opinion. Because eminent radiobiologists from all over the world participate in ICRP committees, ICRP recommendations are in fact close to being international consensus standards.

What is now the International Commission on Radiological Protection was formed in the 1920's and fully restructured in 1950. Its various radiation protection recommendations form the basis for the regulations, norms, standards, codes and laws issued by other international organizations as well as by national governments. Among these other international bodies are the WHO International Reference Centre on Environmental Radiation, the IAEA, ILO, FAO, United Nations Scientific Committee on the Effect of Atomic Radiation, ENEA, Euratom, the Standing Commission on Peaceful Uses of Atomic Energy of the Council for Mutual Assistance (CMA) and the International Radiation Protection Association. The IAEA has published Basic Safety Standards for Radiation Protection, the ILO a Model Code of Safety Regulations and a Manual of Industrial Radiation Protection, and the ENEA, Euratom and the Standing Commission of CMA have also all produced radiation protection standards. The main ICRP recommendations are given in Appendix A.

Most non-natural radiation currently experienced by the general population is from medical sources and is presumably beneficial. Some results from fallout, and some, though still very little, derives from planned and accidental releases from nuclear facilities. Now ICRP recommendations can be, and are, interpreted in somewhat different ways by different countries, and the US and UK approaches to planned radiation releases demonstrate this. UK "derived working limits" are calculated from the ICRP standards by endeavouring to trace the "critical route" followed by particular released radioisotopes in the environment, and applying the ICRP figures to the critical group of individuals thus identified, monitoring to ensure these ICRP figures are not exceeded. In the United States, MPCs for water and air are laid down for each radioisotope, and discharged effluent must not exceed these figures at the site boundary, specific monitoring requirements being laid on the licensee.

The long-term adequacy of the UK, US and other approaches and standards in the context of large nuclear power programmes, though obviously controversial, cannot be discussed here, but neither ICRP standards nor their application by particular countries should be regarded as being beyond revision.

Cost Benefit Analysis

Life is unavoidably hazardous and the elimination of man-made risks is therefore a chimera. It would still seem reasonable to suggest that no individual should go in ignorance of the hazards associated with any given circumstance or activity affecting him, insofar as reliable knowledge exists about the nature and extent of the hazard. An immediate problem here is the presentation of what may be highly technical or statistical information in a form which makes sense to the lay reader. This is a problem which for the most part has not been solved.

It also seems reasonable to suggest that the benefits of reducing risk should be broadly commensurate with the associated costs, and that the resulting cost-benefit ratio should be fairly uniform, if not for all risks then at least for similar categories of risk. Many countries formally adhere to precepts of this sort. The case for cost-benefit analysis has been well put by two EPA scientists:

> "a large and increasing number of toxic and hazardous substances enters the environment or appears in consumer products each year... without stringent regulations, or perhaps with no controls at all... Some toxic substances cause known potential hazards... but the majority is not well understood... In view of these informational deficiencies, policymakers face the complex task of setting optimal standards on product content and environmental quality. This problem becomes particularly acute with early warning systems... The limited time horizon for early warning precludes an extensive, detailed analysis of risks and benefits. Yet regulation, to be effective over the long run, cannot rest simply on intuitive decisions or arbitrary preferences. Inherent values and needs of society must be identified and, if possible, quantified in a framework that reveals the major welfare impacts of regulation. There is consequently a need for the development of methods to assess the cost-risk-benefit tradeoffs of alternative decisions."[5]

The hard fact remains that cost-benefit analyses are, at best, objective and society-wide, while the costs and benefits of all possible actions, and of inaction, are experienced for the most part subjectively and unevenly by individuals and communities. Cost-benefit analysis necessarily must put a value on health and welfare, and even on life itself. But how exactly is one to factor

in the discounted value of, say, a small number of excess cancers twenty years hence in a way which is humane as well as technically sound, and which adequately reflects the fact that risks and benefits may not accrue to the same individuals.

It has been said so often that it really ought not to need saying again, but it seemingly does: only accredited decision-makers can be entrusted with taking decisions, and no analytical scheme however sophisticated can substitute for such people. The very best schemes of the cost-risk-benefit kind (but only the very best) can do a useful job of structuring decisions, forcing implicit assumptions into the open, providing guidelines and reference points, revealing the sensitivity between assumptions and consequences, etc., but judgments have still to be made either by individuals or by committees, or through some still more complicated arrangement. Happily, poor analyses and unwise judgments both wither in the light of common sense; it is to that light they need to be brought, lest they flourish in the unchallenging dark.

The Polluter Pays Principle

An OECD Council Recommendation of May 1972 provided, inter alia, for adoption of a Polluter Pays Principle (PPP) in member countries.[6] Exceptions to the principle were contained in a recommendation of November 1974, and documents defining and applying the principle were published in 1975. The essence of this principle is that the polluter should be the first party to pay, albeit he then passes on all or some of his costs. The cost itself would be determined by government and would reflect the blend of preventive and restorative measures decided on, as well as any residual pollution. The principle is concerned with cost allocation rather than with any objective environmental standards, although it is held to be fully compatible with the latter. A variety of means of implementation are available. The uniform application of this principle, it is argued, is essential if a distortion of international trade is not to result. The provision of government subsidies to enhance pollution control is correspondingly a sensitive matter internationally. There are many difficulties with the principle, both of a practical and economic kind - who exactly should pay? how much? and what precisely for? - and of a pragmatic and political kind - why should governments penalise their domestic industries? how can they be sure of acting equitably?

The essentials of the principle can evidently be extended to cover conditions in the occupational environment. The basic argument is that ultimate costs should fully and uniformly reflect all diseconomies (environmental and occupational hazards, etc.). The

main counter-argument essentially asks why, if the market fails to allow fully and uniformly for the diseconomics, this should be done artificially. In deciding between these arguments, some of the points to be remembered are: "the market" has in almost all cases long since ceased to be natural; the operations of the international economy mean that unless diseconomies are treated relatively uniformly, there will be a tendency for hazardous/polluting activities to be relocated where standards are lowest; there is a responsibility on government to place a value on non-material goods where the public at large are unable to do so; the values of health and safety, if not amenity, are only partially commensurate - below some given absolute level of hazard - with economic considerations; there is likely to be only a rough and ready, and therefore controversial, connection between PPP and the administrative practices to which it gives rise; PPP is no substitute for a flexible commonsense, and evolutionary approach, etc.

TLV's, Records, Compensation

It may be that the TLV concept in general, as opposed to particular TLV's, now deserves critical international analysis. Among the many disturbing issues which the concept raises are the following:

- the problem of especially susceptible individuals and classes of people;
- the possibility of long-term cumulative effects, perhaps from different substances, and allowing for synergism;
- the danger of TLV values becoming used, despite warnings, as "safety" guidelines;
- international differences between TLV's;
- the ethical and economic dilemmas of establishing TLVs for substances with known cmt effects;
- the importance to be attached to what is merely offensive as against the straightforwardly injurious;
- methods of setting and revising TLV's;
- methods of testing and evaluating TLV's, and regularity of monitoring.
- the proper legal standing of TLV's.

Two other issues which deserve consideration in this context are medical record-keeping and compensation. Until recently, the establishment of medical records allowing correlation of disease aterns with occupational experience was, virtually everywhere, not taken very seriously. Even in the case of the nuclear industry, where medical standards and surveillance have generally been far better than is normal in more traditional sectors, only in 1968 did the US establish a Transuranium Registry to record the health records

of people exposed to plutonium, etc., and the UK did not begin a similar exercise until 1975. It has now gradually come to be realized that the compilation of detailed occupational health records, their retention for upwards of 30 years, and their availability to genuine investigators are all essential elements in coping with late effect phenomena. Even now, far more attention really needs to be paid to this question.

By contrast, compensation is still a cinderella issue. It is currently under discussion in the UK and Sweden and several important court cases are oustanding in the US. Cases of negligence or bad industrial practice are not the only problem, although if the firm ceases trading before the health effects of its operations become clear, or before damages can be won, then the duty of the state does not become crucial. More disturbing are those instances, and there are very many of them, where the firm adheres to good practice as this is defined at the time, but the hazards in its activities become apparent only much later.

The possibility of compensation is naturally important also to those affected environmentally rather than occupationally. This is most obviously true in the case of industrial accidents and disasters, when the damage and loss caused by a particular plant may be greater even than arises over long periods in the occupational situation. But long-term chronic environmental effects on populations have their importance as well, and are far harder to establish technically and legally for purposes of compensation.

Compensation for occupational and environmental health damage seems deserving of substantially more public debate than it receives. Part of the problem is that the number of people involved in any given case is usually small.

Rates of Response

There has been an enormous growth of concern about man-made hazards, both environmental and occupational, during the last 6 or so years, and this may be expected to continue. The phenomenon is an international one precisely because the problems are international and because the countries of the world, the advanced industrial ones especially, are in close and continuous communication with each other. However, this close communication, through bodies such as WHO, ILO, OECD etc. does not, as perhaps one might expect, always lead to a rapid, simultaneous and uniform response to the same or a closely similar problem.

The particular example of environmental pollution by mercury shows that in this case over the critical time (1960's) there was far from being a rapid international response to the problem. As the OECD report on mercury puts it "The Japanese and Swedish experiences with mercury pollution did not create any general public awareness in Canada and the USA of the potential for similar crises on the North American Continent". However, one might say that there was now reasonable uniformity with regard to appreciation of the risk from mercury, somewhat less uniformity with regard to standards and control provisions generally, and less still with regard to enforcement. By contrast, there does not even now appear to be general uniformity of appreciation with respect to the risks of asbestos, yet there was a rapid and substantially uniform response (at least in intent) to the hazard posed by vinyl chloride. It may be said that the hazards of asbestos have become gradually understood over a long period, while those of vinyl chloride were eventually made clear in a comparatively short period, the case of mercury falling somewhere between the two. Putting it another way, given the increased public sensitivity nowadays to hazards of these kinds, the vinyl chloride danger produced a regulatory response which asbestos has still barely achieved.

There is often a lead country in respect of any hazard - the UK for asbestos, the US for vinyl chloride, Sweden (and Japan) for mercury, etc. Increasingly, one must expect this lead country to be the United States.

The US System

No one who studies the documents and hearings integral (in the 1970's) to the US regulatory process in the case of any occupational or environmental hazard could fail to be impressed. Even the summaries and "signposts" published in the Federal Register represent a very detailed record of rule-making procedures and substance. That the whole is embedded in an intricate framework of administrative law and subject to judicial review encourages still more confidence. This is a mill which can grind exceeding small, but it can also sometimes grind exceeding slow. And, despite all protestations, it is also firmly embedded in as political - and as commercial - an environment as is to be found anywhere in the world. One must further remember that federal arrangements very frequently have their reflections or equivalents at the state and local levels. In some instances the federal picture may even be the least convincing one. Nevertheless, in evaluating compliance, uneven state enforcement must be seen in conjunction with a quality of federal enforcement which itself often falls considerably short of matching the performance achieved in standard-setting. It is certainly hard to resist the

conclusion that in the US regulatory processes for man-made hazards, the highest intellectual effort necessarily being concentrated in the technical and legal areas, this effort is often let down when it comes to policing the resulting regulations and penalising offenders.

Testing Toxic Chemicals

The first two recommendations of the NAS-NRC report, Decision-Making for Regulating Chemicals in the Environment, relate to the burden of proof issue. The NAS/NRCcommitee would place on the sponsor the burden of showing a net benefit to society from a new chemical, and once the Government had made a "reasonable case that the challenged use of an existing chemical creates an excessive hazard", the burden of showing net benefit would in this case too shift to the sponsor.

There is a great deal of international activity on this matter. Switzerland, Japan and Sweden now have toxic substances laws; the US finally succeeded in 1976 after trying for 6 years to frame legislation acceptable to a coalition wide enough to get the law passed, and in the UK the Control of Pollution Act 1974 gave the DOE general enabling powers in regard to dangerous chemicals, including the right to information from manufacturers, and the HSE is also taking action. The OECD has been investigating the subject since April 1974, and the UN Environment Programme 3rd Governing Council meeting took a decision to establish an International Register of Potentially Toxic Chemicals.

It may be that in one or two decades, it will be the present situation which will seem a looking-glass world. The tacit right to the virtually unrestricted introduction of new chemicals has come about for two reasons. First, only recently has the potential gravity of the hazards being released into the occupational and general environments come to be widely appreciated; and second, even with the dangers now apparent, governments understandably remain frightened of inhibiting innovation. As a result, only in limited areas and to a mostly limited extent (food, drugs, pesticides) has regulation hitherto really bitten. An easy reversal of the present order of things can hardly be expected. Fortunately for the rest of the world, because the US is responsible for such a large proportion of new chemical products, all other countries will immediately benefit if the battle is won there, even without action of their own. But they too will then need provisions comparable to those in the US if other chemicals are not to slip through the net, and also to prevent American companies taking advantage of less strict regulation elsewhere, as to some extent they already do.

It is clear that much thought must continue to be devoted to the question of priorities among chemicals to be tested, to the problem of what tests are adequate, to the actual distribution of costs and testing even if the burden of proof issue is settled in principle, to matters of confidentiality, and to the legal difficulties associated with liability, insurance and compensation. Much useful thinking already has been done, and the technical basis exists for more far-reaching legislative action than has as yet been forthcoming in most countries. One 4-year old study, though no doubt open to challenge on points of detail, suggests one attractive way forward.

> "The usual toxicity tests commonly used in most countries for evaluating chemical hazards... are grossly inadequate... It is a most astonishing phenomenon that simple, practically cost-free measures are not utilized... It is unproductive and self-defeating to repeatedly deal with an individual chemical on an emergency basis... A relatively small investment in genetic education and in the development and application of mutagenicity tests can lead to enormous savings in the sums now expended for carcinogenicity and toxicity testing... It is unrealistic to expect that public health will be safeguarded by voluntary agreements".
>
> (Jack Schubert: A Program to Abolish Harmful Chemicals, Ambio, June 1972, 79f).

The Political Context

The sine qua non in the control of man-made hazards is the setting of as clear and specific standards as possible, and the determination to enforce them. The former requires an increasingly sophisticated technical competence to perform the complex research which necessarily underlies such standards, or at least the technical competence to take international standards and apply them nationally. A standard can rarely be simply a numerical datum. Normally, extensive support provisions must be stipulated as well. It may also be necessary to specify in detail what test procedures and instruments are to be employed, the conditions under which they may be used, the interpretation to be placed on the results, etc.

In turn, the determination to enforce standards requires a no less clear framework of law. But there cannot be law unless there is political agreement about its desirability and its substance, and it cannot be enforced unless there exists broad public concern and approval. There is, unfortunately, no simple recipe for political agreement, at least in the western liberal democracies, but there perhaps is one, or at least a partial one, for public concern. It is

the provision of adequate, timely, accurate and relevant information, and to as wide a public as possible. Standard-setting and enforcement needs to be fully accountable if it is to be taken seriously.

The consequences of an authoritative and accountable system can extend far beyond the occupational and environmental sphere.

Wallace Johnson has made the very important point that legislation such as the US CleanAir Act and the Federal Water Pollution Control Act does very much more than simply affect the air or water. As he says,

> "it relocates industry, it changes centres of population, it alters life styles and living patterns, and it touches immediately a broad range of interests, from the aesthetic to the economic... It follows then that the agency that administers statutes of such comprehensive scope is... an agency whose policies, like the statutes it administers, have an impact going far beyond the area suggested by the name of the agency".

Format of the Study

The three main sections of this study deal with the UK, the US, and Sweden. In each case the situation with regard to the occupational context is reviewed first, followed by a similar treatment of arrangements covering the general environment. The most salient developments relating to the six hazards included in the main Science Council study are then outlined. In the UK and US cases one or two aspects are singled out as being of particular interest - the issue of confidentiality in the case of the UK for instance, and concern about cmt effects in the case of the US.

It is the contrast between the UK and the US which emerges most clearly, and only partly because the one is aunitary, the other a federal state. This constitutional difference is in fact of less significance here than in many other cases, precisely because in the regulation of the environment and of the workplace the US federal government has now reserved very extensive powers for itself, while the UK government traditionally has largely delegated the responsibility of execution to local authorities. The UK has built a complex regulatory structure over almost a century, though with benchmark legislation in both the environmental and occupational fields coming in 1974. By contrast, it is in the 1970's that the US has really made great strides. Then again, the UK approach has emphasized consensus and the identification of flexible and reasonable regulatory targets, commonly not tightly quantified,

whereas the US style has accepted confrontation as inevitable, and has also sought to specify objectives numerically and exactly. Partly as a corollary and partly as an independent factor, the legal system in the US has been a much more available battleground for the many interests concerned. In both countries, but again especially in the US, the basic environmental and occupational health issues have in recent years been the subject of much discussion by official and quasi-official bodies; there has been no shortage of reports and recommendations.

For both countries, and for Sweden also, occupational and environmental hazards have acquired a new dimension of political, official, and public importance. They are no longer peripheral matters, or the concern only of specialists and extremists.

CHAPTER II - THE UNITED KINGDOM

The Occupational Environment

State involvement in occupational health and safety in the UK dates from the early 1800's. By the 1970's there were five government departments involved, seven government Inspectorates, nine major Acts of Parliament, and between 500 and 1000 other relevant laws, regulations and codes. Inevitably, the overall situation was impossibly complex and frustrating, both to managements and to government departments and their Inspectorates. In these circumstances, the worker was bound to be the chief loser. The 1950's and 1960's also saw important medical and technical developments in the occupational health field, and many new occupational risks were identified.

In 1970 a committee of enquiry was created under the chairmanship of Lord Robens and in 1972 it reported. The terms of reference of this committee included hazards to the general public arising from the workplace, as well as the more clear-cut considerations concerning occupational health. Most of the committee's recommendations were accepted by the political parties and, in due course, were given legal force in the Health and Safety at Work Act of 1974 (HSWA). The main thrust of the Robens Report was that apathy was the biggest problem, and that although legislation could not substitute for intelligent self-regulation, a comprehensible and efficient state framework was necessary if effective interaction was to take place between those creating risks and those affected by them. The HSAW is of unprecedented significance in the British context and a discussion of some of its key features follows.

The Act created a new Health and Safety Commission, supported by a Health and Safety Executive (HSE). The former has an independent chairman, three union (TUC) nominees, three employer (CBI) nominees, two local authority nominees, and one member from the non-governmental safety organisations. It is independent of government but is, naturally, responsible to Parliament through the relevant Minister. It is charged with supervising the general administration of the Act and has specific statutory responsibilities to promote research, to make proposals for new regulations, and to provide an advisory and information service. The Commission established a major research committee in January 1975; other committees on toxic substances, and medical matters were to follow, as were industry-based committees. The Commission's operational arm is the Executive, but the Commission is not allowed to interest itself in particular

cases which have become the concern of the Executive - only the Minister can do this. The Executive combines the former Inspectorates of Factories, Mines and Quarries, Nuclear Installations, Alkali and Clean Air, and Explosives. It also took over the Safety in Mines Research Establishment and the Employment Medical Advisory Service (EMAS, which was set up under the EMAS Act of 1972: there are now some 100 medical advisers). It thus has some 1400 inspectors and they operate from 18 regional offices. As is explained below the Alkali Inspectorate was not immediately integrated into the new Executive, pending decision on a report by the Royal Commission on Environmental Pollution. The Act aims to encourage a climate in which consultation and consensus further displace legal initiatives, but it also provides for much tougher penalties than existed formerly, and in particular, fines are much higher - in the High Court without limit; for the first time imprisonment up to 2 years is included, and personal liability is in future to be pressed against individuals rather than simply against companies.

For the first time also the general public is to be protected, and there is a requirement that members of the public be properly informed about any hazardous activity which might affect them. It has therefore in effect been accepted in Britain that there should be no sharp distinction between the workplace and the general environment so far as the regulation of hazards is concerned. Indeed, it is recognized that steps taken to minimize risks in the workplace could actually increasethose to the nearby general public, and the Robens Committee specifically criticised the "invisible ring fence" they felt existed between the two. Emissions such as asbestos or lead dust are covered by this new provision, but general damage to the environment is not - that remains a matter for other legislation. The old ambiguity, discussed below, between local authority responsibilities for controlling straightforward emissions such as smoke, and those of the Alkali Inspectorate for controlling more complex emissions, has also not been greatly affected by the new Act.

The scope of the new Act is uniquely comprehensive. It protects some five million employees not covered by previous legislation, and in effect, virtually all workplaces and all people at work are now included. The Act is also naturally an enabling one, leaving the Minister and Commission with broad powers, subject to formal processes of consultation, to establish and, as appropriate, to amend the Act's detailed provisions. The intention is to promote a system which can respond quickly and effectively to future technical and medical developments in the determination and control of hazards. Two main, and traditional, administrative instruments are available for this purpose, Regulations and Codes of Practice. Regulations are subsidiary legislation made under delegated powers and are,

therefore, enforceable through the Courts via the criminal law. It is specifically provided that although the normal enforcing authority is, say, a local authority, the Health and Safety Executive can by regulation override this. Codes of Practice are not legally binding in the same way as regulations. However, a provision is laid down for formal approval of a Code by the Commission, whether the latter itself is or is not responsible for formulating that Code, and such a Code must be admittedin evidence in a criminal case if a breach of a statutory requirement is alleged. Whether or not a Code has been formally approved it is admissible in a civil case at the discretion of the Court. The great advantages of Codes of Practice are said to be that their language can be technical lay as required, rather than legal; that they can arise from consultation among those most affected by them, or most experienced in the matters they cover; and that they can be quickly introduced and revised.

The Robens Committee was in no doubt that Codes were to be preferred to Regulations wherever possible. The heart of the Committee's argument was paragraph 138:

> "Regulations which lay down precise methods of compliance have an intrinsic rigidity, and their details may be quickly overtaken by new technological developments. On the other hand, lack of precision creates uncertainty ... regulations should be confined to statements of broad requirements ... Methods of meeting the requirements may often be highly technical and subject to frequent change in the light of new knowledge. They should, therefore, appear separately in a form which enables them to be readily modified."

In support of this argument the Robens Committee cited the Alkali Inspectorate's similar bpm approach, which it felt had worked well; this is discussed below. And as a second example the Committee mentioned the Technical Data Note of detailed guidance published by the Factory Inspectorate in support of the 1969 Asbestos Regulations. The Robens Committee nevertheless fully recognized that Codes were by no means all equally good.

The HSWA is intended to promote the nomination of safety representatives and the formation of safety committees within companies. There is a statutory requirement that employees be given a company statement on health and safety policies, and an annual directors' report on this subject can also be called for. Obviously, this and the issues regarding disclosure of information to which it gives rise are highly contentious matters. The gulf between the natural suspiciousness of employees and the almost inevitable reticence of employers has, in the past, generally not been effectively bridged by the Inspectorates. The reluctance of the

Factory Inspectorate to disclose information it acquires should be seen at this time as a continuing problem, in that it retains an uncertain amount of statutory protection in the new Act. Under the Act the Commission certainly has very wide powers to compel disclosure and, in specified circumstances, to pass information on to affected parties, provided the information has been obtained directly and does relate strictly to health and safety questions. Whether employees will feel satisfied that adequate and timely information is reaching them, and whether managers will feel more inhibited in future in discussions with Inspectors, only time will tell.

In anticipation of the Act, the Factory Inspectorate began in the early 1970's fundamentally to change its working methods, switching its effort from a concern with safety hardware and reliance on regular inspection, to more flexible and selective attention in depth to situations with high-risk consequences, including particularly those involving multinational companies, an approach said to have involved a new abrasiveness. Thus by 1973 the number of prosecutions increased 50% to 1800, and closure orders doubled - although there were still only 37 of these in 1973, with some 200 threatened in that year. These figures, as the Inspectorate admitted, were "still modest", given the 250-300 000 inspections carried out annually.

The Inspectorate was also by this time giving growing attention to environmental hygiene, especially to carcinogens; tests by its Occupational Medicine and Hygiene Laboratory increased tenfold to nearly 13 000 since the creation of the Industrial Hygiene Unit (IHU) in 1966. "A great step forward in the quantification of risk" was how the 1973 report of the Chief Inspector of Factories described the creation of the IHU. The first steps to enable the Inspectorate to carry out routine environmental monitoring had also been taken in 1966. Toxic samples analyzed in 1973 and 1974 by the IHU included the following:

	Lead	Asbestos	VCM	Mercury	NO_x	Nitrous fumes
1973	3739	2002	-	460		72
1974	2714	1848	958	530		-

The Robens Committee had in fact singled out toxic substances for special consideration. Its worries were that although potentially dangerous chemicals found increasing industrial use, many were not covered by statutory provision; and that co-ordinating arrangements in respect of information about them were inadequate. The Committee consequently recommended a comprehensive system of notification for new substances, binding on both manufacturers and importers, and

suggested the creation of a permanent expert advisory committee. It did not recommend official screening of all new chemicals: the proposed advisory committee would instead keep a special watch on substances whose chemical structures made them suspicious. Progress in the establishment of agreed threshold limit values had until this time been relatively slow in Britain. But following these observations of the Robens Committee and similar ones, as noted below, by the Royal Commission on Environmental Pollution, and in the light of the VCM case, the Health and Safety Executive announced in early 1977 that it would in future require appropriate test information.

In regard generally to environmentally significant chemicals, the UK has become involved in three linked initiatives to promote information exchange:

- its own proposed data network on such chemicals;
- an EEC chemical data and information network; and
- UNEP's international register of potentially toxic chemicals.

The General Environment

Pollution in Britain is mainly controlled by statutory provisions, backed by criminal sanctions, although with certain limited civil liabilities. Individuals also have rights in Common Law, both to compensation and to the granting of an injunction, and there is also one criminal action, nuisance, which the private individual can use. It was stated in a White Paper, The Protection of the Environment, 1970, that

> "The British system of law in this, as in related fields, does not traditionally rely on the very heavy penalty as the main deterrent. It relies rather on persuasion and the belief that, especially to industrial firms, it is the disgrace that counts and not the fine. The weapon of prosecution has in the past been sparingly used. But the government now believe that the present penalties are both incoherent and generally too lax".[7]

This White Paper held that three factors were necessary for enhanced environmental control: better technical knowledge; economic priorities and decisions; a correct legal and administrative framework. It added that:

> "There is also a fourth, and that is the will to do the job. Government can and must give a lead. But success will depend on an increasingly informed and active public opinion".

It should be said in this context that it is not absolutely certain that the traditional style of British legal practice fails to lend itself effectively to chemical hazard control. To a considerable extent the law has not been fully tested by individuals, and it is certainly harder to find environmentally-experienced legal assistance in Britain than it is in the United States. The division in the UK legal system between solicitors and barristers is almost certainly another barrier. The British approach to pollution control is essentially pragmatic in that there are few national standards and the object is normally to ensure compliance with standards judged reasonably practical.

Like the HSWA, the Control of Pollution Act (CPA) of 1974 was a major legislative benchmark so far as the control of hazardous substances is concerned. This Act is being brought into effect in phases as economic circumstances permit, to replace existing legislation. The CPA must be seen in the contextof the very substantial reorganization of local government which has taken place in Britain in recent years.* There are now two tiers of local government. New Water Authorities were also created in 1974. They became responsible for granting pollutant discharge consents, inspection, monitoring etc. in regard to rivers, and for sewage. An important regrouping of central government arrangements in the environmental field had already occurred in 1969-70 with the creation of the Department of the Environment (DOE).

Central government in Britain mostly confines itself to providing the legislative framework within which local and other public authorities operate, and with the provision of advice to these authorities. However, in the cases of agricultural chemicals, radiation, aircraft noise and scheduled industries under the Alkali Acts, control too is central. In Britain central government is well placed to compel local authorities to comply with its directives, not least because it supplies them with more than half the money they spend. Nevertheless, these authorities have major responsibilities in the environmental field, as do other statutory bodies like the Water Authorities, and advisory committees such as that on pesticides and other toxic chemicals.

Scotland and Northern Ireland have somewhat different arrangements for the control of pollution. The Industrial Pollution Inspectorate for Scotland has effectively paralleled the Alkali Inspectorate, working under an agency agreement. Its remit, however, has also extended to water pollution and waste disposal. Some UK legislation applies as it stands to Scotland as well as to England

* England and Wales, except London 1974, Scotland 1975.

and Wales; in other cases closely similar legislation is incorporated in a separate Scottish Act passed at the same time.

The Royal Commission

The Royal Commission on Environmental Pollution was established, unusually as a standing body, in February 1970. The Commission naturally is independent of government, but it can investigate a topic suggested to it by a department, as well as enquiring into any matter which it judges to be important. The Commission is not an environmental ombudsman, and at the outset it deliberately excluded from its purview the occupational environment, which at the time the Commission was set up was already being considered by the Robens Committee. The Commission further decided that it was no part of its function to oversee the work of existing bodies, the Clean Air Council, for example. The Commission began from the position that

> "one of the major causes of excessive pollution is that, given existing legal and institutional arrangements, the free market has not so far provided an adequate mechanism for ensuring that pollution is kept within socially optimum bounds".

The "basic criterion for deciding how much to spend on abating pollution" was held to be cost-benefit analysis. However, the Commission acknowledged the practical difficulties of measuring costs and benefits, the ethical rather than scientific judgments involved in measurement, and the highly political implications of redistributive measures to combat pollution. The Commission also made it clear that it would not expect policy slavishly to follow recommendations deriving from cost-benefit analysis.

Chapter IV of the Royal Commission's first report summarized the overall environmental situation in Britain as it appeared in 1970, and out of this developed priorities. Certain priorities for action were noted, all of them being subjects on which the Government already had authoritative advice at hand. Several problems already receiving attention from other bodies were noted:

(a) air pollution, where there were reports from the Warren Spring Laboratory on the National Survey of Air Pollution; a research survey by the National Society for Clean Air; a need for the adaption of abatement techniques to specific industries, as noted by the Alkali Inspectorate; and work on the long-term effects of motor vehicle emissions being undertaken by the Air Pollution Unit of the MRC;
(b) disposal of solid wastes on land was being studied by the Warren Spring Laboratory and the Working Party on Refuse Disposal, and there

was already a disquieting review by the Technical Committee on the Disposal of Solid Toxic Wastes;
(c) agricultural pollution was a matter for the Advisory Committee on Pesticides and Other Toxic Chemicals, the Nature Conservancy, a Farm Wastes Disposal Committee, and the Agricultural Advisory Council;
(d) freshwater pollution was receiving intensive study, e.g. from the Central Advisory Water Committee, the Water Resources Board, and the Working Party on Sewage Disposal;
(e) sea pollution was the subject of international activity, and noise pollution was under study by the Noise Advisory Council.

Two of the six problems singled out by the Commission for its own further studies were general: the economics of pollution control, and the qualifications of pollution control personnel. With regard to the other four, the Commission decided that it would immediately study estuarial pollution; that it regarded an early examination of monitoring arrangements as important to decision-making; that the voluntary arrangements for controlling pesticides needed to be appraised with a view to making them mandatory; and that the control and disposal of radiation waste should be surveyed.

The Royal Commission described its second report as a "consultative document" and in it were raised three questions which the Commission wished to have publicly aired. First, the Commission had been struck by the "insistence upon confidentiality" about the release into the environment of industrial wastes. This confidentiality, the Commission noted, was statutorily guaranteed, the object being to protect commercially useful information. The Commission thought this defence to be no longer valid, essentially its "only value" now was to protect industry against Common Law actions. It was in the public interest that information about wastes be generally available, rather than confined to statutory bodies. Public confidence about industrial concern for the environment would be strengthened if the "needless cloak of secrecy were withdrawn". The Commission had no doubt that the pressures for disclosure would continue to grow and cited with approval the section in the American CEQ's 2nd Annual Report dealing with the citizen's right to know. This issue is discussed further below.

The second issue on which the Commission in 1972 wanted immediate public discussion was the need for an "early warning system" in respect of the environmental impact of new commercial substances and the wastes involved in producing them. Again the CEQ's Report was quoted, this time with regard to the reversal of the traditional attitude of "innocent until proved guilty", which the CEQ had felt was occurring in the US. The Commission's view on this was very illuminating:

> "a literal interpretation of this attitude would be unrealistic. A manufacturer cannot 'prove' that a product is safe before use, because its danger may lie in long-term effects which only time would disclose... such a burden... would certainly inhibit desirable technological innovation; indeed it would be against the public interest..."

The Commission had in mind instead toxicological tests of the sort already used for pharmaceutical products, pesticides, and food additives, and thought they might be extended to, for instance, heavy metals likely to become combined with organic radicals, fat-soluble stable chemicals, and stable chlorinated components and chelating agents. The Commission thought there should be a category of substances regarded as being "under suspicion", those marketing them being responsible for monitoring and announcing their environmental impact. Two considerations, other than toxicity, which it was said should influence decisions were the production scale envisaged and the likely uses of a product. The Commission understood the Government to be in discussion with industry on this matter, and did not advocate "indiscriminate extension" of an early warning system to all new products (a "needless burden"), only to those which were naturally under suspicion. The Commission was also thinking in terms of a "voluntary scheme", and hoped as well for an international data bank on correlations between chemical structure and environmental impact.

The third urgent topic raised by the Commission in its 2nd Report was the land disposal of toxic wastes. A Technical Committee on Disposal of Toxic Solid Wastes, appointed in 1964, had reported in 1970. Its report had revealed a serious gap but had received little publicity. In any case, the Commission felt that the Committee had understated the seriousness of the position and the need for urgent action. Liquid effluents discharged to sewers and rivers were mostly subject to rivers and public health legislation, and incineration of wastes to control under the Alkali and Clean Air Acts. But local authorities had no duties either of collection and disposal or even of voluntary control, with regard to the land tipping of toxic wastes; neither the public health nor the planning laws were up to the task.

> "Indeed, the success of the development in the UK of statutory control of air and water pollution has led to an anomaly, namely, that some of the more highly toxic waste materials produced by industry go out of the factory gate to be tipped in holes or dumped at sea".

The Technical Committee had recommended a comprehensive new code of law, and a 1967 Working Party on Refuse Disposal had reached a similar conclusion. The Commission was aware that action was

intended by the Government to parallel local government reforms, but did not feel that this amounted to adequate priority and therefore urged, successfully in the event, an interim Act to reduce the public risk.

Confidentiality

The issue of confidentiality, one of the main questions the Royal Commission on Pollution was concerned with in its 2nd Report, also arose in the 1971 report of the Alkali Inspectorate. The Inspectorate then argued that it was fully aware of the need to make information public and of the importance of public pressure in raising standards and improving legislation. But only a relatively few people were said to be capable of properly assessing emission data, and extremists in the environmental movement, and unbalanced media reporting came in for sharp criticism from the Inspectorate. "We must try", the Chief Inspector wrote "to eliminate gulfs and adversary attitudes where they exist." He had written similarly in 1967 that "abating air pollution is a technological problem... great care has to be exercised by all to prevent the development of adversary attitudes."

The official response to the Royal Commission's requests for openness was a report by a Working Party of the Clean Air Council. Ironically, there were criticisms of the limited opinions this committee itself obtained. The committee concluded that there was "no single, comprehensive, recognised source of information", the "principal authoritative sources" being the Alkali Inspector's reports and Environmental Health reports by the Association of Public Health Inspectors. There was "need for local information... carefully considered and presented to the general public in proper perspective..." However, lest an industrialist, by supplying information, lay himself open to legal action "specific provision should be made to incorporate in clean air legislation the principle that only those responsible for enforcement... should be able to take criminal proceedings." Naturally, it would "clearly not be desirable to seek to prevent private persons from bringing civil actions for damages..."[8]

Until the position was somewhat eased by the Control of Pollution Act 1974, the law in Britain mostly actively prevented public disclosure by Government bodies of information relating to pollutant discharges, even when those discharges were themselves illegal. This situation had come about partly as a result of a wholly unforeseen, and more or less accidental, general extension of Section 2 of the Official Secrets Act 1911, and partly as a result of more specific provisions in particular Acts relating to pollution.

It meant that even those seriously affected by a pollutant discharge often could not obtain sound information from government sources. And the main intent of these very restrictive provisions was to protect commercial interests. The 1974 Act at last made more information available, and even opened up the possibility of private prosecution.

Local authorities for their part have been generally rather inhibited, partly by tradition, partly by simple lack of information, and partly no doubt by inclination and concern for local employment and economic considerations.

The 3rd Royal Commission Report dealt with estuarial waters: it was noteworthy for the fact that two Commission members produced a minority report setting out the case for tackling pollution in part by means of a system of charges.

A reconstituted Commission further refined its terms of reference in its 4th Report. The Commission's experience by now was that

> "It is usual to find that any aspect of pollution that appears to give cause for particular anxiety is already the subject of active investigation by some official body".

The Commission therefore saw itself as a "watchdog body" and did not expect normally to have to concern itself with immediate problems demanding urgent action. The Commission naturally welcomed the new Control of Pollution Act, but was concerned that its general reservation of powers to the Secretary of State should not frustrate publicity at the local authority level for pollution information. The "best practical means" approach traditional to Britain was commended and it was acknowledged that the alternative approach of statutory limits could be inflexible and wasteful. Nevertheless, the Commission noted that certain EEC countries employed the latter approach and the Commission's members expected themselves to have to consider it further in an enquiry into air pollution. The EEC Community Action Programme on the Environment adopted by the Council of Ministers in July 1973 was approved, and the Commission noted that the UK was now bound by several relevant EEC directives, for example, those specifying levels and measurement methods for motor vehicle emissions.*

* It may be mentioned here that an EEC draft directive on air quality objectives for SO_2 caused New Scientist to comment in 1976 that "Whitehall has been moving steadily if nervously towards air-quality objectives for several years". The movement remains slow.

The Alkali Inspectorate: BPM

The Alkali Act of 1863 required all alkali works to condense 95% of their HCl emissions. An Inspectorate was created as a result of this Act. A second Alkali Act of 1874 introduced the concept of the "best practicable means" (bpm) to prevent noxious emissions, and further Alkali Acts of 1881, 1892 and 1906 added new categories of plant. The 1906 Act established "scheduled processes" which had to be licensed. This involved, and still involves, their meeting requirements laid down by the Inspectorate, unless the plant is an existing one but the process a newly scheduled one. The 1906 Act created only four specific emission standards, plants having otherwise to use bpm to prevent or render harmless any noxious emissions. By 1972, 2170 plants were covered under 60 separate schedules, the balance having swung from local to national control following a 1957 Public Inquiry at which the industrial lobby vigorously opposed increasing the powers of local authorities (LA's). The Inspectorate nevertheless remains very small - 42 members at the end of 1974 - so that their districts are very large and inspection of a given plant is relatively infrequent.

In 1973 the Alkali Inspectorate was represented on British Standards Institution committees; 11 regional Clean Air Advisory Councils; the Chemical Society Environmental group; the Clean Air Council and Panels; 5 interdepartmental committees (including Lead Works Emissions and Warren Spring Laboratory Research Review); 5 international organizations; 28 local Liaison Committees; the National Society for Clean Air; 8 Working Parties; plus various other self-initiated committees. About 14 000 visits and inspections were made, with more than 2000 quantitative gas analyses and almost 2000 samples being taken. Some 300 of those visits were to unregistered works, on an advisory basis only, to assist LA representatives. The Inspectorate has clearly been spread rather thinly. Its essential mode of operation has remained the same for almost 100 years, and the term Alkali was retained in the name of the Inspectorate long after it had ceased to be relevant.

The essence of the Inspectorate's approach throughout this period was a reliance, first, on persuasion rather than punishment, and second on the concept of bpm. It has been the Inspectorate which has defined bpm, taking into account public demand, the economics of the industries concerned, and the national interest. The bpm concept was set out in Section 7 of the Alkali Act, but "practicable" is defined only in Section 34 of the Clean Air Act (and in the Control of Pollution Act 1974), and it is to this definition that the Inspectorate has worked, although the provisions of the Clean Air Act did not actually apply to the Inspectorate. The elements of bpm are

costs, the state of the technology, and local conditions. Bpm was said by the Inspectorate in 1973, to turn on (a) standard-setting etc.; (b) prior approval of appliances; (c) routine inspections; (d) legal action where necessary. It was in two parts, prevention and dispersion, with the latter being considered only when the bpm of prevention had been applied.

Almost anything could in principle be regarded as coming within the scope of bpm. The Inspectorate would usually regard compliance with voluntary standards, known as "presumptive limits", as demonstrating bpm, and even a failure to meet these might still be found acceptable. On the other hand, the Inspectorate has maintained that it does not hesitate to take legal action, but insists that legal action cannot solve technical problems. A Private Member's Bill containing tougher legislative provisions failed in 1973; it had not, the Chief Inspector wrote, been in keeping with the Inspectorate's traditions.

The Inspectorate has thus found itself concerned with industrial profitability, and specifically with the balance between this and the technical possibilities for pollution improvement. Local conditions which might, for example, have led to tighter standards for an especially polluting plant or group of plants, have not in fact been greatly influential with the Inspectorate, a single emission standard normally applying to each class of plant, and only the prescribed chimney height (to lower the concentration of emissions) varying with plant size.

Inherent in the Inspectorate's policy has been the thesis that "there are no such things as harmful materials, there are only harmful concentrations". The Inspectorate's powers are unusual internationally precisely because they have involved inspectors in an intimate knowledge of the relevant industrial processes, and because the Inspectorate has been given as much autonomy as possible. The Chief Inspector wrote in 1969 that

> "In the international field, comparisons of standards of emission are frequently quoted which are far more stringent than those in Britain, but... only rarely are the tough standards being achieved in practice... We believe in the setting of realistic standards, easy of interpretation and measurement".

In 1973, he described the implications of the polluter pays principle as "mind-boggling." His view then was, "Why replace the existing simple, effective system with a complicated, unproven theory?" On the other hand, he did agree that "one needs to live with (bpm) and use it regularly, like a good system of contract bridge played with a co-operative partner, in order properly to

understand all its nuances." Among its great advantages were that it could be altered at will by the Chief Inspector to reflect technological advances, or, to some extent, changing public demand.

The development of standards in association with bpm has been a matter for the Inspectorate, the plant management and any research association of which the company might be a member. No independent body, for example representing the public, has been involved. Even for its presumptive standards the Inspectorate has generally had to rely on industry to do its own monitoring. It has even asked no more, on occasion, than measurements once a year. Industry has furthermore been under no legal obligation to develop techniques for controlling its pollution, and the Inspectorate has thus felt that it had to encourage such expenditure. The Inspectorate has also normally allowed a substantial period for compliance with any new standard, sometimes longer than industry itself has sought, and has regarded any plant which met its requirements as having the right, subject to necessary maintenance, to an economic life. The Inspectorate thus in effect has allowed plants to work to old standards until their abatement equipment has come to need replacement. The Inspectorate has aimed broadly for uniform standards within an industry, and provided it has adjudged bpm to have been used, has thrown its weight behind the plant management in the case of public complaint. Bpm, however, has had no legal standing and in principle the Inspectorate could always insist on specific safeguards in the public interest.

Views on the Alkali Inspectorate

A special report on the Alkali Inspectorate was published in 1974 by Social Audit, an independent, non-profit making body and the publishing arm of the Public Interest Research Centre. This found that the Inspectorate had much of which to be justifiably proud, but regarded it as essential that the Inspectorate become fully accountable. The frequency with which presumptive standards had been changed (10-15 years) did not demonstrate the need for the flexibility the Inspectorate claimed as a great advantage of bpm. The pride the Inspectorate took in interdependence with industry, refusing to report in detail on the performance of individual plants even when there was no legal barrier, made it particularly ill-suited to its current role.

The Inspectorate was "accustomed to having things its own way", it became "characteristically peeved" when the public ran out of patience, and complaints were met with "an aloof rebuttal". The Inspectorate's expertise was in the technical field, yet it was making economic and political decisions. "Whatever safeguards do

exist for the public in the bpm they are always liable to be lost in the Inspectorate's overriding concern for the economic consequences of its requirements." These apparently harsh conclusions reached by Social Audit were well supported by quotations, taken from the Annual Report of the Inspectorate.* It seemed that the Inspectorate's policy of confidentiality applied to local authorities as well as to the general public. There was also concern that, because the Clean Air Act 1968 had removed even the limited powers of prosecution given by the 1956 Act to local authorities in respect of registered works, the Inspectorate had declined to prosecute in 18 out of 19 cases urged by local authorities. There were in fact only two prosecutions in nearly 50 years until in the mid 1960's, prosecutions against small-time polluters put the number up to around 12: "The contrite offender generally has nothing to fear."

To underline Britain's (former?) very gentle attitude towards enforcement, between 1970 and 1974 the number of infraction letters issued by the Alkali Inspectorate ranged from 25 to 60, prosecutions varying between five and nine. About half of these were successful, the average fine coming out at around £50. Even these figures have to be qualified, since the Inspectorate itself has decided when there has been an infraction, and it has mostly confined prosecution to small-time polluters, especially cable burners. Over the same period, with some 40-75% of LA's reporting, there were each year 2500-3000 contraventions of the Clean Air Acts, leading to 50-133 prosecutions, most of them successful, with fines averaging £30. The Control of Pollution Act raised the maximum fine to £400.

The overall UK organization for pollution control was briefly reviewed in the Royal Commission on Pollution's 5th Report. The Commission felt then that central control was probably essential when the hazard was extremely serious, e.g. radiation, or when highly technical issues were involved. Otherwise, since abatement often depended on the balancing of local interests, the Commission saw the value of local responsibility. Its members were particularly pleased therefore that the Government had asked them to review as a matter of urgency arrangements existing in the UK for pollution control.

The Commission's review began from the Public Health Acts of 1936, 1961, and 1969, the Clean Air Acts of 1956 and 1968: and the stricter Alkali Act of 1906. The power of the Public Health Acts, which is ex post facto, derives from the concept of a "statutory nuisance", enabling local authorities to serve abatement notices, to take action in a lower court, where bpm is a defence, and in the High

* And a subsequent report by the same organization into the Avon Rubber Company itself turned up significant breaches of the Clean Air Act.

Court where it is not, and where failure to comply could lead, and has led, to imprisonment or the closure of a plant. LA's have still more control over so-called "offensive trades". The Clean Air Acts concentrate on smoke, grit, dust and fumes by the regulations established subsequently by various Working Parties. Technical advice, e.g. on chimney heights, is available from the Alkali Inspectorate. When no combustion is involved the LA's must have recourse for control to the Building Regulations. The Clean Air Acts allow LA's, with ministerial permission, to take control of works scheduled under the Alkali Acts, controlling them in respect of smoke, dust and grit, but not in respect of other pollutants. There are now some 450 relevant LA's controlling emissions from 300 000 premises. The LA's have provision for some 6000 Environmental Health Officers (previously public health or sanitary inspectors), although the actual number is considerably below this.

The Alkali Inspectorate, the Commission said, was "intimately involved" with industry; air quality aims were "implicit rather than explicit"; the emphasis was on controlling emissions although the Inspectorate did set general presumptive standards; and while there was flexibility to adapt to local circumstances, bpm could also include much more than emissions. The Commission was impressed with the Inspectorate's "important powers of prior approval", and fully understood that bpm was not "all technically possible means".

The Commission's general comments on the Alkali Inspectorate were especially revealing. The Inspectorate had operated from its 1863 inception "with a remarkable degree of autonomy". Although some claimed that the Inspectorate's relationship with industry was "cosy", the Commission did not doubt that the Inspectorate had generally been a hard bargainer, but "what is clear is that a system operating on the basis of co-operation with industry has a particular need to satisfy the public." Criticisms of the Inspectorate sprang from "real deficiencies in the system", and these largely had their origins

> "in the fact that the Inspectorate have not sufficiently adapted to changes in society's attitude to pollution and to public accountability... to the public whose interests they serve they sometimes appear remote and autocratic. There has been some clumsiness and insensitivity in the Inspectorate's public pronouncements and an air of irritation with those who presume to question the rightness of their decisons."

It was "nonsense" to suggest, as some Inspectors did, that public relations were not their business, and the Inspectorate's policy of not releasing emission data was "misguided". The Inspectorate had, however, sponsored liaison committees bringing in local interests in

some cases, and a Working Party of the Clean Air Council had recommended the extension of this experiment, its recommendations in modified form appearing in the Control of Pollution Act 1974. The Inspectorate had, the Commission felt, been run too cheaply and the coverage possible with its small size was inadequate. Also, although bpm might have a precise meaning for the Inspectorate and industry, to the public it could easily appear as "no more than a verbal formula devised by officialdom to disguise inaction."

The Commission deplored the provision of the HSWA which effectively prevented the Inspectorate from making public emission details from specific plants, and was pleased that the Control of Pollution Act removed the worst effects of this by allowing LA's to obtain the information, which they could then make public. The Commission thought it right that industry should be responsible for the regular monitoring of its emissions, but in addition felt that industry should be encouraged to make the resulting information publicly available, and also that controlling authorities should do more independent testing.

Of LA environmental health departments, responsible inter alia for air pollution from non-scheduled plants, the Commission could say only that their quality was "patchy". It was not always the case that the authorities with the most serious problems had the best staff or the most interested elected members. Approaches also varied, some LA's behaving like the Inspectorate, others believing more in prosecution. There were naturally more local pressures than in the case of the Inspectorate, but this did not always make for improvement. The Commission, like Social Audit, found that relationships between the Inspectorate and LA's were not always good. Formally there was no relationship but as adviser to the Secretary of State, the Inspectorate was essentially the author of many of the circulars, memoranda and regulations sent out to LA's, and LA's were bound to be concerned about registered premises in their areas. There was particular uncertainty as to the powers of LA Environmental Health officers to enter registered premises under the Public Health Acts, and the Commission thought this should be tested in the courts.

The Commission found it impossible to compare the effectiveness of LA's with that of the Inspectorate, not least because the plants controlled by the latter presented the most difficult problems. The Commission did see it as an "important advantage" that the Inspectorate could tackle problems nationally.

It was noted by the Commission that the division of control responsibility between central and local authorities in the case of air was unique, but after much thought the Commission concluded that only a national body could have the expertise necessary to control

technologically difficult processes. It found the bpm approach to be "inherently superior to control by nationally fixed and rigid emission standards", so much so that it recommended the extension of bpm to other forms of pollution. The Commission saw rigid statutory air quality standards as neither wise nor practicable. It nevertheless suggested the introduction for certain air pollutants, including NO_x and lead, of air quality guidelines, not legally enforceable, in the form of bands ranging from a highest tolerable level to a level below which further control action would be unjustified, targets within this band being set by LA's according to local conditions.

The closest co-operation was urged between the Alkali Inspectorate and Environmental Health Officers, and the Commission was concerned at the lack of co-ordination among the Inspectorate, the 459 LA's, 20 Water Authorities and 139 Waste Disposal Authorities. It therefore called for a new Pollution Inspectorate based on the Alkali Inspectorate, which would ensure an integrated approach to industrial pollution at source extending bpm to "best practicable environmental option", and including water and land as well as air.

The Royal Commission's Sixth Report: Nuclear Power

The sixth report of the Royal Commission was published in September 1976. It dealt with the environmental implications of nuclear power and was immediately accepted as making a major contribution to this issue, internationally as well as within Britain. In its investigation of the public policy issues raised by nuclear power the Commission's report discusses inter alia international and national control arrangements for nuclear power, reactor safety and siting, plutonium security, waste management and general energy strategy.

A number of detailed policy and administrative recommendations were made in this report. They included proposals to thoroughly revamp the NRPB so that it would have a statutory responsibility to advise the Government on basic standards as proposed by ICRP and Euratom, and also a responsibility for ensuring the adequacy of environmental research on nuclear power. It was also suggested that the NRPB should periodically publish comprehensive reports on radiation exposure; co-ordinate monitoring activities; extend its register of radiation workers to cover ex-employees; and be responsible for specifying emergency reference levels. The Commission called for a review of NII criteria and methods and identified a need for independent expert advice to the Government on reactor safety. The setting up of a Nuclear Waste Disposal Corporation was advocated, together with an appropriate advisory

committee. Enhanced research programmes involving the Research Councils were proposed, both for land and ocean bed disposal of high level wastes, and also more generally. The resources being devoted to radiological research were described as being "about right", although there was said formerly to have been insufficient co-ordination between the various groups; the quality of the research on radioactivity in the marine environment was thought impressive, but there had been inadequate research on radioactivity in the atmospheric and terrestrial environments, and there was need for continuing research on radioactivity in the natural world as distinct from its effects on man.

Some of the more striking observations of the Commission seem well worth quotation here, both for their own sake and as indicating the overall tenor of the report.

1) At the level of radiation likely to be permitted in relation to possible somatic effects, the genetic effects should be of little concern .... On present evidence the derived standards for plutonium exposure and uptake are not seriously in error.

2) .... we can see no better way of deriving basic standards than by accepting the ICRP recommendations.... but in a matter of such fundamental importance there is need for independent assessment, not least as a safeguard should ICRP members ever come to be determined more by government choice than by professional achievement. (The Commission was particularly concerned that Britain had no expert body with statutory advisory responsibility, the MRC having only a loose responsibility and the NRPB only a peripheral one.)

3) The practical aim of (reactor) design can only be to ensure that the probability of an accident is sufficiently small in relation to its possible consequences... The hazards .... certainly do not appear to us to be unique in scale and of such a kind as to suggest that nuclear power should be abandoned for this reason alone. (The Commission was here accepting that the theoretical calculation of risks could be a proper guide to policy. The alternative, that the real risks would in the event be determined by unpredictable human fallibility, the Commission thought was a view which "pressed too far, would set an arbitrary and unduly restrictive limit on technological development".)

4) ... we should not rely for energy supply on a process that produces such a hazardous substance as plutonium unless there is no reasonable alternative .... a major commitment to fission power and the plutonium economy should be postponed as long as possible, in the hope that it might be avoided altogether.

5) ... it would be irresponsible and morally wrong to commit future generations to the consequences of fission power on a massive scale unless it has been demonstrated beyond reasonable doubt that at least one method exists for the safe isolation of ... long lived, highly radioactive waste for the indefinite future. (The Commission was confident that an acceptable solution would be found.)

6) ... we regard the approach to future energy supplies that forms the basis of official strategy as unconvincing (for technical reasons, and in addition) There ... appear to us to be very considerable environmental objections to the high-nuclear, high-electric, energy future that is foreseen in the official strategy ... It should be the aim of present policy to seek to lessen the possible future need for dependence on FBR's (Fast Breeder Reactors).

7) There is a need ... openly and deliberately to weight the risks and costs of embarking on a major nuclear programme against those of not doing so ... a special procedure is needed ... The ultimate aim is clear; it is to enable decisions on major questions of nuclear development to take place by explicit political process. (The Commission had in mind a process along the lines adopted for US environmental impact statements.)

Occupational vs General Environment

The difficulty of distinguishing the interests of the occupational and general environments is real. It is well brought out by comparing the views of the two UK bodies, the Robens Committee on Safety and Health at Work, and the Royal Commission on Pollution (5th Report). The view of the former was that "where the internal and external problems arise simultaneously from the same technical source, it is not sensible to divide the control arrangements." Since the Factory Inspectorate and the Alkali Inspectorate were concerned "with atmospheric contaminants arising from sources which both must inspect", the Robens Committee recommended that both should come under the umbrella of the new Health and Safety Executive they were proposing, and this was subsequently brought about by the HSWA.*

However, the Royal Commission, recognizing the need for liaison between these two Inspectorates, emphatically rejected the

*At the Commission's request, the Alkali Inspectorate had not been fully integrated into the Health and Safety Executive, as recommended by Robens, pending the Commission's own report.

proposition that there was an identity of interest between workers and the local public. The new arrangement amounted to an "inherent organisational bias against environmental problems." The Alkali Inspectorate was concerned solely with air pollution, while this was a small part of the Factory Inspectorate's responsibilities. The criteria used by the two bodies were also very different: "Levels of pollutants have sometimes to be accepted as concomitants of employment which would be manifestly unacceptable in the external environment" - especially susceptible groups, amenity and damage to agricultural having also to be considered in the latter case. The Commission's view on this question was essentially the same as that of the Alkali Inspectorate, which had felt its attitudes on inspection and enforcement and those of the Factory Inspectorate, to be "far apart".

Asbestos

After 1972, disposal of asbestos waste was regulated under the Deposit of Poisonous Waste Act, which stipulated proper notification of local authorities and of water authorities. Disposal standards were set out in a code of practice issued by the Asbestos Research Council, an industry-sponsored body. The 1974 Control of Pollution Act went further, giving licensing powers to new Waste Disposal Authorities. The DOE's toxic wastes section has been expanded, and a number of working parties with industrial representatives were set up in October 1973 to devise codes of practice in appropriate cases. Only some one per cent of the total waste, it was found, was chemically treated or incinerated. The DOE also now sponsors an Industrial Waste Information Bureau as part of the Hazardous Material Service. This has been operating since 1970, and the Chemical Industries Association have had their Chem Safe system working since 1974. The Royal Commission has endorsed the view of the Working Group on the Disposal of Awkward Household Wastes that local authorities should also do more. Information on poisonous household and industrial chemicals is available to doctors from the National Poisons Centre on a round-the-clock basis.

The UK situation with respect to an asbestos occupational health standard is that the substantive provisions of the 1969 Asbestos Regulations (Regs. 7 and 8) are not applied at concentrations below 2 fibres/mL over a 10-minute sampling period. Requirements for improvement in the standard of control at concentrations above this depend on the actual concentration as confirmed over a 4 hour period. For crocidolite (not imported since 1970 but met with in demolition) a respirator is required at concentrations above 0.2 fibres/mL. A fibre is defined as a particle of length greater than 5 μm

(micrometres) and with a length:breadth ration of at least 3:1, fibres of diameter greater than 3 μm being excluded.

An advisory panel on problems arising from the use of asbestos was created in 1965 to advise the Senior Medical Inspector of Factories. This panel recommended in 1968 a long-term prospective study of the health of asbestos workers, and in 1974 this study was in the hands of the Department of Employment's Employment Medical Advisory Service (EMAS). EMAS is also compiling a register of mesothelioma deaths, and this formed the basis of a 1974 report.

One phase of an asbestos survey being carried out by the Factory Inspectorate covered the larger manufacturers, 5000 workers were examined and 700 samples taken over 4-hour periods. The "most encouraging" results showed that 92.6 per cent of dust counts were below the "very stringent hygiene standard" of 2 fibres/mL. The subsequent phase of this survey dealt with the remaining 3800 workers covered by the 1969 Asbestos Regulations. For this, 400 samples were taken over 4-hour periods at 38 factories, 93 per cent proving to be below 4 fibres/mL and 76 per cent below the 2 fibres/mL standard, a less satisfactory result than had been recorded in the previous phase, as the Inspectorate acknowledged.

The Chief Inspector of Factories reported in 1975 that there were 189 deaths in 1974 associated with asbestos and 139 new cases - figures typical of each of the preceeding 6 years. Given the latent period involved, despite the new legislation of 1970, it must be some years before these figures showed a decline.

The Government announcedin May 1976 that policy with respect to industrial disease generally would be reconsidered following the report of a Royal Commission then expected to complete its work in 1976.

Some 1200 factories are subject to the 1969 Asbestos Regulations, plus of course countless construction/demolition sites, etc. There were only three prosecutions under the 1931 Asbestos Regulations between 1931 and 1970, but 26 in the first 3 years of the 1969 Regulations. In 1974 there were 14 successful prosecutions, several instances involving demolition, and some of the cases putting the public as well as workers at risk, often to crocidolite. The Inspectorate noted that the recommendations of the Joint Advisory Committee Report "Precautions in the Use of Asbestos in the Construction Industry" were evidently not always being followed.

In 1975 the Health and Safety Executive was participating in the work of the International Agency for Research on Cancer, and the US and UK authorities were then described as being in close contact on

asbestos questions. The Factory Inspectorate had also in 1974 hosted an EEC seminar on asbestosis at which comparative legislative practice had been discussed. Government-sponsored research on asbestos was at this time being conducted by the Air Pollution Unit, the Pneumoconiosis Unit, the Clinical Research Unit of MRC, the Cardiothoracic Institute, and the Institute of Occupational Medicine.

The Asbestos Regulations of 1969 apply to all workplaces and, indirectly, protect relatives of asbestos workers by their provisions in regard to the cleaning of protective clothing. The Commission on Environmental Pollution in their 4th Report regarded as unclear the general environmental situation with respect to asbestos and fine-fibred substitutes. There was no environmental risk of asbestosis, and probably none of lung cancer, but the register of mesothelioma cases had been started only in 1962, since when cases had increased from 17 to 80 annually, usually from areas with heavy occupational exposure. The Asbestos Regulations of 1931 and 1969 and the voluntary agreement which had been entered into to ban crocidolite, were important industrial precautions, but the Commission felt that more information was needed about the air near building sites, and also stricter regulations covering asbestos disposal.

As 1972 was Britain's "year of lead", and 1974 of vinyl chloride, 1976 was the "year of asbestos". Concern was triggered by the March report of the Parliamentary Commissioner for Administration (Ombudsman) intoconditions at the former Acre Mill (Hebden Bridge) plant of Cape Asbestos. The Ombudsman had investigated this plant as a result of a complaint forwarded to him in the normal way by the local MP, who in turn had been petitioned by a former employee of the plant now suffering from asbestosis.

A report of this nature was a new departure for the Ombudsman and it seems doubtful that with his limited resources he will continue to have an impact in the area of man-made hazards. In this connection however, it may be noted that the Local Government Act of 1971 provided for local commissioners who can investigate maladministration at the local level.

Although technically limited in his inquiries to recent years, the Ombudsman in fact used the long latency of asbestosis to extend his remit back to 1949, producing a major report which is perhaps the most critical indictment ever made of the Factory Inspectorate. At least 40 employees at the Acre Mill plant are known to have died of asbestosis and the Ombudsman's report makes it quite clear that the Inspectorate's performance at Acre Mill fell considerably short of what might reasonably have been expected. A less noted part of his

report, however, stressed the limited advance between 1930 and the 1960's in scientific knowledge about the dangers of asbestos.

The Ombudsman's criticisms of the Factory Inspectorate were accepted by the Secretary of State for Employment, who responded by setting up an interdepartmental committee, chaired by the head of the Health and Safety Executive and with representatives from both sides of industry, to review the health risks of asbestos in the occupational, product, and general environments, (the MP for Hebden Bridge had wanted a public enquiry). Up-to-date figures were given by the Secretary about the Factory Inspectorate's "radically" different attitude to the asbestos hazard since the period covered by the Ombudsman's report: 51 firms had been prosecuted for contravention of the regulations; 66 prohibition notices and 15 improvement notices had been served under the HSW Act; factory visits were no longer by appointment, except very unusually.

Several developments followed the Ombudsman's report. The Food Additives and Contaminants Committee announced that it would investigate the use of asbestos in its area of responsibility - mainly brewing and vinegar production. There was a series of serious "scare" incidents, parts of schools, hospitals, multi-storey car parks, blocks of flats, etc. being evacuated following the discovery of asbestos hazards, in particular from blue asbestos insulation. A pressure group, Asbestos Action, was set up to promote better regulation, and the Asbestos Information Committee retaliated with a major newspaper campaign ("20 sensible questions you asked about asbestos and health. And the answers"). The latter was judged by many responsible commentators to contain misleading information. An 8-year old confidential report by the Department of Health's standing medical advisory committee, Control of the Cancer Hazard due to Asbestos to the General Population, also came to light at this time.

There was also concern in Britain in 1976 about glass fibre. Following a US NCI report the UK MRC and the International Agency for Research on Cancer in Lyons are understood to be conducting measurement and survey research respectively into this subject.

Lead

The Windeyer Committee, three of whose members were also members of the Robens Committee, was appointed in February 1972 to investigate the circumstances of lead poisoning at the RTZ Avonmouth smelter. There had been growing concern from 1968 to 1972 about occupational exposure to lead at this plant, and towards the end of the period about environmental pollution as well. Over the period, lead readings in the plant had been within the TLV only 43 per cent of the time; up

to 62 per cent of readings had been 10 times the TLV; and readings up to 45 mg/m^3 had been obtained. The Appointed Surgeon* was the Works Doctor, and he had suspended 42 workers in 1969, 17 in 1970 and 40 in 1971. Lead poisonings at the plant notified to the Chief Inspector of Factories were two in 1968, 25 in 1969, two in 1970 and 11 in 1971, with some blood levels up to 220 mg/100 mL. Clearly, here was a very serious problem. The factory Inspectorate "had made repeated representations" to the Company over the previous four years, and had several times considered whether to apply for a Court Order to close the plant, desisting only because the Company "showed itself ready to accept and implement" the Inspectorate's advice.

The Windeyer Committee in its report advocated the concept of "over-exposure" rather than lead poisoning, and it noted that the Chief Medical Adviser at the Department of Employment had recently issued to doctors a supplementary Note of Guidance - "Biochemical Guide Lines in the Surveillance of Lead Workers". The Committee suggested as an interim measure that "particular supervision" should be given to workers with blood lead levels above 80 mg/100 mL, and that they should be suspended if there was "marked or rapid deterioration" in their condition, or automatically if their blood lead went above 120 mg/100 mL. A level of lead in air of 0.2 mg/m^3 had "come to be widely accepted as the upper permissible level of exposure over a 40-hour working week", but the Committee felt further refinement of this criterion to be necessary. The Committee was also firmly of the opinion that information obtained from monitoring lead in air concentrations, and the personal levels of lead absorption as obtained from routine blood tests, should both be made freely available to workers. The Company had previously withheld this information, largely on the ground that it "would be misleading except to a medical expert". Given the precautions which had been taken, the Committee found no general environmental hazard at Avonmouth, but thought "potentially more serious" the hazard from lead carried out of the plant in clothing.

The Chief Inspector of Factories devoted a chapter of his 1972 Report to the lead problem. He pointed out that whereas there had been only one lead poisoning fatality since 1950, general demands "that standards of health for those employed should not be significantly different from that of the general population" had "dispelled any sense of complacency", especially since in the case of lead "the sum of cases of reportable poisonings and reportable suspensions" had remained fairly constant. Measurements and advice had been stepped up following co-operation since 1970 between EMAS

* Under the Factory and Workshop Regulations 1911 for Lead Smelting and the Lead Processes (Medical Examinations) Regulations 1964.

and the Industrial Hygiene Unit (IHU). The legal situation was complicated by the existence of a series of codes covering "many but by no means all" processes. A reduction of the TLV from 0.2 to 0.15 mg/m^3 was foreshadowed.

A lead refinery in the Isle of Dogs had focused public attention on lead in 1971, the problem in this case being environmental rather than occupational, in that blood lead levels of local children were above the national average. The work of the local Medical Officer of Health, of the IHU, and of the Alkali Inspectorate had suggested "very strongly" that contaminated clothing was responsible. Recommendations by the Factory Inspectorate to factory owners had followed. The Inspectorate had also greatly increased the overall attention it gave to the lead hazard, concentrating on 20 major factories; five prosecutions and two closure orders had followed, compared with one and two respectively in 1971. In addition, following the Windeyer Report, a group consisting of representatives from the Inspectorate, the Alkali Inspectorate, EMAS, CBI, TUC and trade associations had formulated a Code of Practice for two major sections of the industry.

Two conclusions which the Chief Inspector drew from the events of 1971-2 concerning lead were first, the need for good communication all round on health hazards, and second, a reinforcement of the view that

> "the approach to control must be quantitative, and that progress is made by the painstaking steps of measurement to identify the source of the hazard, by initiation of improvements based on these findings and by monitoring to check that precautions are effectively being maintained".

Standards in certain sections of the lead industry were still said to be "unacceptably low" in 1973, and even though the number of lead poisionings reached an all-time low of 36 in 1974, the first year of the new code, the Inspectorate continued to insist that there was no room for complacency. A Code of Practice for the lead battery industry was by this time nearing completion, and the EMAS/MRC Working Party on lead, set up after the Windeyer Report, had recommended more research on the consequences of long-term lead exposure.

The Chief Alkali Inspector acknowledged in his 1972 report that lead was "one of the few cases" where there was a "definite overlap of responsibilities" with the Factory Inspectorate. Parallel measures had therefore been taken by the two bodies, "a real drive" being made against lead works, with testing more than doubled. No non-occupational cases of lead poisoning had emerged, however,

although families of lead workers had proved to have statistically significant higher blood lead levels than the general population.

It was noted in the Inspector's 1973 Report that the Inspectorate had assisted the Department of Employment and the Factory Inspectorate in preparing Lead: A Code of Practice for Health Precautions and the DOE its circular Lead and the Environment. An attack on the City of Birmingham authorities for their handling of lead emissions from a battery factory had, in the words of the Chief Inspector, "rightly" come to naught, and some of the several hundreds of works handling lead, but formerly outside the Inspectorate's province, had newly come under it. Results at Avonmouth were still "disappointing".

A bpm for lead was formulated as an appendix to the 111th Annual Report (1974) of the Alkali Inspectorate. It was as usual described as providing a "basis for negotiation... flexibility is left to meet special local circumstances by consultation". The bpm distinguishes three classes of works and lays down emission standards, guides on chimney heights, sampling arrangements etc. For the largest lead works "The aim shall be not to exceed a mass rate of emission of 12.0 lbs/hour." The Alkali Inspectorate stated at this time that there had been a "steady, sometimes spectacular, improvement in emissions from lead works", due to public pressure and the attention paid by the Inspectorate itself.

The DOE circular Lead and the Environment (6/73) was issued in January 1973. It expressed concern at the high blood lead levels found in individuals, especially children, resident near lead-using premises. Local authorities were reminded of the responsibilities of their Public Health departments under the Public Health Acts of 1936 and 1969, and were asked to prepare, if they had not already done so, lists of potential sources of this danger. It was pointed out that the Alkali Inspectorate had responsibility under the 1906 Alkali Act for certain scheduled processes involving lead, and that the Factory Inspectorate had responsibility for the health of lead workers, the latter responsibility extending to the problem of contamination carried outside the plant on the workers or their clothing. LA's were directed where necessary to seek specialist assistance from the corresponding two District Inspectors. The letter issued by the Factory Inspectorate early in 1972 to all known lead-using factories was attached to this circular, and local authorities were also reminded of the circular Environmental Hazards of Lead, sent by the Chief Medical Officer of the Department of Health and Social Security to all Medical Officers in December 1971.

The Factory Inspectorate's letter contained recommendations on the burning of lead-containing materials, personal hygiene, and the

prevention of dust escape. These recommendations were couched generally and had been arrived at after discussion with relevant government departments, the CBI and the Trade Associations. The 1971 circular had called for epidemiological surveys where necessary of people living near lead works.

Lead was the subject of a further DOE circular in 1973 (53/73), and of one in 1974 (115/74). The latter dealt with the report of the Interdepartmental Working Group on Lead in the Environment and its Significance to Man (set up 1972, report published September 1974). This report identified food as the main source of lead absorption in Britain, found the average diet to contain substantially less lead than the provisional tolerable maximum laid down by WHO, but nevertheless asked the Food Additives and Contaminants Committee to review the Lead in Food Regulations (1961). More stringent limits on lead in baby food also resulted from this report.

Most UK water supplies were said by the report to contain very much less lead than the 0.1 mg/L limit regarded by WHO as a tolerable maximum. (A reduction of this to 0.05 was at this time under consideration by both WHO and the EEC.) Plumbo-solvency problems were however said to be still occurring in two parts of Britain, and where chemical treatment was inadequate, replacement of lead piping was seen as desirable, interim arrangements for affected houses being suggested.

With regard to the lead content of paint, the report noted that there had been a statutory limit where toys were concerned since 1967, and stringent new limits on lead pencils, pens, etc. since August 1974. Further, manufacturers had undertaken to label all paints containing more than 1 per cent lead, and an EEC directive was being prepared giving labelling requirements for paint containing dangerous substances. Lead-containing eye cosmetics were a special problem for children of Asian origin and another EEC directive banning lead in cosmetics was also being prepared. Cooking utensils with metal coatings were already covered by UK regulations and others were being prepared in respect of ceramic ware.

It was reaffirmed that there was no evidence that airborne lead amounted to a general hazard, but it had nevertheless been thought prudent to reduce progressively the lead content of gasoline, the reduction planned for the end of 1973 having at this time had to be postponed to November 1974.

Soil contamination was seen in the 1974 report as a threat to children and to crops, but it was stated that no figure could be given for an acceptable level of this mode of risk.

It was somewhat unusual that this interdepartmental committee report was published. It was also rather remarkable how many departments were seen to have some responsibility for lead - the Departments of the Environment; Education and Science; Employment; Health; Trade; Agriculture; and the Scottish and Welsh Offices. The range of permitted lead levels for different purposes which emerged from the report gave rise to partiuclar comment - food 2 ppm (0.5 baby foods); toys 5000 ppm; children's paint 250 ppm; household paint 10 000 ppm etc. The report listed 53 government-sponsored research projects on lead.

The Food Additives and Contaminants Committee reported in December 1975 that while lead levels in the diet were not, on the available evidence, hazardous, the margins of safety were not as great as they should be. The Committee asked for a maximum of 1 ppm for most foods, less for baby foods, and 0.25 ppm for alcoholic drinks. It wanted also an end to the exemptions in respect of fish, and for orchard spraying with lead arsenate to be discouraged. The Working Party on the monitoring of foodstuffs for heavy metals also produced a report devoted to lead, at this time. It emerged from this that two children per year died of lead poisoning in Britain, but also that food was not responsible for these deaths.

The Royal Commission on Environmental Pollution was satisfied in 1974 that no emergency action on lead was called for, although it thought there was no general agreement about the validity of the conclusions in the Central Unit on Environmental Pollution's report on lead. Blood lead levels were similar for urban and rural inhabitants but it was not known if there was a danger at levels intermediate between the existing average (15-35 µg/100 mL) and industrially undesirable levels (80), nor was the effect of inhaling town air at 1-3 $\mu g/m^3$ known. One apparently unimportant physiological change had been discovered at intermediate blood lead levels, but there was no evidence of lower intelligence among children who lived near a lead works.

The 1971 lead in gasoline limit of 0.84 g/L was reduced to 0.64 at the end of 1972. A Private Member's Bill, to eliminate the lead content of gasoline completely, received a second reading in the House of Lords early in 1974, but made no further progress. The gasoline industry agreed voluntarily in 1972 to reduce the lead content of gas to 0.55 in 1974 and 0.45 by the end of 1975. A review was initiated by the Energy Secretary in December 1974 and in the interim the lead content remains at 0.55, the oil crisis having been responsible for the delay. The EEC has proposed 0.4 (1976) and 0.15 (1978). The Commission has suggested the use of lead traps. In May 1975, airborne lead measured at three roadside sampling points in UK

cities ranged from 1.4 to 2.3 $\mu g/m^3$. Arrangements were then being made to extend sampling to 20 sites.

Mercury

The 3rd Report of the Royal Commission on Environmental Pollution, dealing with estuarial waters, contained an appendix which suggested that although the average daily intake of mercury in Britain (25% of it from eating fish) was, at 8 µg, well within safe limits, coastal fish had substantially more mercury than distant waters fish, although at 0.1-0.55 ppm and 0.05-0.1 ppm respecitvely, the figures were still below levels believed to be dangerous. The Commission later observed that government reports on cadmium and mercury in 1973 had mostly confirmed an earlier (1971) report on mercury, to the effect that the population as a whole was not receiving excessive doses. The Commission noted that the 16th FAO/WHO expert committee on food additives had recommended a maximum 300 ug weekly intake of mercury for 70 kg man, not more than 200 mg of this to be methyl mercury. Routine surveillance and other administrative action had been initiated in Britain following the 1971 and 1973 reports of the Working Party of the Monitoring of Foodstuffs for Mercury and Other Heavy Metals.

Two things worried the Commission. The first was groups at special risk, either through unusual diet or because of low body weight (children). The critical group technique had not been applied here as it had in the case of radioactivity, and the Commission urged that this be recitifed where possible. he Commission's second worry was about the unknown long-term and synergistic effects of heavy metals at intermediate concentrations. In reply to those observations by the Commission the government has stated that a study of environmental mercury is nearing completion, and that cadmium is to be examined in detail.

Mercury "scare" stories are infrequent. A serious incident did occur in 1974 when a British firm exported in error to Europe animal feedstock containing the same mercurial fungicide as had given Sweden several problems in the 1950s. Some 80 000 animals were reported as having had to be slaughtered as a result. Mercury was also the subject of special concern in 1976 in the context of school laboratory safety, nominally the responsibility of the Department of Education and Science, but seemingly not subject to very rigorous direction or control.

Biologic Limit Values (BLVs)

Other means exist and may be necessary for monitoring worker exposure other than reliance on the Threshold Limit Values for industrial air, namely the Biologic Limit Values. These values represent limiting amounts of substances (or their effects) to which the worker may be exposed without hazard to health or well-being as determined in his tissues and fluids or in his exhaled breath. The biologic measurements on which the BLV's are based can furnish two kinds of information useful in the control of worker exposure: (1) measure of the individual worker's overall exposure; (2) measure of the worker's individual and characteristic response. Measurements of response furnish a superior estimate of the physiologic status of the worker, and may be made of (a) changes in amount of some critical biochemical constituent, (b) changes in activity of a critical enzyme, (c) changes in some physiologic function. Measurement of exposure may be made by (1) determining in blood, urine, hair, nails, in body tissues and fluids, the amount of substance to which the worker was exposed; (2) determination of the amount of metabolite(s) of the substance in tissues and fluids; (3) determination of the amount of the substance in the exhaled breath. The biologic limits may be used as an adjunct to the TLV's for air, or in place of them. The BLV's, and their associated procedures for determining compliance with them, should thus be regarded as an effective means of providing health surveillance of the worker.

Unlisted Substances

There are a number of reasons why a substance does not appear in the Threshold Limit list; either insufficient information is available or it has not been brought to the attention of the Threshold Limits Committee from which a limit can be developed, or it is a substance that could be included in the Appendices E and F pertaining to Nuisance Particulates and Simple Asphyxiants. Substances appearing in these appendices serve as examples only; the appendices are not intended to be inclusive.

"Notice of Intent"

At the beginning of each year, proposed actions of the Committee for the forthcoming year are issued in the form of a "Notice of Intended Changes". This Notice provides not only an opportunity for comment, but solicits suggestions of substances to be added to the list. The suggestions should be accompanied by substantiating evidence. The list of intended Changes follows the Adopted Values in the TLV booklet.

Oxides of Nitrogen

The 1974 report of the Royal Commission on Environmental Pollution reported that the National Survey of Air Pollution being co-ordinated by the Warren Spring Laboratory had 1200 monitoring stations. Smoke and SO_2 were the main pollutants being monitored, but from 1975 20 stations would also measure heavy metals, and three would measure NO_x. The Commission had already indicated that NO_x and photochemical smog were not seen as urgent problems in Britain. However, another official report in 1974, The Monitoring of the Environment in the UK, did recommend additional measurements of, inter alia, NO_x and heavy metals. The UK has also joined in EEC studies of motor vehicle emissions and their health effects, particularly CO and NO_x.

The Alkali Inspectorate announced in 1974 a bpm of the usual flexible type for nitric acid works. Its twin aims are that "the acidity of the tail gases... shall not exceed 1000 ppm expressed as nitrogen dioxide... The final emission to air shall be substantially colourless." Existing plants are, as usual, allowed to continue to operate to old standards, in the absence of "international agreements or national pressures in the future." The Chief Inspector has stated that it has seemed to him to be getting things out of proportion to demand less NO_x from nitric acid plants than is put out by internal combustion engines.

Motor vehicle emissions in Britain are controlled under the Motor Vehicle (Construction and Use) Regulations 1973, issued under the Road Traffic Acts of 1960 and 1972. Vehicles must be constructed to emit no avoidable smoke or visible vapour. The Motor Vehicles (Type Approval) Regulations 1973 introduced a scheme for vehicles manufactured after 1 July 1973. This allows compliance with an EEC directive (70/156) of 1970. Vehicles with gasoline engines manufactured after 10 November 1973 must meet with standard emission requirements laid down in Reg. 15 annexed to the 1958 International Agreement of Geneva (Cmnd. 2535). These essentially follow EEC directive 70/220.

Radiation

The Atomic Energy Act of 1946 made no particular reference to health, but the Atomic Energy Authority (AEA) Act of 1954 naturally made the AEA responsible for the consequences of any ionising radiations it produced. An AEA Health and Safety Branch was formed in 1959, partly following the Windscale accident of 1957, Britain's most serious nuclear accident to date. The AEA Act of 1971 transferred fuel processing and isotope production from the Authority to two state companies, the latter becoming subject to the Nuclear Installations

Act of 1965. The Central Electricity Generating Board operates nuclear power stations and has its own Nuclear Health and Safety Department, and corresponding radiation rules.

The Nuclear Installations Act (NIA) of 1959 placed with an appropriate Minister responsibility for the licensing and safety regulation of all nuclear installations, except those operated by government departments or the AEA. This Act was consolidated into the Nuclear Installations Act of 1965 and further amended in 1969. Its essential feature is that a site licence is required to operate a nuclear facility. The Minister may attach such conditions to this as he thinks fit, assisted by the Nuclear Installations Inspectorate and his Nuclear Safety Advisory Committee.

Various Regulations have been issued under the NIA. Thus there is a list (1965, extended 1971) of relevant installations, and other 1965 Regulations relate to Dangerous Occurrences. The Excepted Matter Regulations of 1965 are interesting in that determination is specifically related to International Atomic Energy Agency (IAEA) provisions insofar as the Vienna Convention on Civil Liability is concerned, and to the European Nuclear Energy Agency (ENEA) Steering Committee provisions insofar as the Paris Convention on Third Party Liability is concerned.

The Radioactive Substances Act of 1948 laid down ministerial responsibility for radioactive substances and radiation apparatus. British practice was then based on the amended recommendations of a committee of 1921, these themselves having in 1928 formed the basis of the first international recommendations. Two sets of Regulations were made under the 1948 Act to cover road transport of radioactive substances, there being statutory and related forms of control over other methods of transport. One of these Regulations gives effect to corresponding IAEA regulations. The 1948 Act also led to the creation of the Radioactive Substances Advisory Committee (RSAC). This indeed was the Act's most significant achievement, since this Committee greatly influenced the codes of practice which were formulated in the health field, these codes and the Factories Act proving to be more useful than the provisions of the 1948 Act itself. A panel of the RSAC also responded to a ministerial inquiry of 1959 by recommending new legislation on the disposal of radioactive waste. Its recommendations were embodied in the Radioactive Substances Act of 1960. This lays down, inter alia, requirements regarding approval and monitoring of waste disposal. So-called "derived working limits", based on ICRP recommendations, are used in effect as standards governing radioactive release. These require the exposure of individuals to be within ICRP limits (somatic effects) and of the population as a whole to be within 1 rem/person in 30 years (genetic effects). The Alkali Inspectorate makes some 50 visits each year to

nuclear establishments to ensure compliance with the 1960 Act. Actual releases are normally within 1-2% of the derived working limits, and an investigation follows releases above 10%.

The Radiological Protection Act of 1970 established the National Radiological Protection Board. This took over the radiological protection responsibilities of the Atomic Energy Authority's Health and Safety Branch, the functions of the RSAC, and those of the Radiological Protection Service operated until then by the Medical Research Council (MRC). The Board was also given general functions in regard to research and the provision of advice, was designated as the UK body to co-operate internationally in respect of radiological protection, and was made responsible for the co-ordination of National Arrangments for Incidents involving Radioactivity. The NRPB can have up to nine members, appointed after consultation with the AEA and the MRC, and is itself assisted by an Advisory Committee of up to 24 members on which representatives of government departments and others can serve. Among the Committee's responsibilities is a requirement to advise the Board on problems involved in complying with international agreements or standards, and the Board in turn is required to consult the committee before giving advice in this area. The British Committee on Radiation Units and Measurements is now jointly sponsored by the NRPB and MRC and has a two-way liaison with the International Commission on Radiation Units and Measurements.

The 1961 Factories Act superseded Orders of 1942 and later in respect of radiation. The 1968 and 1969 Regulations under this Act apply to work exposure to sealed and unsealed radiation sources respectively and have been enforced by the Factories Inspectorate, although in fact they cover a much wider range of work locations than is suggested by the term "factory". The Regulations call for the designation of an individual to undertake special responsibility in respect of the Regulations in any workplace, and also for a register of classified radiation workers who are to be covered by special medical surveillance. Schedules attached to the Regulations establish maximum permissible radiation doses and are derived from ICRP and MRC recommendations. As compared with ICRP recommendations,

	Any radiation		X, Y, n	
(in rems)	Quarter	Year	Quarter	cumulative
Limb extremities	40	75		
Eye lenses	8	15		
Rest of body	15	30	3 (1.3 women)	5 (Age-18)

the doses apply to planned, emergency and accidental exposures; they relate to parts of the body rather than to organs; they give a cumulative annual dose for uniform radiation of the whole body rather than a maximum permissible one; and they exclude the intake of radioactive material. The Factory Inspectorate has investigated between 27 and 72 genuine cases of excessive radiation doses annually in recent years under the Ionising Radiations (Sealed Sources) Regulation 20 of 1969, some two-thirds being above 5 rem. These are analyzed in detail to discover the contributory cause.

Regulations under other Acts deal with further aspects of the radiation hazard, e.g. National Insurance Regulations covering compensation for radiation injuries and Food Regulations covering process irradiation. Provision was also made for Regulations under the Consumer Protection Act of 1961, but in fact manufacturers of radioactive equipment, in a manner typical of British regulation generally, elected voluntarily to submit their products for approval by the Miscellaneous Sources Panel of the Radioactive Substances Advisory Committee.

It is again typical of British practice that many aspects of radiation are covered by codes of practice rather than by legislation. Three such codes, covering medical and dental, research and teaching, and veterinary use, were prepared by RSAC panels. Other codes cover transport, schools, shoe-fitting, etc. It should be remembered that although these codes do not strictly have the force of law, damage resulting from failure to comply with them would certainly provide grounds for civil liability. Similarly, although standards also have no legal standing, a wide range of relevant standards have been published by the British Standards Institution, and are important guidelines for government inspectors.

It should be noted that the Medical Research Council has no formal responsibility, but here as elsewhere it has been extremely influential over the whole field. Its former Protection Service was mentioned above. It has also from time to time released major reports - The Hazard to Man of Nuclear and Allied Radiations (1956, 1960); The Assessment of the Possible Radiation Risks to the Population from Environmental Contamination (1966). Its various committees too have made contributions in the radiation area, notably that on Protection Against Ionizing Radiation (recommendations on maximum dietary and respirable air contamination after accidents); a 1975 report on plutonium toxicity; and the Committee on Radiobiology (priorities and long range research). And, as just one example of the MRC's many connections with other bodies, a recent director of MRC's Department of Clinical Research who is also a current member of the NRPB produced a report for OECD in 1976 on estimated population exposure from all artificial radiation sources. Finally, the British

Institute of Radiology has also, especially through its Radiation Protection Committee, performed a useful supporting role.

Radioactivity was described by the Royal Commission on Environmental Pollution in 1974 as "unusually dangerous and insidious". The Commission noted that in the early days of motor cars a man with a red flag had had to precede them on foot, but now he was gone and the UK alone was apparently prepared to accept 7000 deaths a year from motor vehicles. The point was that

> "a potentially dangerous technical development may well be safeguarded when it is first introduced but... more casual attitudes may develop when it becomes a dominant feature of industrial society".

The Commission had therefore decided to make a special study of radiation. The members of the Commission were not implying, they stressed, any criticism of current arrangements, but were simply responding to the evident timeliness of a review. This report was discussed briefly above. Opposition to nuclear power generally emerged in Britain in 1974, and had become a definite political factor by 1976, although still not on the American and German scale.

Vinyl Chloride

The vinyl chloride case demonstrated to the Factory Inspectorate that "in order to control risk it is necessary to know first of all that it exists, secondly to quantify it, and thirdly to have a standard setting an acceptable limit." There had been little interest, as the Inspectorate saw it, in Viola's 1970 demonstration of rat tumours caused by vinyl chloride monomer (VCM) because of the enormous concentrations involved, (30 000 ppm). VCM had even then been known to be toxic, an anaesthetic, a fire and explosion hazard, and at concentrations above 1000 ppm, to be a contributory factor in acro-osteolysis, Raynaud's phenomenon and scleroderma. The British TLV of 200 ppm published in Technical Data Note 2 (TDN2) 1972 had, nevertheless, been believed to be adequate to control these known risks. Then came the work of Maltoni, supported by ICI, Solvay, Montedison and Rhone-Progil, showing tumour induction in proportion to exposure down to 250 ppm. On 23 January 1974, the Chief Factory Inspector had been informed of the three US deaths from angiosarcoma, at an average exposure of 19 years.

Employees were thereupon informed by the medical officers of the firms involved, following advice from EMAS and with the assistance of the TUC Medical Adviser. EMAS at once began epidemiological studies. Six plants in Britain handled VCM at this time and these were visited by the mobile laboratory of the Industrial Hygiene Unit. Progress in

reducing VCM concentrations began to be made immediately, but it was decided to forma Joint Working Group with representatives from the TUC, CBI, the Inspectorate and EMAS. This met first in June 1974 and considered a draft in December 1974. A temporary Vinyl Chloride Code of Practice for Health Precautions was published in February 1975. The interim standard adopted was a ceiling of 50 ppm and a time-weighted average of 25 ppm (later 30 and 10 respectively), "allowing that wherever practicable exposure should be brought as near as possible to zero concentrations."

The Working Group intended to keep this standard under review. The control of vapour was seen as a much more fundamental and important objective than reliance on respirators. Monitoring of threatened environments was prescribed in the code, in principle once each shift, but in practice every few minutes automatically. The US agencies NIOSH and OSHA assisted in the British process of deliberation, as did European countries, but the interim UK standards differed markedly from the US ones. The Inspectorate pointed out that the US target necessarily emphasized respirators, and that until January 1976 these were not mandatory in the US below 25 ppm. US monitoring requirements were also said by the Inspectorate to be significantly less stringent than UK ones. The UK objective had been "a practical standard that industry could with diligence achieve", and 50 ppm was at the outset seen as a limit below which no risk to humans had been clearly demonstrated, although a zero target was well understood to be the ideal for any carcinogen. The Chemical Industries Association claimed in May 1974 that all VCM levels in Britain were by this time below 50 ppm, but there were continuing reports that levels above 50 ppm, in some cases well above, were still occurring in at least one plant (Vinatex).

Only two possible cases of VCM-related angiosarcoma had come to light in Britain by this time. Emphasis had been on regulation of VCM manufacture and polymerising, because VCM levels in PVC processing, even without control measures, were known usually to be well below 10 ppm. Processing was not covered by the Code of Practice, but epidemiological studies of process workers were put in hand.

The Factory Inspectorate itself contrasted the co-operation of government, industry and unions in the UK Tripartite Working Group with the confrontation which it was felt had occurred in the US. The Chief Inspector was also pleased to record that whereas in the past lack of public interest in occupational health had frequently had to be deplored, on this occasion the media had demonstrated a consistent and responsible interest. It was of interest that the Chief Inspector felt that

"it was industry's misfortune rather than its fault that vinyl chloride... proved to be carcinogenic, a discovery made as a result of industry's own voluntary research."

The Inspectorate saw VCM as typifying the basic problems in dealing with carcinogens - the long latent period, the lack of reliable tests for carcinogenicity, ignorance of the existence of a threshold and of dose-response. Remedial measures could range from prohibition, as with beta napthylamine under the Carcinogenic Substances Regulations (1967), to stringent control, as with VCM. Across the board prohibition as a policy was not, however, really feasible because of the benefits, and sometimes also it was a case of "better the devil we know". The "real enemy", it was felt by the Inspectorate, was lack of positive evidence to identify the hazard, and thus to devise protective measures, rather than the "depressing saga" of the annual discovery of new carcinogens. The "commonsense approach" was to expect from industry good general standards - in the past VCM workers had been unnecessarily exposed to VCM levels above what even then had been sensible.

The UK fully supported Convention 139 and Recommendation 147 drafted at the 59th Session of the ILO in Geneva, June 1974, most of whose precepts had already been included in the UK's approach to carcinogens.

A provisional bpm for PVC polymer plants was also formulated at this time by the Alkali Inspectorate, as usual, only on a flexible basis for negotiation. The initial estimate of normal VCM loss had been 88 lb/ton PVC; on discovery of the VCM hazard this was quickly reduced by a factor of 10, using the best immediately available control methods, and the provisional bpm now set a target of 0.4 kg/t, at a prescribed discharge height. Long period monitoring arrangements were not at this stage judged to be proven, but short period sampling suggested that public exposure over long periods would be lower by a factor of 10 than the 0.2 ppm (90% samples), 2 ppm (10% peak samples) measured by the Factory Inspectorate for the Alkali Inspectorate downwind of relevant plants.

The VCM case in part led to the Royal Commission on Environmental Pollution making recommendations in its 1974 Report or toxic chemicals generally. Minute contamination of finished products by VCM, and environmental concentrations of 0.1 ppm near factories were not thought likely to be very significant, but the Commission observed that it was fortunate that high VCM concentrations led to an unusual rather than a common cancer. The UK had a system of advisory screening committees for food, drugs and agriculture, and the HSWA of

1974 extended this to the occupational setting.* Section 94 of the Control of Pollution Act contained reserve powers to catch chemicals which got through the existing and planned screening networks. Sweden and the US were understood to be preparing similar enabling legislation, while Japan and Switzerland required additionally biotoxicity and bio-accumulation tests of all new chemicals.

The Commission, having in its 2nd report suggested a data bank to correlate chemical structure with environmental effects, had subsequently invited the Royal Society to consider this, and the latter's British National Committee on Problems of the Environment had suggested a selective arrangement using existing systems. The Department of the Environment had taken this up and engaged the UK Chemical Information Service as consultants. The UK bank would be included in the UN Environment Programme's planned International Register of Potentially Toxic Chemicals, and also in the projected European Chemicals Data and Information Networks of the EEC, both these being special instances of the International Referral System for Sources of Environmental Information approved by UNEP in March 1974.

However, as well as data banks the Commission stressed that it was necessary to ask the right questions about new chemicals and the OECD's Sector Group on Unintended Occurrence of Chemicals in the Environment was thought to be one of the several international bodies looking at this. The Commission remained very concerned: on the one hand there was the rapidity and scale of new product introduction, on the other,

> "the effects of some substances on the environment may be extremely subtle, indirect and long term in character, so that potential hazards may be undetected until serious damage has been done."

The Government's response to this was to the effect that

> "the screening of new chemicals for possible long term environmental effects is a complex question, as is the interaction of chemicals with each other in use. Departments... have... taken all the precautions which can reasonably be taken at the present time... It is... important to retain a sense of balance".[9]

Five initiatives were singled out for mention by the Government. There were now "quite advanced plans for setting up a national

* It was stated in a House of Commons reply of 15 May 1974 that expert non-departmental advice was provided by the Chief Employment Medical Adviser's Advisory Panel on Occupational Cancer.

register of environmentally significant chemicals to be used both by Government and industry in screening and assessing chemicals." The UK was participating in the OECD study of "possible internationally compatible arrangements for the screening of new chemicals." The Health and Safety Executive had work in hand on the screening of new substances in the workplace and this had "considerable relevance to the environment." New arrangements to transform the environmental monitoring systems in Britain would "contribute towards the early identification of environmentally harmful substances." And finally, steps had already been taken in respect of non-agricultural uses of pesticides.

CHAPTER III - THE UNITED STATES

The Occupational Safety and Health Act

President Johnson, supporting an occupational safety and health bill, in 1968 described the existing federal protection in this field as a "patchwork of obsolete and ineffective law." The 1968 bill was lost in the House Rules Committee, leaving worker protection yet again to the Walsh-Healey Act of 1936, which had established certain safety criteria, but only for those engaged on federal contracts; to an Act covering harbour workers; and to various mine safety acts. Congress did enact comprehensive mines and construction industry safety acts in 1969, and in 1969 President Nixon again asked for a general standard-setting authority in the occupational safety and health field. Accidents quite apart, the annual rate of occupational disease was recorded by the Bureau of Labour statistics at almost 400 000 in 1970, and this and the accident figures finally led to passage of the Occupational Safety and Health Act in 1970 (OSH Act).

The OSH Act was a major legislative initiative, bringing virtually all employees in the US under federal coverage, the vast majority of them for the first time. In view of the criticisms of the OSH Act which have since been made, it is essential to recognize that, with the minor exception of the Walsh-Healey Act, employees had until 1970 been dependent for their occupational protection on state schemes of greatly varying quality, and on consensual standards. The OSH Act, among other things, established a three-man Occupational Safety and Health Review Commission (OSHRC) to hear appeals, and a National Advisory Committee on Occupational Safety and Health (NACOSH) to help recommend standards, the latter having representatives from both sides of industry and from the relevant professions. A new post of assistant secretary in the Labour Department was to be designated with specific responsibility for this field, and this resulted in the creation of the Occupational Safety and Health Administration (OSHA) to enforce the Act. At the same time occupational safety and health research and criteria development achieved Institute status, with the creation in the Department of Health, Education and Welfare (HEW) of a National Institute for Occupational Safety and Health (NIOSH).

The "special duty" clause of the OSH Act allowed the Secretary of Labour to adopt existing national and federal consensus safety standards within two years of the Act's coming into force in April 1971. "Federal" standards were those promulgated under the Walsh-Healey Act; since there were only some 34 violations of these stand-

ards in 1969, enforcement was evidently not vigorous. "National concensus" standards were (in the occupational health field) mainly those prepared by the American National Standards Institute (ANSI) and the American Conference of Governmental Industrial Hygienists (ACGIH). Following adoption of these standards, 60 days were then to be allowed for appeal, hearings being held within a further 30 days if requested, with a definite ruling to emerge within a final 60 days. Exemptions were to be possible, and so were emergency standards. Emergency standards were to become effective immediately on publication in the Federal Register,[10] but were to be subject to a formal hearing within 6 months. Asbestos was one substance to give rise to an emergency standard, and there were also emergency standards in respect of 14 carcinogens in 1974.

Some 170 existing standards were promulgated within the allowed 2-year period, many of them "specification" standards never intended by those who had formulated them to have the force of law. It does not seem to have been much considered when the OSH Act was passed that neither the federal nor the consensus standards had received the scrutiny necessary if they were to become legally binding, and on the total workforce. As voluntary guidelines suddenly became statutory standards, there was much criticism that too many unsatisfactory simplifications had been made. In particular, a concern with "performance" standards, which could stimulate rather than freeze the state of the art, came only later. OSHA's experience well illustrates the dangers of rushing legislation forward in a complex technical field where the government's involvement has not previously been major, even when this is done from the best of motives.[11] OSHA standards now run to some 600 pages in the Code of Federal Regulations.

There is also a "general duty" clause in the OSH Act. This has been defined by the federal courts, and to succeed under it OSHA must show that the hazard in question could in principle be eliminated, and that practical means for eliminating it are at hand.

The standards taken over by OSHA were essentially environmental limit guides and nothing more - the TLV's of ACGIH demonstrate this perfectly. The OSH Act provides for standards which must contain considerably more than this, including particular sampling techniques, analytical methods, medical tests, work practices, monitoring and record keeping, and hazard warning arrangements, as well as the basic environmental limits. Standards recommended to OSHA by NIOSH must therefore be multi-dimensional. They must also be supported by criteria documents which are based on publicly available information, rather than simply on the opinion of practitioners.

It was known when NIOSH was established that over half a million chemicals had been in recent use in the US, that more than 13 000 toxic substances were used regularly, and that 1000-2000 were deserving of immediate criteria documents. NIOSH's investigation of toxic substances has thus been especially important. Among the indices which NIOSH has used in determining priorities have been: number of personnel exposed; relative toxicity (including cmt potential); incidence of exposure; quantities involved; and the trend of use. Professional consensus judgments have had to substitute for relative toxicity information and incidence of exposure where these have not been known. The OSH Act actually provides for the publication of an annual Toxic Substances List. The 1973 List published by NIOSH contained 11 000 compounds, detailed human data being available for only a few hundred of these.

NIOSH also joined with OSHA and the American Society for Testing and Materials (ASTM) in Committee E-34, which selected 27 substances on which to identify the difficulties of developing standards. NIOSH has itself set up some 31 industry studies, to collect data on known diseases and to search for unsuspected hazards. The OSH Act further requires it to offer hazard evaluation services to employers and employees on request.

To develop its criteria documents NIOSH has relied very heavily on literature review and very little on research: some 80-90 per cent of its critieria development has of necessity been contracted out.[12] A draft criteria document is first prepared by occupational health professionals. It is then subjected to adversary review by three carefully selected groups. The first of these consists of senior NIOSH personnel, the second of members from the professional community, the third of members nominated by invited professional societies. Nobody who has participated in the development of a criteria document is included in these groups, but each group becomes in a sense an advocate of the criteria, as revised after its individual and collective review, before the next group; although "all reviewers realize that they are not participating in a consensus activity." The final standard recommended by NIOSH puts health and safety first and considers the feasibility of control within the available technology; the economic impact of criteria is not among NIOSH's concerns.

NIOSH criteria documents have necessarily been much more comprehensive than ACGIH/ANSI standards, and the environmental limits proposed by NIOSH have usually been below those in the earlier standards. A particular problem experienced by NIOSH has sometimes been the lack of data to complete a standard. When, for example, dose-effect relationships have not been known, the criteria document has had to stress engineering safeguards. NIOSH has formally

advocated a policy of no detectable exposure for substances with no known safe exposure limits. Another difficulty NIOSH has encountered results from the lengthy process involved in developing criteria. To avoid leaving workers unprotected in the interim, NIOSH had advocated supplementing of the existing ACGIH/ANSI standards in the first place, together with the acceptance of a "work practices" approach, with full NIOSH review following later as opportunity arises.

NIOSH has claimed that its criteria development process has resulted in "the most comprehensive review and critical analysis... in this country or elsewhere of available information for the development of standards for occupational health." Thirteen criteria documents had been developed by 1974, including ones on asbestos and inorganic lead. However, OSHA had by 1976 established final standards in respect only of two of the 37 cases for which NIOSH had by that time provided documents. Some 30 criteria documents are understood to be planned for 1976, with a further 25 in 1977.

The OSH Act made possible federal inspections of work places and provided for penalties, ranging from $1000 for a serious violation, to $20 000 or a year's imprisonment or both in the case of a second conviction of a wilful violation which has led to the deaths of employees. Between its inception in April 1971 and May 1975, OSHA actually made almost a quarter of a million inspections and alleged 870 000 violations, with proposed penalties totalling over $20 million.

The OSH Act also authorized OSHA to approve state plans if they are as effective as the federal one, OSHA offering 90 per cent of their cost of development and 50 per cent of their cost of execution, and retaining the right of review for up to four years, and also the right to enforce new standards pending equivalent adoption by the states. A new programme was initiated in 1975 under which interested states were to be sent new draft standards before public comment was invited. The final version of the OSH Act does not allow the Secretary of Labour to close a hazardous plant without a court order, though in Senate debate it was stated that about 29 states already had such a provision.

After a final OSHA standard has been published in the Federal Register, relief is still available to employers through one of three routes: (a) a temporary variance order for a year with the possibility of renewal, a route open when an employer can show in effect that he is doing all he reasonably can to comply and to safeguard his employees in the interim; (b) a permanent variance rule when an employer claims to offer equivalence of protection; (c) a petition to alter the standard. The GAO complained early in 1976 that the states and OSHA have not in fact always fulfilled their

obligations in cases where variances have been sought. Employers have 15 days to contest citations issued by OSHA compliance officers, the case then being assigned by the OSHRC to an administrative law judge. After this there may be review by the OSHRC itself, and appeal may then be made to the US Circuit Court of Appeals.

The bewilderment of small businesses faced for the first time with the need to comply with complex OSH Act provisions was reflected in an amendment agreed by Congress in 1972. This amendment would have removed from OSHA inspection firms employing less than 15 people, but in the event it was lost when the President vetoed the 1972 bill for unrelated financial reasons. An Act of 1975 does, however, exempt employers with less than 10 employees from keeping certain health records. A 1975 bill, supported by the Administration, to allow OSHA to advise on occupational regulations, was opposed by the AFL-CIO, which argued that it weakened still further the compliance effort by diverting attention to consultation. OSHA has nevertheless contracted with the American Industrial Hygiene Association to assist small businesses to meet OSHA standards, and financial assistance may also be available to such firms from the Small Business Administration. It is said that a "clear separation" is maintained between consultative and compliance activities, though the consulting officer must advise employees and OSHA if he discovers a serious hazard and the employer fails to correct it. OSHA has some 1200 inspectors/hygienists.

OSHA was in 1976 considering specially how to inform employees about potential carcinogens, and has asked the NRC to consider the matter, an unusual and somewhat uncertain issue legally for the latter to tackle. OSHA's initiative resulted in part from a request by Dr. I. Selikoff that two versions of a 1974 New York Academy of Sciences Conference on industrial carcinogens be published, one for professionals and one for workers. Two class actions were currently pending in this same area, one by asbestos workers at a Texas plant, and another by vapona workers in Virginia. The American Occupational Medicine Association and the American Industrial Hygiene Association have also both recently discussed some of the ethical questions raised by this problem. This may also be the point to quote a somewhat cynical comment by a usually well-informed Washington commentator:

> "The dilemma centres on the need to apply scientific information which is far from precise to mandatory legal standards at the possible cost of a plant shutdown. Under those circumstances, if cancer may be in their future a generation from now, some workers may insist on their right not to know."[13]

The OSH Act, OSHA itself, and the OSHRC have all three in their short existences experienced considerable political difficulties and substantial criticism. Thus, the Senate report on Watergate contained a disturbing reference to a memo of June 1972 sent by the then head of OSHA to his immediate superior. This stated that "no highly controversial standards" would be proposed during the Presidential campaign; it referred to OSHA's "great potential... as a sales point for fund-raising and general support for employers" and it asked assistance "to promote the advantages of four more years of properly managed OSHA for use in the campaign."

In another election year, 1976, OSHA morale was again very low, a circumstance not helped by President Ford's unfavourable references to it on the hustings. Its then head, a professional, suggested that professionals had formerly been reluctant to work with the organization because of their reservations about its standing and approach. Yet he himself now came in for criticism, on grounds admittedly of legal and scientific caution rather than because it was thought he wanted to favour industry. There have certainly been delays in proposing standards, in setting hearings, and in decision-making generally. So much so, indeed, that the Secretary of Labor was at one point forced to write to the AFL-CIO arguing that the reasons for the delays were technical and procedural rather than political. A particular cause of delay has been the need to produce inflationary impact statements (IIS's). The President, severe on the regulatory agencies generally, in November 1974 issued an Executive Order requiring all regulatory actions to be accompanied by IIS's, and the Council on Wage and Price Stability subsequently applied this ruling to OSHA. OSHA lacked the capacity to prepare these IIS's in-house and by 1976 at least 14 proposed standards had been affected, 11 of them, including those for asbestos and lead, having had to be delayed until after the 1976 elections. OSHA was in consequence sued by the Oil, Chemical and Atomic Workers Union, which alleged that the OSH Act does not allow delay for assessment of inflationary consequences.

Employer criticisms of OSHA have included demands for more precise standards, a longer period to comment on proposed rules, discretionary rather than mandatory penalties for first offenders, a resolution of overlaps between OSHA and other federal agencies, and more assistance to small firms. The MCA would like to see OSHA set standards of good practice for industries rather than regulate chemical by chemical. The US Chamber of Commerce would like more emphasis on voluntary compliance. There have been some 100 bills to amend or repeal the OSH Act.

The fact that OSHA, in its first 5 years of existence, came under four Secretaries of Labor and three Assistant Secretaries

certainly did not help its image or confidence. Further, by 1976 the implementation programme involving the states was said to be "in a shambles", only 23 states having even after 5 years, had their plans approved.[14] The original consensus standards were by now widely recognized as needing revision, the standards-setting process generally had "seen one setback after another", and in general OSHA had been "unable to develop any real constituency." In enforcement as well, OSHA's powers seemed heavily dependent on the outcome of two test cases before the Supreme Court, and OSHA's Head acknowledged a "pressing need" for more and better compliance officers, especially in regard to agents injurious to health. OSHA continued to insist that correction was better than punishment.

In the case of NIOSH, two quotations well illustrate the general tone of the criticisms directed at the organization:[15]

> "There are no deliberate attempts to formulate any kind of research policy based on the real problems in the workplace. They don't bring input from labour into the design of their research projects. What they have is a lot of old-time researchers who are accustomed to pursuing their own interests... without regard to the timeliness of their work".

(Nicholas Ashford, undertaking a study of occupational health for the Centre for Policy Alternatives at MIT)

> "They have a lot of dead wood and meaningless programmes... Their hazard evaluation programme is a total failure. The evaluations they do are meaningless... All they do is measure how close companies come to the TLV's. And when they get important information they sit on it without alerting anyone".

(Sheldon Samuels, AFL-CIO director of health, safety and environmental affairs).

It may be mentioned here that NCI also came in for similar and substantial criticism in the wake of the VCM affair, on grounds of misplaced priorities.

The OSHRC's troubles appear to have centred on two things. First was the recommendation to firms by national industrial organizations to contest all OSHA decisions. This led to OSHRC receiving over 5000 cases in its fifth year, and contributed to a huge backlog. Second, there were severe disagreements between two of the three commissioners. One of these was displaced as chairman by one of the other two in 1975 without prior consultation. The new chairman, a former Bethlehem Steel official, then embarked on a reorganization which critics maintained was intended to strengthen

his position in the event of a Democratic victory in November 1976. The displaced chairman for his part argued that the reorganization was intended solely to eliminate dissenting and concurring opinions. He even published an astonishingly bitter letter to the chairman, as well as initiating a suit against him. It is of interest in this connection that less than 50 per cent of OSHRC majority decisions have been upheld in the courts of appeal.

A Task Force report from the 1975 US National Conference on Preventive Medicine, sponsored by the National Institute of Health, summed up very succinctly the shortcomings of OSHA, NIOSH and the OSH Act. OSHA was said not noticeably to have affected US occupational health, thought it was recognized that there was not really sufficient statistical information to make a firm judgment, not least because of reporting exemptions granted to small employers. OSHA personnel were described as being inadequately trained, there were held to be too few of them, and it was pointed out that penalties averaged only $20, substantial penalties generally being imposed in respect only of safety, and not health, violations. OSHA had also insufficiently emphasized the general duty clause of the OSH Act, for example by failing to require industry to perform occupational health surveys. For its part NIOSH also had too few staff, they were mostly in the lowest civil service gradings, and its funding and facilities were inadequate. The report also specifically indicted the politics of the standards-setting process, as well as the new requirement for inflationary impact statements.

Attention should also be drawn here to an NIEHS task force which made some very pertinent recommendations. This group described occupational hazards as representing

> "a public health area which is highly susceptible to preventive strategies... also a potential source of valuable new information on environmental hazards since exposures which occur in the workplace are generally more intense and prolonged than those which occur in the general environment."

The task force asked for a National Health Index, to help correlate deaths with previous occupational histories, and also for more correlation of epidemiological studies with laboratory tests on cmt effects - the National Centre for Health statistics having no programme to correlate disease and occupation. Improved medical surveillance systems were said to be necessary, as well as fertility studies and studies of pathological effects on offspring. There was held to be a tremendous lack of information about the relationship to disease of very many exposure patterns, and where information existed it was said often not to be applied in the best way to protect workers. The OSH Act was seen as having severe limitations -

regulations could tackle only a restricted number of hazards, compliance officers were in short supply, and small firms could not afford occupational health programmes. The report suggested that

> "a more significant impact might be achieved by providing incentives for industries to develop programmes meeting a set of well-defined performance standards. This might assure better protection for workers. In addition, it could help ensure protection against hazards not covered by regulations."

The Environmental Protection Agency

An Environmental Quality Council, (later the Cabinet Committee on the Environment) was established by Executive Order in May 1969. It was to be chaired by the President, and the six relevant Cabinet officials were to be members. A 15-member Citizens Advisory Committee on Environmental Quality was established at the same time. In January 1970 the President signed the National Environmental Policy Act (NEP Act) indicating that he intended the three-man Council on Environmental Quality (CEQ) established by the Act to stand in as close relationship to himself as did the existing Council of Economic Advisers. The NEP Act itself required all federal agencies to prepare an environmental impact statement before undertaking any project likely significantly to affect the environment. The EPA (see below) as the federal standards authority for the environment was not regarded as subject to this requirement, but in April 1974, apparently under some pressure from the House Committee responsible for its funds, it announced that it would in future comply. An Office of Environmental Quality in the Executive Office of the President was created by the Water Quality Improvement Act of April 1970. Environmental pollution was also the main focus of the President's State of the Union message to Congress in January 1970, and of a special message in February 1970. In the latter the President called specifically for an expanded federal role in establishing and enforcing air and water standards.

In July 1970 the President proposed the consolidation in one agency, a new Environmental Protection Agency (EPA), of the federal government's responsiblities and interests in this field. The President's plan is understood to have been opposed both by the Secretary of the Interior, who apparently wanted his own department to have overall responsiblity as a Department of the Environment, and the Health, Education and Welfare (HEW) Secretary. However, there was no serious Congressional opposition within the 60-day veto deadline allowed by law and the President's proposal thus went into

effect. The EPA enjoys departmental status as compared with the subdepartmental status of OSHA.

The EPA assumed the following responsiblities as from December 1970:

- From HEW: the National Air Pollution Control Administration, Bureau of Solid Waste Management, Bureau of Water Hygiene, Air Quality Advisory Board, (part of) Bureau of Radiological Health, pesticide control from the Food and Drug Administration.
- From Interior: the federal Water Quality Administration, the Water Pollution Control Advisory Board, (part of) the Bureau of Commercial Fisheries, pesticide studies of the Fish and Wildlife Service.
- From the Atomic Energy Commission: environmental radiation standard-setting.
- From the Executive Office of the President: the functions of the Federal Radiation Council.
- From Agriculture: the pesticides registration programme.
- Various studies from the CEQ.

Altogether, it was very understandable that the CEQ should, in its first report, describe 1970 as "the year of the environment".

It is convenient to summarize here the requirements of a US environmental standard as defined by the EPA Administrator in a 1974 seminar.[16] It must, he said,

- protect human health and welfare, and the environment;
- be based on the best technical information;
- meet all legal requirements, and be enforceable;
- in balancing risks and benefits, contain a margin of safety in favour of public health and welfare.

His description of the EPA standard-setting process included the following elements:

- the gathering of all health and environmental data on a specific pollutant;
- the evaluation of this data by EPA experts, possibly with the aid of technical advisory committees and consultants;
- the circulation of the proposed standard within the EPA, with a view to cost-effectiveness, complications of enforcement, impact on other programmes, etc.;
- the circulation of the proposed standard among other federal agencies, state agencies, ANSI, etc.;
- the promulgation of the standard in the Federal Register.

EPA personnel were said by the Administrator often to be members of various standards groups, but this did not automatically mean adoption of the resulting standards by the EPA. It is of interest

that a Dow Chemical spokesman at this same seminar suggested US emulation of the Canadian system in standards development, to provide for industrial participation at an early stage.

The EPA Administrator referred at this time to "a lack of conceptual clarity and agreement" among the environmental laws of the US, and he gave examples:

- in some cases there are primary standards for health and secondary ones for welfare, while in other cases the same ones apply to both;
- the EPA may in some cases be required to take technology and cost into account, in other cases, not;
- the time scales set by law frequently prove impossible to meet.

There was, he explained, more consistency in dealing with emission, effluent or product standards, where the requirement was couched in terms of the "best available demonstrated technology", although even then there could be spirited argument about "best" and "demonstrated".

The Administrator stressed that the EPA could not wait on consensus; improvements could come later but compliance deadlines were often set by law. The existing data base was small and the "very essence" of environmental regulation seemed to be continued refinement of requirements, although the law did not really acknowledge this. Regulatory agencies, he thought, needed to "bend over backwards" to facilitate citizen participation. New steps to widen participation in the regulatory process were in fact announced by the EPA late in 1975.

The EPA and its activities have naturally been the subject over the years of several reports. Two may be mentioned. An NAS-NRC report in 1974 was somewhat critical of the Agency's Office of R & D, although the committee which produced the report acknowledged both that the legislation under which the EPA operates called for very unco-ordinated and ill-balanced research objectives and deadlines, and that there was no integrated approach to pollution control in the EPA as a whole. The second report deserving of mention is that of 1975 on Decision Making for Regulating Chemicals in the Environment prepared for the EPA by the NAS-NRC. This report has received wide circulation and was alluded to in Chapter I.

Clean Air Act and Oxides of Nitrogen

The first federal air pollution legislation was an Act of 1955 which authorized research. An Act of 1963 gave cities and states additional powers of control, and the Motor Vehicles Control Act of

1965 initiated federal action in respect of automobiles. The Air Quality Act of 1967 strengthened federal, state and local controls, but the first strong measure was the Clean Air Act Amendments of 1970 (CAA 1970). This legislation, which virtually rewrote the 1967 Act, was comprehensive and has become perhaps EPA's most controversial programme.

The CAA 1970 created a new system of national ambient air quality standards (NAAQS's) based on air quality criteria and control technique documents. The criteria were to reflect up-to-date, but necessarily incomplete, scientific information regarding the health and welfare effects of pollutants. Primary standards, with an adequate safety margin, based on the criteria were to reflect EPA judgment. The primary standards to protect health were to be reached within 3 years: secondary ones to protect the environment within an unspecified but "reasonable" time. This NAAQS approach to air pollution control is recognized to be very different from that adopted in other countries.

The CAA 1970 also provided for the promulgation by the EPA of national standards of performance for new stationary sources of air pollution; for national emission standards for hazardous air pollutants from stationary sources; for stipulated national emission standards for motor vehicles and aircraft; for regulation of fuel additives, etc.

The Standards of Performance for New Stationary Sources since laid down by the EPA (CFR Table 40 Part 60) provide, inter alia, for notification and record keeping, performance tests not later than 180 days after start up, and emission data to be available to the EPA and to the public unless the EPA agrees otherwise. States are permitted to enforce tighter standards if they wish, and test methods, procedures, emission monitoring, etc. are laid down in great detail. The Act also provides for fines of up to $25 000 a day and for prison sentences of up to a year for first offences.

Two specific performance standards for stationary sources which contain NO_x provisions are those for fossil-fuelled generating plant and for nitric acid plants. For the former the NO_x standards (CFR 40 /60.44, July 1974) were set at 0.20, 0.30 and 0.70 lb/million Btu for gas, liquid and solid fossil fuels respectively, any 2 consecutive hourly periods, when these figures are exceeded to be reported. For nitric acid plants, the standard was set at 3.0 lb/ton expressed as NO_2/100 per cent nitric acid, with a maximum 10 per cent capacity.

The EPA decided in 1973 that firms convicted of criminal violation of the Clean Air Act should forfeit federal funds, with

non-criminal violations leading to a loss of contracts in excess of $100 000. An Executive Order to this effect, covering both the Air and Water Acts, but excluding defence contracts, was signed in September 1973. Certain delays until 1979 in compliance requirements for coal-burning plant were sanctioned by the Energy Supply and Environmental Co-ordination Act of 1974, in response to the energy crisis. The possibility of tighter NO_x standards for stationary sources was raised in the 1976 amending bill before the Senate.

For aircraft engines, NO_x standards effective from January 1979 have been included in the CFR. The figures vary for new/in-use/jet/piston engines; those for example for gas turbines manufactured on or after 1 January 1979 being:

turbo fan - 3.7 lb/1000 lb-thrust-hours/cycle (under 8000 lb thrust)
turbo jet - 3.0 lb/1000 lb-thrust-hours/cycle (over 8000 lb thrust)
Turbo prop - 12.9 lb/1000 horsepower - hours/cycle

The NO_x standards for motor vehicles are discussed more fully below. Diffuse as opposed to point sources have increasingly come to be seen as a problem. The EPA has also wanted state review of major indirect pollution sources, a move opposed by, for example, the Council of Shopping Centres, such centres of course being a major indirect source.

The CAA 1970 in fact required the EPA to promulgate national primary and secondary ambient air quality standards for six named pollutants, one being NO_x. That finally announced for NO_x Federal Register 30 April 1971) was 100 ug/m_3 annual arithmetic mean (0.05 ppm). The secondary standard is the same as the primary one in this case. The original proposal for a 24-hour average value in addition to the annual one was deleted in the case of this pollutant, because no adverse effects could be demonstrated for short-term NO_x) exposure at levels observed in ambient air.[17] This standard had in the event to be deferred 11 months to July 1973 because of measurement difficulties.

Under the CAA 1970 the states had until January 1972 to submit implementation plans to limit the six selected pollutants, the EPA accepting these plans or imposing its own by July 1972, and the states then having to comply by July 1975. In April 1972, the EPA announced that 20 states had requested delays to July 1977 for one or more of the six pollutants, 12 of those requests being in respect of NO_x.

The implementation plans required by the EPA amounted to a total control strategy and could include emission limitations on stationary sources, traffic controls, emission charges, process alterations, revised management practices, etc. An adequate emission inventory, monitoring network and episode control system were called for, together with legal authority for state action at different levels of air pollution.

The state implementation plans (SIP's) cover 247 air quality regions. Those for some 30 of the most severely polluted regions had specifically to include transportation controls. These vehicle-miles-travelled reduction plans could include tolls, bus lanes, car-parking, parking restrictions, etc. They had already produced 300 law suits by February 1974, two thirds of these being in California, and the EPA's rights in this area are not clear and have been tested at least five times in the lower courts, although not (to 1976) in the Supreme Court. The Supreme Court did decide in April 1975 that states were allowed under the law to exempt specific non-compliers provided that the state as a whole met NAAQS's. The Court has also ruled that the EPA does not have to consider technical or economic feasibliity in considering SIP's - arguments along these lines must be made earlier, at the state level.

At the mid-1975 deadline for compliance with the CAA 1970 the EPA stated that 156 of 247 air quality regions were failing to comply in respect of at least one of the six pollutants, 13 of these cases being NO_x. The steel industry was castigated as the worst offender, followed by the electricity industry. Reasons given for the continuing delays in compliance ranged from complexity, legal challenges, and poor state regulations, to industrial resistance and the unanticipated energy and economic situations. No state at this time had full federal approval for its implementation plan. In 1976 the EPA told 45 states that revisions in their plans were necessary if national standards were to be attained/maintained, an increase in national NO_x emissions being partly responsible. The SIP revisions require all achievable ("technology forcing") emission limitations by July 1977, all other measurs to meet NAAQS's by July 1978.

For some 10 cities, the EPA had earlier acknowledged that a postponement of the NAAQS's deadline was the only alternative to gas rationing. In fact a gas rationing proposal was made by the EPA for the Los Angeles Basin. This followed a suit brought by the Centre for Law in the Public Interest, which alleged that in the autumn of 1972 this was the only region of the country for which no implementation plan had been proposed. The EPA expected little public support for its proposal, and little was forthcoming at a public hearing.

With respect generally to the Clean Air Act and Amendments, the EPA has said that "it was clearly the intent of Congress to involve citizens in the enforcement of federal standards." Citizens can as a result bring actions both against polluters and against the EPA.[18] Legal action is also quite generously open to other parties - industrial firms, cities and states, etc.

The first important amendments to the CAA 1970 arose in 1976 and were handled by the Senate Public Works Committee and the House Interstate and Foreign Commerce Committee. A Senate filibuster on the last day of the 94th Congress in the event defeated a joint conference report of these two committees and the amendments therefore lapsed. Similar versions were reintroduced in Congress in 1977.

A key issue in 1976 was "non-deterioration", i.e., whether the 1970 Act and its predecessors did or did not permit actual deterioration of air quality to the levels set by national standards. A Supreme Court ruling of 1973 had forbidden the EPA to approve any state plan which allowed deterioration and as a result, in 1975 the EPA had designated three categories of region - Class I where there could be virtually no pollution, Class III with pollution up to the national standards, and Class II into which all regions were first put, states having authority to transfer regions to I or III. EPA itself reviews all industrial plans for 19 major industrial plant types, but there was considerable EPA uncertainty on the issue, compounded by the many law suits pending, the expected Congressional action, and a ruling then anticipated from the US District Court in Washington, D.C.

The lobby situation over the CAA amendments has been formidable. On the one hand, there is the "Washington Environmental Co-ordinating Committee", including representatives of the US Chamber of Commerce, the National Association of Manufacturing, the Business Roundtable, the American Petroleum Institute, etc., plus the Electric Utilities Clean Air Co-ordinating Committee. These critics charged, for example, that an EPA report "Health Consequences of Sulphur Oxides", published in 1974 as part of the Community Health and Environmental Surveillance System (CHESS) programme, contained intentionally distorted findings. For "non-deterioration" on the other hand, is the National Clean Air Coalition, which includes the Sierra Club, Environmental Policy Center, American Lung Association, League of Women Voters and Common Cause.

The CAA 1970 itself set the following automobile exhaust emission standards: hydrocarbons (HC) 0.41 g/mL; carbon monoxide (CO) 3.4; oxides of nitrogen (NO_x) 0.4 (HC and CO standards to apply to 1975 models, NOx standard to 1976 models). These standards,

amounting to a 90 per cent reduction in emissions, have been subject to three 1-year delays, but are currently due to take effect in 1978 unless Congress agrees to a further delay. Interim standards are now HC 1.5, CO 15.0, NO_x 3.1 (1976) 2.0 (1977).

These standards apply to gas and diesel fuelled light duty vehicles and trucks. The relevant provisions in the CFR (Table 40 Part 85) extend to over 230 pages. Cars sold in California must meet tighter state standards. No NO_x standard was laid down for heavy duty vehicles in the early years of the Act. The EPA asked in October 1975 for a 90 per cent reduction in motor cycle emissions by 1980.

Predictably, the automobile manufacturers have been constant in their pressure for a postponement of the date on which emission standards would become final, and in their demands for relaxed interim standards they have frequently enjoyed administration support. Thus, included in President Ford's State of the Union Message in January 1975, was a suggestion that to improve automobile gas consumption 40 per cent by 1980, emission standards should be correspondingly relaxed for 5 years. Responding to this, Ralph Nader disclosed that a Federal Energy Administration study showed that the pollution standards could be met even with a 40 per cent improvement in fuel economy, and an NRC report agreed that there was no incompatibility.

Apart from questions of fuel economy, other reasons for delay put forward by the manufacturers have inlcuded general technical difficulties and the fear that tight time deadlines might prevent identification of the best long term solutions. Another source of grievance has been that operators of stationary pollution sources are required only to use best available technology at reasonable cost, and are not asked to achieve stipulated emission limits for specified pollutants.

EPA was responsible for two and Congress one of the three delays in the introduction of the automobile standards. EPA's stand has rarely pleased environmentalists, as for example, when it agreed at one point to emission averaging over different automobiles as advocated by an NAS Committee, or as when, on another occasion, it allowed a trade-off among the pollutants produced by heavy vehicles. Of particular embarrassment to the EPA was the concern which arose in the autumn of 1973, to the effect that catalytic exhaust converters could lead to a new sulphuric acid mist hazard, possibly even more dangerous than the HC/CO hazard being removed. This was the reason given for the EPA's 1975 decision to defer its 1977 standards until 1978. An NRC report and one performed for the converter manufacturers, both suggested that the EPA had exaggerated the sulphuric acid problem with catalytic converters, and the Clean Air

Coalition have argued that it would in any case be cheap enough to produce desulphurized fuel. The warranty on the catalytic converters has also been a political issue.

The automobile NO_x standard has throughout been the source of particular difficulty. The NAS Committee on Motor Vehicle Emissions, in the first of its 6-monthly reports, as called for in the CAA 1970, was critical of government and industry research efforts with regard to NO_x. The EPA indicated early in 1973 that a relaxation of the automobile NO_x standard was imminent and later that year explained that errors had been made in measuring all-source NO_x emission, so that its emission by motor vehickes was less serious than had previously been thought. The EPA continued thereafter to be unsure about the NO_x standard, and although the NAS in 1974 offered complete support for the EOA's CO and HC standards, changes were suggested in respect of NO_x. The 0.4 g standard suggested was perhaps more stringent than was necessary to meet the NAAQS for NO_x. This report blamed vehicle emissions for 0.25% of the urban health hazard (4000 deaths a year). An NAS Conference in 1973 had already concluded that the health effects of NO_x were more poorly documented than those for any of the other main pollutants; that a reliable method of sampling and analyzing for NO_x was urgently needed; and that the existing air quality standard was based on a study which had since become suspect. The EPA was in fact forced to reclassify 42 Air Quality regions in respect of NO_x in 1974 because of the unreliability of its measuring technique.

The EPA has nevertheless taken motor vehicle NO_x emission seriously. A defect in their NO_x reduction systems allowing emissions 15-60% above the federal limits prompted the EPA to order Chrysler to recall over 800 000 1973 model vehicles in March 1974; Ford on its own initiative in August 1974 recalled over 200 000 vehicles because of the possiblity of a failure in their NO_x control arrangements.

Proposals before Congress in 1976 would have retained the original HC and CO motor vehicle emission standards, but would have enforced them at dates varying from 1979 to 1982. Industry has continued to complain specifically about the NO_x standard and 1976 proposals were for a 2 g standard for 1977-79, with a 1 g standard not being demanded before 1985. The original 0.4 standard would then become, in the words of the responsible Senate Committee, a "research objective". One House proposal in 1976 would, on the other hand, have set the NO_x standard at 0.4 by 1981, or else 2.0 in 1981-2, 1.5 in 1983-4, the EPA to decide. Another (Senate) proposal provided for 2.0 by 1977-81, the EPA to decide thereafter. The 1976 proposals having fallen, as explained above, similar proposals were again before Congress in 1977.

There appear to have been few developments of note with regard to NO_x as an occupational hazard. NIOSH is understood to have forwarded criteria documents for these substances to OSHA early in 1976, essentially recommending continuation of the existing OSHA (ACGIH) TLV's.

Water Pollution

Congress passed the Water Pollution Control Act Amendments in October 1972, basic legal authority for federal regulation having been established by Acts of 1948 and 1965. The 1972 measure was formally vetoed by the President, who had at first apparently hoped to use a pocket veto, nominally because of the Act's $24.7 billion authorized cost, but the veto was immediately and massively overridden by both Houses of Congress. The President, however, still cut the funds available to the states under the Act. The bill was strongly opposed by industry and supported by environmental groups, who were nonetheless unhappy at the degree of discretionary enforcement it permitted. The 1972 Act was the US's "most comprehensive and expensive environmental legislation", and it introduced a "major change in the basic approach to water pollution control in the US."[18] This resulted from the Conference Committee's decision to accept the Senate's requirement of a limit on the effluent any given plant could discharge, as well as continuation of the water quality standards approach taken by the House. Industry was required by the Act to use the "best practicable" discharge treatment by July 1977, the "best available" by July 1983; all US waters were to be safe by the latter date; and, as a goal not a regulatory target, all pollutant discharges were to be eliminated by July 1985. Municipalities had to provide "secondary treatment" to remove 85 per cent of pollutants by 1977 and had to use "best practicable" technology by 1983. A new discharge permit programme was to be operated by the EPA, or by the states with the EPA's approval, with special regulations for toxic wastes.

Citizen suits against polluters or the EPA were to be permitted if the citizen could demonstrate an affected interest. There was, in principle, to be full public discussion of relevant pollution information, and enhanced public participation in the regulatory process.

The EPA stated in 1975 that 95 per cent of the nation's worst water polluters had agreed to comply with the 1977 and 1983 deadlines. The EPA had also by 1976 reached settlement with

environmental groups which were suing it to regulate the discharge of toxic chemicals. Information is first to be gathered about 65 such chemicals, including VCM, lead, mercury and asbestos, and six highly toxic substances are to be treated separately.

The 1972 Act also created a 15-man commission to study the costs and benefits of the deadlines laid down in the legislation, and to report to Congress. This Commission reported (not unanimously) in 1976 after a major study. It concluded that the schedule set by Congress was not being fully met nationally, but added that the quality of US waters was improving faster than had generally been expected. It recommended retention of the 1983 goal of safe waters but a postponement of the "best available" technology requirements for 5-10 years, a second commission to report by 1985 on the need for them, discharge permits to be tightened in the interim where water quality criteria made this necessary. The EPA should also, the Commission said, be allowed to grant case-by-case extensions of the 1977 deadline where polluters could demonstrate "reasonable progress". The original 1985 deadline was "counterproductive", because the 1983 requirements would have only a "marginal impact" over and beyond the 1977 requirements; would be "prohibitively costly"; would, with existing technology, create large quantities of residual pollutants; and would shift effort from more important pollution questions. Edmund Muskie, a principal author of the 1972 Act and a member of the Commission, in a dissenting opinion argued that the Commission's proposals would repeal the major innovation of the 1972 Act - the approach based on discharge limits rather than on water quality.

Congress was in 1976 considering an extension of the 1977 and 1983 deadlines and the President's Council on Wage and Price stability has specifically questioned them in the case of the steel industry. Twenty seven states had assumed authority to issue water pollution control permits by 1976 under the National Pollution Discharge Elimination System.

The EPA on its creation also took over responsibility for drinking water standards. There was growing concern in the US in the early 1970's about drinking water contaminants, in particular mineral fibres, and in 1975 the EPA also reported that measurable amounts of carcinogens, including VCM and asbestos, had been found in all 79 of the nation's water systems it had tested. Sixty six organic chemicals had been found in chlorinated Mississippi water in 1974. Interim primary drinking water standards were announced by the Agency late in 1975 under the Safe Drinking Water Act of 1974. They included maximum contaminant levels for 10 inorganic chemicals and six organic pesticides, the levels for lead and mercury being 0.05 and 0.002 mg/L respectively. Minimum monitoring arrangements were

also prescribed as usual the states were to be responsible for implementation when their plans were judged effective, the EPA itself otherwise. The Environmental Defense Fund sued the EPA on the grounds that the standards are inadequate, and the Safe Drinking Water Committee of the NAS-NRC was put under contract to the EPA to report by December 1976.

Asbestos

The original OSHA standard for asbestos was derived from a 1969 federal standard issued under the Walsh-Healey Act. It established an exposure limit of 12 fibres greater than 5 μm in length per millitre. Following an AFL-CIO petition, an emergency standard was promulgated under the OSH Act in December 1971. This established a 5-fibre standard (8 h twa), with concentration up to 10 fibres allowed for up to 15 minutes in 5 hours of an 8-hour day. A standard including these limits was proposed in January 1972, and a permanent standard adopted in June 1972. The latter provided for a reduction in the 8 h twa from 5 to 2 fibres as from July 1976. This was contested by the AFL-CIO and others in the Court of Appeal, which upheld the standard but directed reconsideration both of the effective date for the 2 fibre standard and of the record-keeping provisions of the standard. As a result OSHA decided to initiate a new rule-making procedure and on 9 October 1975 proposed a 0.5 fibre standard, with a ceiling of 5 fibres for any 15 minute period, and retention of medical records for a minimum of 40 years. This proposal also provided, among many other things, for the transfer as necessary of medical records.

OSHA's proposal reviewed the history of asbestos regulation prior to 1971. It was stated that in the NIOSH criteria document of 1971 the recommendation of the British Occupational Hygiene Society had been "given great weight". It was also said that in setting its standard OSHA "hoped that reduction of exposure levels designed to prevent asbestosis would also serve to control the hazard of asbestosis-associated cancer" with "considerable reliance" again being placed on the British experience. The new proposal also reviewed the evidence which had emerged since 1971, evidence which suggested to OSHA that a reorientation to a primary concern with asbestosis-associated cancer was now required. OSHA was also now especially concerned with the long latent period, variability in individual susceptibility, and the contemporary impossibility of defining a "no effect" threshold level. Legal authority was quoted to the effect that OSHA should not be "paralyzed by debate surrounding diverse medical opinion."

The proposed new OSHA standard would apply to all workplaces with the exception of the construction industry, for which a separate revision of the existing standard was intended. OSHA stressed that although its "prime responsibility" was a healthy workplace, the OSH Act made economic and technological feasibility legitimate factors for it to consider, especially in respect of small businesses, and such consideration could lead to a phased introduction of the proposed new standard.

In a separate move, effective 19 March 1976, OSHA made retention of asbestos monitoring and medical records compulsory for 20 years, as compared with the 3-year period in the 1972 standards. OSHA claimed "good cause" for doing this without a hearing under the Administrative Procedure Act, since no new burden was imposed and the loss of records would be "irreparable".

The Asbestos Information Association (AIA) of North America has opposed the new 0.5-fibre standard. It would prefer a delay until the new standard for the construction industry is ready, or else the fallback position of a 2-fibre standard with a 10-fibre ceiling. This it describes as "reasonable and appropriate", and a target which could be achieved in 3-5 years except for segments of the secondary asbestos industry. A report prepared for the AIA by a Tulane University Professor of Medicine argues that, no population having been exposed long enough under the 2-fibre standard, neither this nor the proposed 0.5-fibre standard could really be called "safe", but also suggests that UK and US information, though limited, is "encouraging" in respect of the former. Further, there being to date no scientifically proven safe threshold, this report points out that all exposures should be at, or even below, the lowest level technically feasible, a conclusion said to have profound implications if applied uniformly to all known carcinogens, as the report argues it should be.

An NRC report to the EPA in October 1971 called for rigorous controls on air contamination by asbestos dust and on 3 December 1971 the EPA proposed new limitations on asbestos discharge. Because there were no standardized methods of testing, no quantitative emission standards were laid down. New regulations on asbestos emissions, which were acknowledged as likely to add 8 per cent to demolition costs, were announced in March 1973. Final effluent limitation guidelines for point sources in asbestos manufacture were announced in February 1974. A "no visible emission" standard for asbestos waste disposal, with procedural modifications, was confirmed in October 1975. An EPA-NIEHS Conference in November 1973 on asbestos ingestion produced no conclusive results.

The EPA's regulation of the asbestos hazard is under CFR Table 40 Part 61, National Emission Standards for Hazardous Air Pollutants. It is convenient to summarize here the general provisions of this Part. Under it, the construction modification or operation of a plant producing a hazardous air pollutant is prohibited without EPA approval or exemption. Provisions for application for approval, for start-up notification, for reporting, and for EPA compliance waivers are laid down. Emission tests, monitoring arrangements and analytical methods are stipulated. It is specifically provided that emission data is to be available to the general public unless the EPA is persuaded of the need for confidentiality under Section 1905 of title 18 of the US Code.

The Standard for Asbestos under Part 61 covers mills, roadways, nine listed manufacturing operations including cement products and floor tile-making processes, demolition, and spraying. In the case of mills, manufacturing and spraying, there are to be "no visible emissions". In the case of roadways, all asbestos tailings are banned. More detailed provisions, including notification procedures, are laid down for demolition. The alternative of air cleaning may be chosen instead of the "no visible emission" concept in the case of mills, manufacturing and spraying.

Lead

Congress passed a lead-paint poisoning bill in 1970. This authorized the expenditure of $30 millions over fiscal 1971-3, to assist local government to detect and treat lead-poisoning and to eliminate its causes. An HEW consultant described this at the time as a "uniquely neglected public health problem." This Act was amended and extended for 2 years in 1973, $63 million being authorized for each of these years. A National Childhood Lead-Based Paint Poisoning Advisory Board was created and state and local laws pre-empted. The new Act also defined lead-based paint as paint containing more than 0.5 per cent by weight before 31 December 1974 or 0.06 thereafter, unless the CPSC chairman set another figure below 0.5 per cent. Authoritative estimates at this time were that there were 400 000 child sufferers in the US, 12-16 000 retarded and some 200 dying each year. In the first year of the programme, some 295 000 children were in fact tested, 30 000 having potentially dangerous lead levels, and 4600 needing treatment.

The Senate voted in early 1976 to renew funding under this Act. The CPSC chairman had set the 0.5 per cent level in 1974 and the National Paint and Coating Association argued that there was no evidence that this was dangerous, 70 per cent of US paint being above

the 0.06 per cent level. The new Senate bill required the CPSC as a whole, and not just its chairman, to decide on this issue.

The FDA in 1971 limited to 0.5 per cent lead content of paint which might affect children. In 1975 it reported high lead levels in baby food.

Regulations on the lead level of automobile fuel were published by the EPA in February 1972. From 1974 major service stations were to be required to offer unleaded fuel, i.e., with lead content below 0.05 g/gallon. The lead content of high octane fuel was to be reduced from 2.5 to 1.25 g by 1977. In November 1973, the EPA announced that the maximum gasoline lead content, then averaging 2.2 g/gallon, must not exceed 1.7 in 1975, 1.4 in 1976, 1.0 in 1977, 0.8 in 1978, and 0.5 in 1979. These controls were applied to refiners, with motor vehicle manufacturers, distributors and retailers and lead additive manufacturers, being similarly covered.

This ruling was challenged by, among others, the Ethyl Corporation, on grounds of no demonstrated hazard. The authority of the EPA to rule in the matter was finally upheld by the Court of Appeals in March 1976, and in 1976 also the Supreme Court upheld the EPA's 1973 regulations. Another related development in 1976 was that the National Resources Defense Council successfully sued the EPA to put lead on its list of pollutants under Section 108 of the CAA 1970. Under this a national standard for the substance must be established within a year of being placed on the list, and states must then submit control plans within 9 months, the EPA having 4 months to approve them or formulate its own control plan.

The EPA's particular emission standard for secondary lead smelters as announced in the spring of 1974 is 50 $\mu g/m^3$, with a maximum capacity of 20%.

The "common goal... most often accepted" for air lead concentrations in US industry was 150 $\mu g/m^3$, until in 1957 the ACGIH increased its TLV to 200. In 1971 the same organization advocated a return to 150, but the existing US standard, an ANSI national consensus one adopted without rationale, is 200 (8-hour twa). The NIOSH criteria document on lead submitted to OSHA in January 1973 recommended 150, but on 4 August 1975, following joint NIOSH-OSHA review of subsequent information, a still lower figure was suggested. On 3 October 1975 OSHA published a proposal for a standard of 100 $\mu g/m^3$ (8-hour twa, 40 hour week). This figure was chosen to keep maximum upper blood levels below 60 $\mu g/100$ g. Biological monitoring would be required above an "action level" of 50 $\mu g/m^3$.

The correlation of blood lead levels and air lead levels was thought to be more reliable than a urine-air correlation, but an employer could select for biological monitoring either blood lead, in which case 60μg/100 g became the level at which action had to be taken to reduce exposure on confirmation; or urine, in which case the critical level would be 100μg/L. The proposed OSHA standard contains the usual supplementary detail.

OSHA has delineated the major issues raised by its proposal. They include the appropriateness of the standard selected; the importance of subclinical effects and of effects on especially susceptible groups; the technological feasibility of compliance; the environmental and inflationary impact; and the requirement for biological analysis to supplement air monitoring.

The Lead Industries Association reacted by indicating that it preferred biological to environmental monitoring, with a permissible exposure limit of 80 μg/100 g and an action level of 60. NIOSH was in 1976 considering an expanded lead research programme.

The American Health Association was told in 1976 that occupational exposure to lead "remains a major problem". A Californian study of 898 employees in 47 firms had shown 44% to be above blood lead limits. Several specific lead smelting plants gave rise to particular concern at this time. At two plants almost half of 158 sufferers had received chelation therapy. And of 36 at another, five were said to be on permanent total disability payments. Air lead levels at this second plant had reached 2400μg. The plant had been inspected by OSHA in 1973 and a citation issued, but without a penalty: a 6 month abatement order had been subsequently extended. In another case, some 20 people at a Utah plant invested by city, state and federal officials were found to have blood lead levels of around 120μg. In yet another case, seven children of Memphis lead workers needed hospital treatment.

Also in 1976, a House subcommittee instigated hearings following reports by the Mount Sinai Medical Centre that chelation therapy was being used prophylactically.

Mercury

The FDA announced in December 1970 that 23 per cent (later reduced to 3.6 per cent) of tuna fish, and 89 per cent of swordfish consumed in the US had mercury levels above the 0.5 ppm figure it considered safe. This led to the withdrawal of all swordfish from the US market, and also of some one million tons of tuna fish. There were protests that the FDA "safe" level was ten times that suggested by WHO.

A curb on atmospheric emission of mercury, as well as on beryllium and asbestos, was proposed by the EPA in December 1971, the standard to be 1 $\mu g/m^3$ of air, averaged over 30 days.

The Federal Environment Pesticide Control Act of 1972 provides the "most extensive legal basis" for pesticide regulation, the Food, Drug and Cosmetic Act and the OSH Act also impinging on the work of the EPA's Office of Pesticide Programmes. Control of the mercury hazard by the EPA is also possible under the Refuse Act, the Water Act of 1972, and the Federal Insecticide, Fungicide and Rodenticide Act. Two withdrawal procedures can be used: cancellation, effective within 30 days, a scientific advisory committee or a hearing, or both, being convened on appeal; and suspension, when there is an immediate public hazard, the registrant having to stop on receipt of the order, there again being an appeals procedure.

In March 1972, the EPA suspended registration of 12 mercury-containing pesticides and initiated cancellation procedures for others, the total covering some 18 per cent of mercury in commercial use. In February 1976, the EPA banned most remaining pesticides containing mercury, stating that this would cut by 98 per cent mercury contamination via this route. This ban was later voluntarily delayed by the EPA to 30 June, to allow the courts to decide on its legality. The EPA has meanwhile reported that soil and plants can convert inorganic mercury to the organic form more easily than had been suspected.

In March 1973, under DFR 40:61 the EPA limited to 2300 g/day mercury emissions from ore-processing and chlor-alkali plants, and in October 1975 the limits for sludge incineration plants were set at 3200 g/day.

Radiation

To quote the International Digest of Health Legislation (IDHL), only a survey of "truly gargantuan proportions" could adequately cover US radiation protection law and practice. A very brief summary, in part based on the IDHL's own review, now follows.

Responsibility is broadly shared between various federal departments and bodies, the states and city authorities. The McMahon Act of 1946 and the Atomic Energy Act of 1954 gave the Atomic Energy Commission (AEC) a unique concentration of powers, including comprehensive licensing and regulatory authority. Under a 1959 amendment it became possible for the states to regulate certain (limited) nuclear material, provided their plans for so doing met

with AEC approval. The 1954 Act authorized the establishment of an Advisory Committee on Reactor Safeguards (ACRS), and also of three-member Atomic Safety and Licensing Boards (ASLB) drawn from a panel and able to conduct public hearings. The AEC licensing procedure for reactors has required the granting of both a construction permit - with an ASLB hearing, preliminary safety analysis report, applicant's environmental report, etc. - and an operating permit.

The AEC has essentially relied on the International Commission on Radiological Protection (ICRP) and the National Council on Radiation Protection and Measurements (NCRP) for its numerical standards, the former Federal Radiation Council (FRC) facilitating AEC administrative implementation. Weaknesses in the existing radiation protection measures were pointed out in 1959 and 1966 reports of the National Advisory Committee on Radiation. The eventual result was the Radiation Control for Health and Safety Act of 1968, in effect a new section of the Public Health Service Act, placing new responsibilities for electronic product radiation with the HEW Secretary. The FRC was created in 1959, chiefly to advise the President. Its first report developed the idea of balancing risk and advantage, and affirmed that there could be no safe exposure limit without reference to the reason for it. The FRC was assisted in some of its work by a subcommittee of the NAS-NRC. Various other NAS committees have also advised in the radiation field. The FRC's functions were transferred in 1970 to the EPA, at which time the AEC's responsibilities for environmental standards and certain functions of the Bureau of Radiological Health were also transferred. The EPA thereafter established an Office of Radiation Programmes, and created various monitoring networks. A variety of other Federal Acts, regulations, and standards administered by different federal bodies also bear on radiation. Thus for example, the OSH Act took over standards already obtaining under the Walsh-Healey Public Contracts Act.

The origins of the NCRP go back to 1928. It was reorganized and renamed in 1946, and was given a Congressional Charter in 1968, although it remains quasi-governmental, in 1968. It has some 65 members and works through some 36 committees. The NCRP is unequivocally the pre-eminent US body in its field, but the work of certain other US authorities must also be noted, in particular, the American National Standards Institute (ANSI), the American Society for Testing and Materials (ASTM), the Underwriters Laboratories, the American College of Radiology, the American Dental Association and the Surgeon General's National Advisory Committee on Radiation. ANSI currently has a major nuclear standards programme in hand, the ASTM, the National Bureau of Standards and various professional

organizations being represented on its Nuclear Standards Management Board.

State legislation in the radiation field varies enormously and there are many important divergences. This lack of uniformity is worsened by limited funds and personnel. A specific problem area is workmen's compensation for radiation injuries. Some 12 states have power plant siting legislation.

A major debate on radiation standards and nuclear safety began in the US in the 1970's, prompted and fuelled by the efforts of Gofman, Tamplin, Nader, Commoner, etc. An NCRP report of 1971 found existing US radiation standards to be adequate. This report stressed that although no exposure was safe, exposure of the total US population to the maximum permissible dose (MPD) of 170 millirems would result in only some 3000 extra cancer deaths annually, compared with the figure of 32 000 suggested by critics. It did, however, recommend a maximum of 0.5 rem for pregnant women.

Recent highlights of the continuing US debate on safety and standards follow. These items are not meant to constitute a comprehensive account.

An AEC study discussing the risks associated with nuclear power plant accidents was published in August 1974 and a final version of the study (the "Rasmussen Report"), allowing for 1800 pages of criticism from 90 sources, in late 1975. The final version differs little from the original draft in its assessment of risk probability, but it does substantially raise its estimate of accident consequences. This version again has come under attack, and an EPA report on it in particular argues that it significantly underestimates the deaths and long-term cancer development which would result from a major nuclear accident.

Citizen groups (especially in California, Wisconsin and Vermont) and scientist groups (particularly the Union of Concerned Scientists, the National Resources Defense Council, and the American Physical Society) have continued to criticize procedures, lobby strongly and initiate suits, with the object of producing better standards or a slowdown in nuclear development, concentrating their attacks chiefly on the fast reactor.

Scares and scandals occur regularly, e.g. figures were given by the New York Times in August 1974 showing that there had been over 2000 important violations of nuclear regulations in 1973-4 in the US, including nearly 100 in the top category of seriousness, yet the AEC had revoked licences in only two cases and imposed fines totalling $37 000 for only six others. The AEC's own figures show

that in 1972, for example, there were 371 potentially hazardous abnormal events at the country's 42 nuclear stations, 12 of them involving releases of radioactivity above permissible limits at plant boundaries, although none resulted in a public health hazard. Various "insiders" continue to "whistle-blow" and/or resign from government and industrial organizations from time to time. The AEC Chairman acknowledged in 1974 that that organization had in the past suppressed information on nuclear plant safety.

The EPA expressed dissatisfaction in February 1973 with the AEC's environmental impact statements in regard to emergency safety procedures for nuclear plants, on the grounds that catastrophic possibilities had not been properly considered. The EPA was, however, advised by an Office of Management and Budget memorandum of December 1973 that it should not attempt to set environmental standards for individual nuclear plants. This was to remain a matter for the AEC, and the EPA was to confine itself to setting standards for the total environmental burden of radiation and its standards were to reflect AEC findings regarding the feasibility of emission controls. In May 1975 EPA asked that public radiation standards be reduced from 500 to 25 millirems (whole body). The organization has also from time to time reported particular nuclear incidents. It set final regulations limiting radioactivity in water in July 1976; maximum permitted dosage from artificial sources is to be 4 millirem/year, effective June 1977.

The Federal Government's energy responsibilities were fully reorganized following an Act of October 1974. This Act abolished the AEC, creating instead an Energy Research and Development Administration and a five-man Nuclear Regulatory Commission, the latter taking over the AEC's licensing, safety and regulatory function, including the ACRS, ASLB Panel and Appeal Panel. The AEC's regulatory division became an Office of Nuclear Material Safety and Safeguards in NRC, and new Offices of Nuclear Reactor Regulation and Nuclear Regulatory Research were created.

The "basic purpose" of the Act, as defined by the Senate Government Operations Committee which reported the bill, was to separate the regulatory functions of the AEC, which had been "weak and undernourished", from its promotional functions, where "vast resources" had been committed. A proposal to transfer the AEC's standard-setting authority to the EPA was defeated in the House, and provision in the Senate version of the bill to give financial assistance to individuals participating in regulatory proceedings was eventually dropped in Conference. The Act provides only for civil penalties.

The AEC's director of regulation stated at the time of the transfer of the AEC's regulatory responsiblities to the NRC that

> "The NRC has been freed from the albatross of apparent compromise that hindered the AEC... the AEC was slow to acknowledge what regulation in the public interest really implies. In the 1950's and 1960's the AEC... neglected its regulatory role... the AEC... was slow to shift its emphasis... it... interpreted its regulatory role in a narrow sense - radiological safety. It was left to the courts to explain that the protection of the 'public interest' demanded more."[19]

The director now stressed two considerations: "The public is entitled to be informed of any regulatory activities which affect it. This means all activities ... with regard to nuclear safety, conservatism must be constantly emphasized".

It is not yet clear what difference, if any, creation of the NRC has really made. The early signs were encouraging. For example, the organization demonstrated new teeth in early 1975, closing 23 of the nation's 52 nuclear plants for tests, and indicating that it would delay for at least three years a decision on the use of plutonium in reactors, the AEC having approved this in August 1974 and the EPA having called for a 4-12 year delay. However, 21 of the 23 reactors were quickly declared safe, and interim plutonium licences were granted later in the year. Doubts about nuclear safety within the NRC itself continue to be reported.

Vinyl Chloride Monomer

The main facts in the VCM case from the US point of view appear to be as follows:

1949	Reports of liver damage at 500 ppm (not confirmed).
1961-70	Main preliminary reports of VCM toxicity; Dow adopt a 50 ppm standard following their own research; West German authorities follow with 100 ppm.
May 1970	Viola reports that high VCM concentrations cause cancer in rats.
1971	US Manufacturing Chemists Association (MCA) initiates VCM toxicity research.
April 1972	Maltoni finds angiosarcoma and other tumours in animals at 250 ppm VCM.
Oct. 1972	MCA enters into agreement with European manufacturers sponsoring Maltoni's work not to publish preliminary results.

Jan. 1973 NIOSH requests information on occupational hazards of 23 substances, including VCM.

April 1973 Maltoni presents preliminary results to a Bologna cancer symposium. NIOSH's associate director of carcinogenesis discusses Maltoni's results with him and asks that they be included in a report to the WHO International Agency for Research on Cancer. MCA and European manufacturers agree to make a joint presentation to US and European governments.

June 1973 MCA requests a meeting with NIOSH.

July 1973 MCA communicates to NIOSH an updating of Viola's results at lower VCM levels.

22 Jan. 74 BF Goodrich company report three angiosarcoma deaths among their employees; MCA forwards Maltoni's results to NIOSH, which communicates with OSHA.

15 Feb. 74 OSHA holds fact finding hearing.

March 1974 A European group of toxicologists notes that although industrial VCM exposure is "the most important problem", methods of reducing VCM in plastic products "should be urgently explored", this being "of particular importance" for food containers, for which it was "thought desirable and possible" to reduce VCM to 20 ppm. "As a matter of expediency" some countries might decide on total abolition of PVC manufacture.[20]

5 Apr. 74 OSHA promulgates emergency VCM standard of 50 ppm.

26 Apr. 74 EPA suspends indoor aerosol sprays containing VCM.

16 Aug. 74 CPSC bans VCM in aerosol sprays.

4 Oct. 74 OSHA publishes a final exposure standard for VCM.

Aug. 75 FDA proposes banning rigid or semi-rigid PVC food packaging.

24 Dec. 75 EPA proposes a standard for VCM as a hazardous air pollutant.

1976 Reports that VCM can cause birth defects.

A report of the AAAS Committee on Scientific Freedom and Responsibility concluded from essentially these facts, that in the VCM case

> "a considerable number of scientists were aware of the hazards of vinyl chloride long before the facts were made available to NIOSH or to the public: yet they kept quiet and gave no warning."[21]

In response, an MCA spokesman has argued that the AAAS's presentation of the case contained "omissions and errors that are inconsistent with the committee's concern", to which the chief author of the AAAS report, John T. Edsall, has rejoined that the MCA attitude illustrated the major point which had worried the committee, namely

that new reagents should be regarded as dangerous until proved safe, rather than the reverse as has traditionally been the case.

It is very apparent that there were significant delays in communicating information about VCM carcinogenicity to government agencies, and more controversially, that there was further delay after NIOSH personnel first became aware of the new fears about VCM. It is also clear that the research effort on VCM toxicity was, at least until 1970, well below what might have been looked for, given the material's economic importance. Further, even the high 500 ppm VCM standard does not seem to have been taken very seriously in the US. On the other hand, it must be recognized that it was industrial funding which eventually, albeit belatedly, led to more authoritative information about the VCM danger.

OSHA's 50 ppm interim standard of 5 April 1974 was "expressly recognized" at the time to be highly tentative and results were particularly awaited of experiments already then in progress. The 50 ppm standard was set because "employees were being exposed at levels around the experimentally observed effect level of 250 ppm", and VCM-linked deaths had by this time been recognized in four companies. OSHA was able on 10 May 1974 to publish a proposed permanent standard. This called for a "no detectable level" of VCM at a sensitivity of 1 ppm and with an accuracy of $\pm$ 50 per cent, and included also provisions for monitoring, medical surveillance, respiratory protection, engineering safeguards, etc. Thirty days were allowed for comment, and given that the Act required a final standard within six months, hearings were scheduled for 25 June. The hearing was finally completed on 11 July, with 23 August set as the final date for filing of post-hearing data. OSHA at the same time commissioned an independent report on the feasibility of compliance at various exposure levels, comment on this being allowed until 25 September. This was also the last day for submission of comment on OSHA's environmental impact statement for VCM.

OSHA has described its VCM record as "one of the most exhaustive" it has ever relied on, with 600 written submissions and 4000 pages of testimony. OSHA acted on the advice of NIOSH, the NCI, and a 1970 report by the Surgeon General's Ad Hoc Committee, to the effect that safe exposure levels for carcinogens cannot be scientifically determined. OSHA also rejected arguments put forward at the VCM hearing that man is less sensitive than experimental animals to VCM-induced aberrations; and that current VCM exposures were below that formerly encountered, had not induced cancer, and were therefore safe. OSHA chose to accept that the existing state of scientific knowledge did not allow quantification of a safe exposure level, rather than the alternative position that there was no evidence of cancer induction, either in experimental animals or in

employees, below 50 ppm. It was not expected that VCM and PVC establishments would immediately and completely be able to achieve a 1 ppm standard. "We do believe, however, that they will, in time, be able to... for most job classifications most of the time." Feasibility projections were for the moment necessarily conjectural, and OSHA could not wait until "indisputable answers" were available to the various questions about VCM.

The final VCM standard published by OSHA on 4 October 1974 went into the usual substantial detail in respect of monitoring, medical surveillance, hazard warning, methods of compliance, repiratory protection, emergency situations, record keeping, etc. Its essential quantitative features were as follows:

> Effective 1 January 1975, a permissible exposure limit of 1 ppm averaged over an 8-hour period, with a 5 ppm ceiling averaged over periods up to 15 minutes; employers able to demonstrate that exposures were always below an "action level" of 0.5 ppm to be effectively exempt from most of the VCM standard's provisions; respirators to be optional below 25 ppm until 1 January 1976, compulsory thereafter; records to be kept for a minimum of 30 years.

The original effective date of 1 January was deferred, under industry pressure, eventually becoming 1 April, but OSHA denied a request by Firestone to delay until October 1976 the respirator requirement part of the VCM standard. The US Court of Appeals upheld the regulation in January 1975, and the Supreme Court refused in March to further delay its implementation, while still considering whether to accept appeal against the standard itself. In May the Supreme Court decided against reviewing the lower court's decision on the standard.

The EPA began its own consideration of VCM with the establishment of a Task Force in February 1974, and in May 1974 a study was initiated to determine whether federal regulation of atmospheric emissions of VCM was required, and, if so, under what section of CAA 1970 the EPA should proceed. As a result, the EPA concluded that VCM was a "hazardous air pollutant" within the meaning of the Act, and that it should therefore proceed under the section (112) providing specifically for such substances. On 24 December 1975 the EPA published a proposed VCM standard, together with two support documents, one a scientific and technical assessment of VCM, the other, an environmental impact statement. According to the EPA's figures, 4.6 million Americans lived within 5 miles of a relevant plant, and some 100 million kg of VCM were being emitted to the atmosphere annually. A preliminary monitoring programme suggested that people in the vicinity of a plant were experiencing less than 1 ppm on average daily, with some 24-hour excursions to 1-3 ppm: peak

concentrations of 33 ppm noted at first were not confirmed in a later EPA study.

The EPA had considered taking no action at all, but had felt unable to ignore VCM simply because it was a known carcinogen. One result of OSHA's regulation of VCM was to be reduced emission, but this was not expected to be uniform, and in any case increased ventilation to the atmosphere was to be one way of meeting OSHA's standard. Nor had EPA felt able to delay action. A standard could be long delayed if the agency were to wait for precise dose-effect information, and in any case the organization had concluded that "available evidence indicated that ambient concentrations of VCM pose a public health risk."

The EPA next considered regulating VCM under Sections 109 or 111 of the CAA 1970, instead of section 112. Section 109, the National Ambient Air Quality Standards provision, was rejected because VCM was seen as a localized problem, and because this section and the associated state of implementation plans failed to "provide the expedited means of control which Congress meant to be used for a hazardous air pollutant." Section 111 too, covering new stationary sources was judged inappropriate, because under it regulation would take longer, the level of control could differ as between states, the states could grant variances based only on cost considerations, and the standard development process under this section was a state rather than a federal responsibility.

The EPA still had the problem under section 112 of deciding what the emission standard should be, as this section requires that the standard be set "at the level which... provides an ample margin of safety to protect the public health." The EPA judged VCM to be an "apparent non-threshold pollutant", that is one for which it seemed there was no atmospheric concentration which produced "absolutely no public health risk." Nevertheless, the EPA determined that section 112 did not require a zero standard, since this could lead to the closure of an entire industry. Instead, the EPA elected to interpret section 112 to mean setting standards which reduced emission to the "lowest level achievable by use of the best control technology", the same approach as had been used in the case of asbestos, but not one which had been judicially tested.

The EPA proposed that its standards apply to the 41 existing PVC plants in the US, and to the 17 existing VCM plants, but not to the 8000 PVC fabricating plants - where emissions, already shown to be negligible, were expected to fall further as a result of OSHA's action - or to eight miscellaneous plants. It was recognized that the bat approach would produce different emission levels and ambient air concentrations at different plants due to plant circumstances. To

qualify as bat it was decided that the control technology must already be in use in at least one plant and be adaptable to all relevant plants within the time allowed. In arriving at the standard, costs had been "considered only when they were grossly disproportionate to the emission reduction achieved.. A fine balancing of cost against benefits was not undertaken."

The EPA's proposed standard contained separate provision for the different VCM emission points in VCM and PVC plants. The standard centred on a stack and fugitive emission limit of 10 ppm. Total plant emission limits in terms of kg/h or kg VCM/kg product were rejected, partly because of different plant sizes, partly because of measurement problems. The Energy Supply and Environmental Co-ordination Act of 1974 exempted Clean Air Act actions from the NEP Act requirement of preparing an environmental impact statement, but the EPA elected to prepare such a statement for its VCM standard. According to this impact statement, the standard should reduce hourly VCM emissions at a typical VCM plant by some 94 per cent, and at a PVC plant by some 95 per cent.

Toxic Substances Act

A CEQ report of 1971, one of many similar ones both before and since, argued that there should be adequate testing of new and widely used chemicals. The Administration thereupon introduced a toxic substances bill which would have allowed the EPA to collect data, establish testing systems, control hazardous substances, etc., but would not have required pre-use screening.

As things then stood, only in the cases of pesticides, food additives, and drugs did the burden of proving safety have to be borne before use, and by the user. In all other cases, the question of hazard was left to be raised afterwards, and by the government. The EPA's deputy administrator acknowledged in 1975 that there were inconsistencies in such existing laws as had control provisions for toxic substances.[22] In particular, section 307 of the 1972 Water Pollution Act could not be made to work in this respect, and Section 112 of the Clean Air Act was little better - in this case, if there was no safe threshold for some pollutants, then the "basic rationale for the statute may be in trouble." Apart from these two Acts, others containing control provisions for toxic substances are: Safe Drinking Water (1974); OSH Act (1970); Transportation Safety (1974); Solid Waste Disposal (1965) and Resource Recovery (1970); Marine Protection Research and Sanctuaries (1972); Federal Insecticide, Fungicide and Rodenticide Act (1974); and Federal Environmental Pesticides Control Act (1972). Three EPA lawyers in fact resigned in November 1975, alleging that the Agency was not even using its

existing toxic chemicals legislation very vigorously. The EPA's Office of Toxic Substances contracted in 1974 for information on new uses of existing chemicals and on reasons for environmental concern in respect of both old and new products. These reports were later published.[23]

Toxic substances legislation was passed by both the Senate and the House in 1972 and 1973, but each time it proved impossible to resolve differences between the House and Senate versions. The Senate versions were tougher in two respects: they would have required pre-use screening of all chemicals not regarded by the EPA as clearly safe, and they would have left the EPA free to choose whether to use the new law or an existing law, when there was one, to control a specific chemical. The House versions would in effect have called for the testing of only a limited list of provisionally designated dangerous chemicals, and would have permitted the new law to be used only when no existing one would serve.

In 1975-6 legislation in this field was in the hands of the Commerce Committee of the Senate and the Interstate and Foreign Commerce Committee of the House. Legislation was passed by the Senate in March 1976 (S776), the Manufacturing Chemists Association (MCA) continuing to favour a more restricted House bill, and the Administration remaining "strongly" opposed to the Senate bill, on the grounds that it placed excessive burdens on industry and the EPA, failed to safeguard trade secrets, and offered too much encouragement to the public to sue for regulatory action. The first bill to be supported by the Administration during this session was HR 7664, and in favouring this the government made it clear that it wanted only chemicals posing an "unreasonable" risk to be covered, so as "not to unduly impede technological innovation."

A version (HR 10318) similar to that passed by the Senate was approved by a subcommittee of the House committee in 1975, and its proponents were hopeful that this time a strong bill would pass the full committee and also Congress, although, of course, even then they had to fear the possibility of a Presidential veto.

A weaker bill (HR 12336) was also placed before the House, as too was a compromise bill (HR 14032) preferred by the Administration. A few examples will demonstrate the general differences between the "strong" and "weak" versions. Thus the weak version would have confined regulatory action by the EPA Administrator to chemicals which "cause or significantly contribute to" unreasonable risk; the strong version broadened this to ones which "may or will" so contribute. Furthermore, the weak version would have forced the EPA Administrator to consider the costs and feasibility of testing; would not have compelled him to have a rule-making proceeding if he

proposed not to act; would have attached a member of the Commerce Department to the EPA Priorities Committee; and would have imposed penalties for violations of confidentiality.

Advocates of a strong measure implied that VCM, the PCB's and BCME, which caused 25 cancer deaths in one company, were all examples of chemicals whose dangerous properties would, with such an Act, have been recognized before use. However, while it might well have prevented the original introduction of, for example, kepone, it should be realized that a toxic substances Act could not have been used to control this substance when used as an insecticide.* This is because kepone as an insecticide falls under the Federal Insecticide, Fungicide and Rodenticide Act, and as a pesticide was, like food, drugs, tobacco and nuclear substances, specifically excluded from the proposed toxic substances law.

Another incident much cited by supporters of a strong Act was the contamination of animal feedstock in Michigan in 1973-4 by polybrominated biphenyl. This eventually led to the destruction of some 40 000 animals and to wide public exposure, especially of farm families. A toxic substances law might not have prevented this disaster, but it would quite possibly have mitigated its effects. This was actually only one of 24 similar incidents in the period 1968-74.

The cost of an effective screening programme in the United States for toxic chemicals has been highly contentious. Dow Chemical Co., essentially opposed to all such legislation, earlier put its own annual costs at $2 billions. An MCA study suggested $1/3 - 1 1/3 billions. The EPA itself in a draft impact statement said $80-140 millions, and the Government Accounting Office (GAO) $100-200 millions, the latter pointing out that benefits, such as reduced medical costs, had not been taken into account in its calculation. It is also not precisely clear how many substances per year would be involved, but a CEQ figure is 600, only some of which would require major long-term testing.

Apart from the extremely demanding problem of new chemicals, a toxic substances act could naturally also address itself to a more subtle problem, a significant new use of an old chemical. Such a new use has sometimes, for instance, followed publicity that a particular chemical has cmt potential; a substitute, possibly equally untested, may then be rapidly introduced. In this connection the NCI has

*Kepone, now known to be an animal carcinogen, was discovered late in 1975 to have caused serious illness to 23 workers, including sterility to 14, and to have polluted air and water near its manufacturing plant in Virginia.

warned, for example, that methylene chloride, recently used in decaffeination instead of trichlorethylene - the latter having become a suspected carcinogen - is itself an unknown quantity.

It should be noted that toxic substances legislation is an environmental issue on which the environment lobby has been firmly backed by the relevant unions. It is of interest as well that the 1976 Senate version of the Act, like the Water Pollution Control Act of 1972, contained a provision for the EPA to hold a hearing at the request of any employee who felt he had been intimidated or dismissed because of the law.

A US Toxic Substances Control Act was finally passed by Congress in late September 1976. Its main provisions are as follows. The EPA Administrator can require testing by manufactures of any new or existing chemical he deems appropriate as presenting an unreasonable risk to health or to the environment. Manufacturers are required to notify the EPA 90 days before the commercial introduction of a new chemical, or before promoting a significant new use of an old one. Under the Act the Administrator was given until November 1977 to publish a definitive list of existing chemicals, any substance not on this list to be regarded thereafter as being new. A committee of eight officials drawn from relevant federal agencies was at the same time charged to produce by September 1977 a list of substances with cmt potential for priority consideration by the EPA, this list to be updated twice yearly. The EPA can under the Act effectively ban or regulate any chemical if the evidence regarding its safety is insufficient, but a court order is necessary if the company concerned objects. Chemicals controlled under existing laws are excluded, but the EPA was given more latitude in its use of the available legal alternatives than the House had wanted. The Agency must give reasons when it elects not to act, and it is also open to private citizens to petition it. Its regulation is to be preceded by informal hearings - although to cope with extreme hazards provision is made for rules having immediate effect. Some $10-16 millions annually are set aside to administer the Act, and there is a small fund to assist participants in regulatory hearings.

PCB's are the only chemicals specifically mentioned in the Act. They are not to be manufactured or imported after 1978, and are subject to tight restrictions in the interim. Imported chemicals are to be treated in effectively the same way as chemicals manufactured in the United States. Exported chemicals are not to be regulated but there is provision for foreign governments to be informed about their hazard status.

Manufacturers are required under the new Act to keep medical records of their employees for 30 years.

Interest in CMT Hazards

The Toxic Substances Control Act apart, there is currently intense US interest in chemicals with cmt potential, especially carcinogens. Examples of this interest in 1976 follow:

- The Subcommittee on Environmental Carcinogenesis of the National Cancer Advisory Board was preparing a document, "General Criteria for Assessing the Evidence for Carcinogenicity of Chemical Substances". This is expected to have legal as well as scientific significance.
- The US NCI announced that a National Clearinghouse on Environmental Carcinogenesis would commence in May 1976, with NCI, EPA, FDA, NIOSH, NIEHS, NCAB and HEW representatives. A committee of 30 would work through four subgroups, on priorities, experimental design, data analysis and cost benefit analysis, the whole process to be public. NCI stated at this time that of the 6000-7000 chemicals in large scale use which have been tested, 1000 were animal carcinogens, about 30 known to be human ones, the problem of proof being much greater in this case. Some 150 of the 500-600 new commercially significant chemicals each year were subjected by NCI to long-term rodent feeding tests, at a cost of $100 000 per chemical.
- Detailed proposals were put to the EPA's environmental health advisory committee for a programme on the assessment of carcinogens in the environment.
- A GAO report urged the NCI to develop a uniform federal policy for identifying and regulating carcinogens.
- An NCI-American Cancer Society symposium, "Persons at High Risk of Cancer", was published (eds. M.B. Goldman, P. Cole).
- OSHA was expected to list further chemicals believed to be carcinogenic - an emergency list of 14 had been published on 29 January 1974.
- The House Appropriations Committee criticized the NCI for devoting too little effort to the environmental causes of cancer; NCI's Associate Director for Carcinogenesis resigned in April 1976 for the same reason.
- On 25 May 1976 the EPA published interim procedure guidelines for its assessment of suspected carcinogens. In his covering memorandum, the EPA Administrator stated that:

> "There is evidence that a substantial amount of human cancer is caused by chemical and physical agents in the environment... It is important to emphasize that there are serious regulatory gaps... Regulatory action against chemical carcinogens is relatively new... I recognize that the aspect of cancer research dealing specifically with the issues involved in decision-making is relatively undeveloped".

The Administrator cited experience with ionizing radiation - the "sole exception" until the late 1950's of an agent regulated for carcinogenic action - and with FIFRA, rather than with the Delaney Clause of the Pure Food and Drug Act, as providing basic guidelines for balancing risks and benefits. The EPA's interim procedure document dealt, among other things, with the responsibilities of its Cancer Assessment Group, Office of Pesticide Programmes and Pesticide Chemical Review Committee in handling the regulation of carcinogens.

- There were various scare reports: for example, an EPA commissioned study apparently showed that males residing within a half-mile of a Baltimore arsenic plant had a lung cancer rate four times that for non-industrial parts of the city; an NCI study that 19 of New Jersey's 21 counties were in the top 10 per cent of all US counties for cancer deaths - New Jersey has the nation's highest concentration of chemical plants; Shell reported to NIOSH that 14 of its isopropanol workers had developed cancer; a study of former plutonium workers apparently showed higher cancer rates, especially for leukaemia, than expected: an NCI study supported a Swedish one to the effect that bench chemists experience a statistically significant excess of cancers, especially of the lymph tissues; an argument developed between two HEW agencies, the NCI and the NCHS, the latter having in November 1975 reported a 5.2 per cent increase in the crude cancer death rate, compared with an annual 1 per cent increase; etc., etc.
- And finally, mention might also be made in this context of three among many items from 1975:

(a) a statement by the Environmental Mutagen Society which stressed that reliable identification of mutagens was only the first part of the information needed for their control. The Society wanted the burden of testing placed with manufacturers and limits on mutagens such that the resulting genetic damage remained less than a 12 1/2 per cent increase over the spontaneous mutational background, with no individual during reproductive life exposed to more than 10 times the average. Even this could double the genetic risk and the Society insisted that the individuals at hazard should be so informed. A test calculation suggested that for nitrates the existing exposure limit amounted to 20 per cent of the spontaneous rate:

(b) a report to HEW noted that at least 21 substances on NIOSH's priority list had shown some evidence of teratogenicity, including lead, mercury and NO_x:

(c) an NTIS published search, Environmental Carcinogens, was released in October.

Some Related Developments

Given the orientation of the Science Council study, this short review of relevant US regulatory activity has necessarily been focused on the activities of the EPA and OSHA. However, brief reference really needs to be made also to certain other US developments having some bearing on this whole field.

Thus, note should be taken, especially because of the overlap with the EPA, of the Consumer Product Safety Commission (CPSC), created by an Act of 1972. This took over the functions laid down in the Hazardous Substances Act. The Administration would have preferred the CPSC's powers to go the FDA, and the CPSC has no powers in the field of food, drugs or cosmetics. The five-man CPSC was otherwise given powers to accept voluntary standards, to ban, order court seizure or enforce recall, inspect, test, set standards and subpoena records. State legislation is now pre-empted in its field. Limited citizen suits were permitted against it, including, after its first three years, suits to compel it to develop specific standards. The Act provides for tough civil and criminal penalties. The 1976 Amendments to the Act were framed to facilitate private initiative and to make the CPSC more independent of the Justice Department. One example of such action: the Natural Resources Defence Council filed a petition with the CPSC in 1976 to ban asbestos patching compounds. Particular criticisms of the CPSC have been that it has allowed commercially interested parties to draft standards for its approval and, of special interest in the present context, that it has had an "injuries" rather than a "health hazard" outlook.

The US Administrative Procedure Act, as amended, is nominally intended to furnish citizens with such information about the work of federal agencies as they need to protect their interests. With certain more or less obvious exemptions, agencies are supposed to make available a wide range of specified information in the Federal Register. It is provided, again with fairly predictable exceptions, that citizens shall be enabled to participate widely in agency rule-making, both in writing and orally, provided that the agency agrees to a hearing. Furthermore, citizen initiative is usually possible to compel an agency to act. Recent Acts have gone even further in this respect. In many cases, provision for public hearings is specifically laid down. Beyond all this again there is usually scope for judicial review by the courts of an agency's action or inaction, either as a separate statutory procedure or in the course of a civil or criminal action. The granting of standing in such instances appears to have become very generous in recent years. The Hart-McGovern bill of 1971, based on a Michigan statute, would

formally have assured the standing of citizens in federal courts on pollution questions. It was opposed by the Administration on the grounds that substantive legislation already provided adequate opportunities. In principle, courts do not question facts or technical judgments, confining themselves to the intent of the law, but given the cost-benefit element in regulatory decision-making, this cannot be a simple distinction.

The four-year old Federal Advisory Committee Act led to over half of relevant committee meetings being open to the public in 1975, another quarter being partially open. However, a House Committee report in 1976 accused one agency at least, the FDA, of seriously misusing the advisory committees, complaining in particular about their often being closed to the public, manipulated, and allowed to proceed with unresolved conflict of interest questions. It has also been suggested in the case of the FDA that recent amendments to the Freedom of Information Act, intended generally to make more internal agency documents available to the public, have been exploited more by corporations than by individuals. The FDA was a particular centre of controversy in 1974-76.

Congressional debate on regulatory reform began in earnest in October 1975, with hearings before the Senate Government Operations Committee, one of two committees conducting a joint Senate-House study. The committees were investigating unnecessary delays in the regulatory process, duplication between agencies, agency independence and priorities, Congressional oversight, and the adequacy of public participation. The investigation was of clear importance to the regulation of man-made hazards, and the subject a highly sensitive one in view of the regulatory abuses under the previous Administration and the antipathy shown by its successor to the activities of these agencies. Under the Ford Administration's regulatory reform programme the EPA and NRC were scheduled for consideration in 1978, the OSHA, CPSC and FDA in 1979.

The House has actually reported legislation in 1976 intended to allow the Houses of Congress, acting jointly, to nullify a new regulation proposed by an agency. There was definite Congressional support for this, but firm opposition from the Administration, on the grounds that it would undermine the doctrine of separation of powers. A proposal for such a veto on CPSC regulations was dropped in Conference Committee in 1975. Critics see the agencies as a fourth branch of government, and they have a point - there were almost 8000 regulations in 1974 from 67 agencies, compared with just 400 public laws.

The NEP Act had led to 5430 environmental impact statements by June 1974. A CEQ analysis of 70 federal agencies over the period

January 1970 - June 1975 showed that of 654 court actions under the NEP Act, 333 had been completed, a third of these having been dismissed, with 60 temporary injunctions and four permanent ones, although even in the latter case it remained open to the agency to try a second time to comply with the NEP Act. The NEP Act's first 3 years, a reputable study has suggested, were "marked primarily by a focus on procedural compliance with the Act",[24] the agencies not taking the Act's substantive mandate very seriously. The Act has, it appears, improved the processes of information generation and dissemination, rather than that of decision. On a closely related point, another recent analysis concluded that

> "unless impact analyses incorporate judgements in a very explicit and careful manner they will themselves become the subject of conflict rather than a means of resolving conflict".[25]

And one further recent comment on environmental impact statements seems worth repeating here, W. Schindley of the Freshwater Institute, Winnipeg, in a guest editorial in Science ("The Impact Statement Boondoggle", 7 May 1976) made a swingeing attack on such statements. They consist, in his view, of very inferior science performed by second class scientists and consultants, were funded in relation to the source affected rather than in response to scientific possibilities, and were rarely subject to hard scrutiny.

CHAPTER IV - SWEDEN

Given the Canadian context of this review, consideration of federal West Germany might seem more useful than consideration of unitary Sweden. Two quotations make it plain why Sweden is perhaps the more interesting of the two:

> "Pollution abatement... is not a political subject as such in Germany today. The general public in the main is unmoved by the mounting problem of pollution. This apparent lack of concern has its roots in the deference which is shown to the needs of the industry. Consequently there has been no real pressure on either the Lander or the Federal Government such as has occurred in other West European countries..."[26]

> "If countries... were classified according to (1) their willingness to spend money on the environment; (2) their economic wealth...; (3) anti-pollution laws; and (4) the needed public support to help government agencies carry out their work; then Scandinavia would certainly be in Class A with Sweden at the top."[27]

The first of these statements was made rather more than 2 years ago but still does not seem too harsh in 1976/77.*

The Occupational Context

Swedish occupational safety legislation dates from an 1889 Act, the first labour inspectors being appointed in 1890. A benchmark was the passage in 1949 of the Workers Protection Act and the setting up that year of the National Board of Occupational Safety and Health (NBOSH). Of the 1960's it has rightly been said that "the debate on the working environment was waged with mounting intensity."[29] In 1970 a Work Environment Commission was appointed. It is necessary to digress at this point to explain briefly the role of such Commissions in the Swedish system of government.

*A detailed study of law and practice in the environmental field of West Germany performed as part of a review on the EEC countries, has recently been published. This was available in draft to the present author and is included in the references.[28]

In Sweden, central ministries are very small - about 100 total staff - and they confine themselves to policy matters. The execution of government decisions is entrusted to quite separate administrative boards, of which NBOSH is one. Legislation is typically developed through the work of specially appointed Commissions, usually of 5-10 members supported by a secretariat. The members of a Commission are selected from government and opposition parties, from both sides of industry, from other organizations having an interest in the subject concerned, and from relevant professions. It needs to be underlined here that co-operation between the two sides of Swedish industry has been unusually close.

A Commission may work for several years in closed session, but taking evidence from all who wish to give it. When its report is eventually made to the appropriate ministry, a further period is allowed for comment by all interested parties before legislation is presented to Parliament. The latter works through some 16 standing committees, their chairmanships and composition reflecting parliamentary strengths. There may be closed committee hearings on government bills. It is recognized that the whole process of policy development is "cumbersome and often time-consuming". In Elder's words, "Inquiry proceedings are traditionally thorough, reports are often voluminous... the circulation of draft proposals and of inquiry recommendations... slow down the legislative timetable."[30] However, the effort is thought worthwhile to promote democratic government, a uniquely mature consensual style results, and "the Swedish legislative process can fairly be characterized... as leisurely, thorough and... relatively liberal." It should also be remembered that Sweden operates the "principle of the goldfish bowl", government documents and files being accessible to the public to the greatest extent possible - though as Shonefield[31] has remarked, "the whole business is immensely inconvenient... The catalogue of possible inefficiency is large."

The Work Environment Commission referred to above was chaired by the director of NBOSH. It presented an interim report in 1972 and a final report in 1976. An Act of 1974 was based on the interim report and provided, among other things, for a reinforcement of the system of safety officers. In Sweden the latter now "enjoy special security of employment and are entitled to the training they require". The final report of the commission sets out a complete new code of occupational safety legislation. This is discussed below. In 1972, NBOSH absorbed the National Institute of Occupational Health, setting up its own Occupational Health department; in 1974 NBOSH was moved from the jurisdiction of the National Board of Health and Welfare to that of the new Ministry of Labour. The Board has a current staff of around 400 and the Labour Inspectorate, which reports to it, another 400, each having a budget of some $10 millions. The Board is

responsible in particular for implementing the Worker's Protection Act of 1949, as amended, and, within its field, the 1973 Act on Products Hazardous to Health and to the Environment.

Under another Act, there having been a substantial rise in company profits in 1974, companies with profits in excess of 100 000 Kr. that year were ordered to spend 20 per cent of them within 5 years to improve the work environment, the improvements to be agreed with employees. Firms with profits below this figure could apply for state loans, interest free for 2 years, for the same purpose.

The Work Environment Commission has suggested that the new Act it proposed should override all existing occupational legislation as from January 1978.[32] The proposed Act, with its substantially expanded applicability, it has described as representing a "completely new order of things" as compared with the existing Workers' Protection Act. Consisting, as is usual, of outline enabling legislation to be filled in later by detailed NBOSH regulations, the new Act is intended not only to protect against hazards but, "in keeping with the broader view which is now taken of the working environment", is concerned also to establish conditions "in which the individual can experience his work as a meaningful and rewarding part of his life." Under the Act, the NBOSH and Labour Inspectorate would have considerably greater powers to issue regulations, to inspect, and generally to monitor workplace affairs. The sanctions they could deploy would also be tougher. For example, special conditions for the use of a particular chemical could include instructions with direct penal clauses, or an infringement of a prohibition in respect of a chemical could result in the forfeiture of that chemical or of its value.

The Commission has proposed ending the separate existence of the Explosives and Electrical Inspectorate. Local implementation of the new Act would be conducted through the 19 districts of the Labour Inspectorate. Radiation injury would fall within the new Act, as it does not within the existing one, but enforcement responsibilities in this case would remain with the National Institute of Radiation Protection. The Commission did not support the report of the Committee on the Co-ordination of the Laboratory Resources of the NBOSH and the National Environment Protection Board (NEPB), to the effect that a new institute of environmental medicine be created based on the Department of Environmental Hygiene (temporarily attached to the NEPB). Instead, it wanted the attachment to be the National Board of Health and Welfare.

The Act proposed by the Commission makes several references to chemical hazards. The Act's general objectives in this respect are meant to ensure (a) that a hazardous substance will be used only when

adequate security arrangements have been made; (b) that protective equipment will not be allowed to substitute for direct action to improve the work environment; (c) that particularly susceptible groups such as pregnant women will be protected by prohibitions or by the prescription of special conditions. The Commission has lent its support to a comprehensive approach to chemical hazards, and in particular to the existing role, outlined below, of the Product Control Board under the Act on Products Hazardous to Health and to the Environment. On the other hand, the Commission has noted that

> "the immediate hazards presented by the handling of chemical substances come mainly within the working environment. The overwhelming proportion of these hazards occur first and most intensively in the working environment, and it is here that undesirable effects can be expected to appear first."

It must therefore be "one of the main tasks" of the NBOSH to issue general regulations to cope with this situation, specifically, regulations establishing liability to pre-test.

The Commission has also favoured the expansion of the system of TLV's to cover more chemical and physical hazards, as well as statutory establishment of the system.* Limit values should protect, the Commission says, against long-term risks as well as short-term ones since they involve risk assessments, the assumptions underlying them should be fully spelled out, and the NBOSH's decisions be based on both the technical facts and the opinions expressed by trade unions and employers' associations.

The Swedish Work Environment Fund was set up by the Ministry of Health in 1972. The institution's function is to support research, development, education and information-dissemination in connection with the occupational situation. It is financed through a 0.1% levy on the wages and salaries paid by both public and private employers. It has some $20 millions available to it in 1974.

There is also now a Swedish Task Force of experts for Research on Chemical Pollution in the Work Environment.[33] This has tried to survey work in Sweden and abroad and to determine priorities in relation to Swedish research capacity, specifically identifying

*The Ordinance under the Workers' Protection Act of 1949 provides for work involving dust, smoke, gases or vapours, "in such quantities as to be injurious or offensive to the employees", to be performed in a separate or sealed room, or where this is infeasible, for "satisfactory arrangements" to be made for carrying off the hazardous or unpleasant substance.

projects for the Work Environment Fund. A distinct Swedish research effort in this area is judged desirable for several reasons - some problems are especially important to Sweden; there is a need to promote international co-operation through a sound domestic program; it seems common sense to integrate work already going on in Sweden in related areas; and finally, the country is felt to need more experience in long-term toxicological testing.

A particular urgency is attached by this Task Force to epidemiological injury into the delayed effects of asbestos. It is also regarded as imperative to define technical and biological standard values for cadmium, zinc, copper, chromium, cobalt, and manganese, the relevant figures already being known for mercury and lead. The toxic effect of NO_x is also seen as needing enhanced study. With regard to chemical processes involving plastics, the Swedish view is that research has so far been very thin, and that a total inventory of the substances and intermediate products concerned is therefore vitally necessary.

Mention may also conveniently be made here of two new English language scholarly journals established in the 1970's which well illustrate Swedish concern with the occupational and general environments: the Scandinavian Journal of Work Environment and Health, published by NBOSH and the Environmental Health section of the Swedish Medical Society, with support from Norway, Finland and Denmark; and Ambio, published by the Royal Swedish Academy of Sciences and concerned essentially with environmental management.

The Hazardous Products Act

The Swedish Act and Ordinance on Products Hazardous to Health and to the Environment entered into force on 1 July 1973. The new Ordinance repealed the existing Poisons and Pesticides Ordinance of 1963, the Phenyl Acetone Ordinance of 1969, and the PCB Ordinance of 1972, although the distinctions between poisons, pesticides, PCB's and other hazardous products is retained in the new Ordinance for legal purposes.

A Royal Commission on Environmental Control had deliberated on this whole subject for some 3 years, finally recommending a statute containing a broad statement of fundamental principles - an "overall rule of prudence" - and setting out the authority for the detailed administration of the Act. The Act represents "a substantial broadening and tightening-up of public control over products within its scope", the products being any which comprise or contain substances whose chemical or physico-chemical properties and handling are liable to cause harm, either to health or to the environment,

although certain products already covered under legislation are excluded, such as pharmaceuticals, foodstuffs and radioactive substances. It should be remarked that "even the suspicion of risk constitutes sufficient grounds for intervention", and also that it is not only inherent hazardous properties which are covered, but also those which result from particular forms of handling. Further, once suspicion has arisen, the onus lies with a product's sponsor to prove it groundless: "the burden of any uncertainty as to the hazardous nature of a product falls not upon the public but upon those who wish to market it." As yet, full reports on all chemicals on the market have not actually been required from their sponsors, but this is being considered.

The authority created to implement the Act, the Products Control Board (PCB), replacing the National Poisons and Pesticides Board, was given power to sample and test doubtful products, and funds for this purpose; the NEPB's laboratories and the NBOSH's industrial medicine department were strengthened on an interim basis to facilitate the PCB's work. However, when tests show that an offence has been committed, the responsible party must pay the whole costs of the tests, his duty in other cases being to pay "to the extent and on the conditions prescribed" by the PCB. The Act lays down that the PCB must in the case of possible health hazards furnish on inquiry a ruling as to whether a product does indeed come within the Act, the PCB's duty in this respect being optimal in the case of an environmental hazard, and a fee being payable in all cases.

The product sponsor on whom the Act places the onus of responsibility may be an importer, a manufacturer, or a seller:

> "each person forming a link in the chain must consider not only the risks involved in his own manufacturing operations but also the risks attendant upon the purposes to which he supplies his product."

A "particular liability" falls upon those who change the "risk content" of a product. Those who offer a product to the consumer market are said to shoulder "a particularly heavy liability." In addition, the producer should be "fully alive to the question of waste disposal", even when his product is still under development. The producer's duty of investigation "extends as far as is permitted by investigation methodology, etc." Manufacturers and importers must therefore "keep themselves informed on research in the area", and "the requirements as to investigation should be stepped up at the pace permitted by the rising level of scientific knowledge." The product sponsor must also provide clear labelling as to his product's hazard, take all possible protective mesures, and above all, keep to

a minimum, or if possible replace, the use of the hazardous substance.

The implementing authority, the PCB, has 10 members including the heads of the NEPB and of NBOSH, those of the Boards for Health and Welfare, Food, and Consumer Affairs, three employee representatives, and one business representative. The Board has a general responsibility to "initiate and co-ordinate surveys of the field and investigations of products that can be suspected of being hazardous." Day-to-day responsibility rests with the NBOSH in its field, with the NEPB otherwise, detailed field responsibility falling on the Labour Inspectorate, with the County Administrations, and with the Public Health Committees at the commune level. The PCB and its agents have been given very strong powers. They have the right to all information which could conceivably be relevant including, for example, account books as well as laboratory records. Regulations and prohibitions can be issued covering in as much detail as necessary virtually anything connected with hazardous products. It was intended that the power to prohibit would be used with restraint, in effect only after counselling. Penalties can be attached to compliance orders and there is naturally a right of appeal. Severe penalties, including up to a year's imprisonment, can be imposed for offenders who have behaved wilfully or negligently. No provision has been made in the Act for compensation and "in principle there is little likelihood of being able to claim damages unless some mistake has been committed in the manufacture or handling of a product", but a Commission was at the same time established to consider this further.

The Environment Generally

In the general environmental field the key Swedish bodies are the National Environment Protection Board (NEPB) and the Franchise Board for Environmental Protection (FBEP). The responsible ministry is Agriculture and there is a government advisory committee for the environment, established in 1968, with representatives from the scientific professions, the municipalities, industry, the public and the media.

The NEPB was created in 1967, taking over the Water Inspectorate, the Air Pollution Agency, the Nature Conservancy Agency, and the Sewage and Water Treatment Planning Authorities. It began with mainly advisory and supervisory functions but has taken an increasing part in policy development and decision-making. All major relevant interests are represented on the Board or its advisory committees. The Board has a staff of some 400. Its legislative authority is derived mainly from the Environmental Protection Act (EP

Act) of 1969 and, in its field, the Act on Products Hazardous to Health and to the Environment of 1973. In respect of the latter, its Products Control Bureau acts as secretariat to the PCB. With regard to the Nature Conservancy Act and Ordinance of 1964, the NEPB is essentially only an advisory body, the 24 County Administrations acting in this case as the enforcement authority.

The EP Act was the culmination of a process which saw the legislative authority and administrative capability of the Swedish Government for coping with environmental issues greatly expanded. In respect of water pollution, the Law of 1918 was quite inadequate to contemporary needs, even after the report of a Royal Commission in 1952 and the resulting reorganization of the Water Inspectorate in 1957. In regard to Sweden's natural assets generally, significant progress was made following a Royal Commission report in 1962, the setting up of the Nature Conservancy Agency in 1963, and the passage of the Nature Conservancy Act in 1964. For air pollution, there was no previous legislative base, though municipal public health committees had a responsibility to ensure that "reasonable and adequate" provision for clean air and water was made under the Health Service Statute of 1958. The Air Pollution Agency created in 1964 was confined at first to research and monitoring, advisory functions gradually being assumed later. Finally, the Ordinances of 1962/3 on the implementation of the Poisons and Pesticides Act provided a new basis for coping with these substances.

During the mid-1960's, Swedish environmental research was reviewed by one Royal Commission, environmental legislation by another. The recommendations of the latter, published in 1966, in due course led to the passage of the EP Act and the setting up of the FBEP in 1969. The EP Act amounts to a comprehensive attack on polluting activities. Like most recent Swedish legislation, its terms are general to ensure flexibility, detail being filled in by means of Ordinances and regulations. In this case, the associated Ordinance listed 38 types of establishment for which official construction/alteration permission had to be secured, and a further 25 types for which prior notification had to be made to the county authorities.

Section 4 of the EP Act puts municipalities on the same footing as industry; Section 5 covers "everything that is technically possible to protect the environment"; Section 30 lays down compensation arrangements when the disturbance is extreme, even if a concession or dispensation has been granted; Section 38 gives the NEPB and country authorities the right to suspend hazardous activities; and Section 48 provides for fines or prison sentences of up to a year.

The Act opened up two routes by which a potential polluter could obtain a licence to conduct his activities. In the first place he could apply to the FBEP for a permit, in which case the latter would "try" the case, rather like a court of law, with public hearings, etc. The FBEP is thus "The only example of an 'adversary' type of structure in Swedish environmental policy."[34]

The FBEP has four members. By law the chairman must be a lawyer and the other three members must have had experience respectively in technical matters, in the field of the Nature Conservancy Act, and in industrial affairs. Its permits give legal security, assuming of course that the holder continues to comply with any attached conditions, for up to 10 years. The alternative route open to the potential polluter is to apply to the NEPB for an "exemption" from the FBEP procedure, in which case the NEPB negotiates with him as to the conditions under which such an exemption can be granted. In principle, an NEPB exemption has less legal validity than an FBEP permit because the NEPB can revoke it on notification, but in practice there does not appear to be much difference. The NEPB route is simple and has therefore come to seem increasingly attractive, the FBEP route being less avoidable, however, in the case of major polluting activities.

> According to Lundqvist in 1974,[35]
> "The dominance of consensus-oriented patterns in the environmental policy is shown by the fact that two-thirds of pollution control cases are handled through the negotiative exemption procedure of the NEPB."

And in the words of another commendator in 1975:[36]

> "the EP Act seems to be functioning satisfactorily... the result has been a considerable reduction in pollution.. the procedures for obtaining concessions and dispensations seem to be functioning well... only in a few cases has it been necessary to issue prohibitions or to impose penalties ... the FBEP's decisions have seldom led to appeals."

Whether the NBEP or the FBEP route is taken, the potential polluter still has a duty to take all technically possible measures to minimize or prevent pollution. The "technical limitation is the guideline", and so it follows that control measures must respond to the evolution of the technical state of the art. The NBEP and the FBEP are both required to strike a cost-benefit balance for any proposed activity, local considerations being taken fully into account.

The NBEP initially wanted to develop both air quality and source emission standards, the air resources management approach reflecting public health requirements and the bpm (equals bat) approach allowing for the techno-economic possibilities at particular plants. NEPB committees with industrial representation were set up and overseas practices were examined. In the end, however, the NEPB settled for the bpm approach alone, partly due to the inadequate state of scientific knowledge about health and environmental effects. Preliminary emission guidelines were thus laid down in June 1969 and final ones, following industrial pressure for relaxation, in December 1969. Revised standards were issued in August 1973 and an ambient air quality standard for sulphur dioxide was also finally established that year. For particular plants, tougher requirements than those called for in the emission standards are occasionally insisted on.*

The Swedish government has also tackled pollution by means of grants and subsidies. The major industrial programme ran from 1969 to 1974 and was then renewed for a further year, the NEPB proposing further extensions in respect of new techniques to 1978-9. Fifty five million dollars were allocated to this, pollution control equipment grants up to 25% of cost being available, or 50% in the case of experimental plants. A separate programme for municipal sewage plants was allocated $79 million, 30-50% of costs being available in this case. In addition, between 1 November 1971 and 30 June 1972, 1 September 1972 and 30 April 1973 and November-December 1973, special schemes were operated essentially to stimulate the economy, pollution abatement subsidies under these schemes were 75% in the first case and 50 per cent in the last two, with 60% of the work having to be completed within the stipulated period. These "elevated state subsidies" cost an additional $121 millions, and similar extraordinary municipal programmes (55-75% of costs) another $102 millions. There are now some 1600 municipal sewage plants in Sweden, compared with 10 in 1950.

State subsidies have also been available since 1972 for the storage of hazardous waste. Since January 1976 companies have had to declare all noxious wastes to local municipalities, which have 5 years to construct receiving capacity for such material.

*It has been laid down that total sulphur emission in 1980 must not exceed the figures for 1970 - some 800 000 tons. Oil containing more than 2.5% by weight of sulphur was prohibited by a 1968 ordinance and in the principal urban areas the limit was fixed at 1% by an ordinance of 1970.

A Royal Commission on environmental costs was set up in 1971 to investigate the usefulness of economic methods in controlling pollution.

Parliament established an Environmental Data Committee in July 1974. This Committee is to develop an Environment Data Bank and important statistics derived from this are to be published in an Environment Statistics Annual.

Under the EP Act only individuals who are directly affected can sue a polluter. There is no right to sue the enforcement agencies. The right to sue is similarly tightly restricted by the Act on Products Hazardous to Health or the Environment. In those cases where an individual is allowed to initiate proceedings, the property court may issue a prohibition order, or grant an injunction directing protective steps to be taken. It may also award damages, even when the polluter has obtained a permit or an exemption. These limitations have been criticized by environmentalist groups, who have also expressed reservations about the real openness of the Swedish policy-making process, especially the new tendency to substitute internal departmental task forces for Royal Commissions. Except immediately on its creation, the NEPB for its part has shown little inclination to depart from the consensual style so typical of all Swedish politics.

The Particular Hazards: Asbestos

Stringent new regulations intended further to reduce the asbestos hazard were issued by the NBOSH in October 1975 and subsequently. The essence of the new regulations is as follows:

- reduction in the TLV from 2 to 1 fibre/mL (July 1976);
- complete ban on crocidolite;
- provision for regular air monitoring and respiratory apparatus where asbestos is used;
- asbestos spraying to be allowed only under sealed conditions;
- asbestos no longer to be used for insulation, cement products, in paints, etc.;
- special precautions to be exercised in all demolition work.

In short, asbestos is to be used as little as possible in Sweden in future, and new uses for it are to be avoided wherever possible, less hazardous alternatives always being sought and the NBOSH first being given the opportunity to pronounce on any new plan for its use.

Lead

In the case of lead, Ordinances issued in 1949 under the Workers' Protection Act govern the use of lead paint and provide for medical examinations. A Direction of 1967 on the prevention of lead poisoning is currently under revision.

Ordinances of 1972 dealt both with the lead content of gasoline and with motor vehicle emissions. On lead content, the Poisons and Pesticides Board ruled, before its absorption in the PCB, that this should not exceed 0.4 g/L after 1 January 1973. The emissions ordinance provided both for discharge limitation equipment and for CO and HC emissions limits. HC and CO were to be reduced by some 40% starting with the 1971 models: CO 45 g/km and HC 2.2 (older vehicles - 4.5% CO by weight when idling). Substantially more stringent limits were introduced for the 1976 vehicles: CO 24.2 g/km, HC 2.1 and NO_x 1.9 (cf US 1973/4 standards).

Mercury

The main incidents in Sweden's response to the mercury problem are shown in Table 1.

Sweden began using methyl mercury as a seed dressing in the 1940's and used this substance to a much greater extent than other European countries - one reason for Sweden's early recognition of the mercury problem. Mercury was not completely banned as a dressing even when the dangers became known. Some 3% of seed was treated in 1970, perhaps 30% in 1973, a situation which continued to cause concern to the NEPB, although the mercury compounds used in the 1970's were apparently less environmentally hazardous than methyl mercury. Mercury release by the chlor-alkali industry fell from 30 tons in 1967 to 140 kg (water) plus 2,400 kg (air) in 1972. Emissions fell following the NEPB's requirement of 95% reductions before it would issue permits. A further 20 tons are emitted by ore refining plants, about half each to air and water.

Vinyl Chloride

Sweden has only one PVC manufacturer. Before the American publication of the VCM danger the Swedish standard was 500 ppm and the actual level in the plant of this manufacturer about 32 ppm. On recognition of the danger the Swedish standard was cut temporarily to 20 ppm and then to 1 ppm as from January 1975. The actual level in the Swedish plant had been reduced to 2 ppm by this date and the company was given special permission to exceed the 1 ppm limit during

Table 1 - Response to Mercury in Sweden

	Legislation	Action
early 1960s		Identification of the mercury problem; connections shown between seed dressings and high mercury levels in birds of prey; fish and waters contamination correlated with mercury release from pulp and paper industries.
1962	Pesticides Act	Limited restrictions on the use of mercurial seed dressings.
1966		Discovery that acquatic micro-organisms can transform inorganic mercury into methyl mercury.
1966	Pesticides Act	Prohibition of alkyl mercury seed dressings.
1967		Prohibition of phenyl mercury in the pulp and paper industry (by study of mosses the pollution zone has been shown to extend 10 km).
1967	Food Decree	Ban on fish sales from specified waters with mercury levels above 1 mg/kg of fish. (An expert group has concluded that the highest acceptable daily intake of methyl mercury should be 0.4 ug/kg of body weight. Those on substantial fish diets were judged to be at the lower end of the danger level.)
1967	Water Law	Reductions in water and air emissions from mercury-using plants, especially mercury-cell chlor-alkali plants.
1970s		Rapid recovery of the terrestrial environment, the acquatic environment improves much more slowly. Sweden's largest lake, Vanern, partially threatened with black-listing.

1975. A US symposium on Potential Environmental Health Hazards in the Rubber and Plastics Industries was told in 1976 that Swedish VCM workers had four times the expected death rate due to liver and pancreas disease. VCM was classified as a poison by the PCB in 1974, all pesticides, etc. containing it being recalled.

Radiation

The basic Swedish legislation covering radiation consists of the Atomic Energy Law of 1956 and the Radiation Protection Law of 1958. The former prescribes Crown Authorization for any handling of nuclear material and the latter similar authorization for all radiological work. The radiation authority was initially the Radiation Protection Board, but the responsibilities under the Act were transferred in 1965 to the National Institute of Radiation Protection (NIRP), directly under the Ministry of Health and Social Affairs. Radiation is explicitly excluded from the EP Act of 1969, but in regulating radioactive discharges into the environment the NIRP acts in close consultation with the NEPB. In 1974 a Nuclear Power Inspectorate was created out of the Atomic Energy Board.

Sweden currently has four nuclear power stations (11 reactors) for completion by 1980, half the country's energy is to be nuclear by 1985, and a further 13 reactors have been scheduled for 1990. In 1973, the Industry Committee of the Riksdag recommended that no further decisions be taken in respect of new stations until more information became available on R & D trends, etc. Three of the Committee's members actually called for a formal 1-year nuclear power moratorium. However, in a parliamentary debate of 15 May 1973, which centred on the questions of nuclear waste and plutonium hazards, the Industry Minister insisted that there was no alternative to nuclear power, and the Committee's proposal was defeated by 218 votes to 70.[37]

In 1976 Sweden's Social Democratic Government lost office for the first time in 44 years and the new prime minister was the leader of a party opposed to nuclear power. The importance of this issue in the election nevertheless remained unclear; of the three parties in the new coalition government, that of the prime minister was the only one actually to lose ground as compared with the 1973 election.

APPENDIX A

ICRP Recommendations

Occupational MPDs (adults)			Dose Limits (general public)
Gonads/red bone marrow	5	rem/year	0.5
Skin, bone, thyroid	30	rem/year	3 (1.5 children)
Hands, forearms, feet, ankles	75	rem/year	7.5
Other single organs	15	rem/year	1.5
Whole body	5	rem/year	0.5
female abdomen	1.3	rem/quarter	-
pregnant women	1	rem total	-

Up to $\frac{1}{2}$ the MPD (or MPC) per quarter is also permitted as an occupational exposure, and the whole body exposure is not to exceed 5 (age -18) rems.

Maximum permissible total body burdens and maximum permissible concentrations have also been published by the ICRP for well over 200 radionuclides, taking as reference organ in each case that where most damage is done, the MPC's being based on intake by the standard man working for 50 years. ICRP has also recommended that the genetically significant dose to the population should not exceed 5 rems/generation from non-natural radiation. No somatic dose limit for the population at large has been suggested, the ICRP arguing that the individual dose limits should make the population somatic effect small. (The NCRP has established a figure of 0.17 rem per person for the US).

APPENDIX B

Relevant aspects of the Pollution Control Structure in the UK

	Government Department	Responsibile Division	Activities	Staffing
Air	DOE	Alkali and Clean Air Inspectorate	Scheduled processes - control; Other - advice to local authorities	35 staff
	DOE	Directorate of Vehicle Engineering & Inspection	Smoke from road vehicles	Smoke control only a minor part of duties
	Department of Industry	Warren Spring Laboratory (Air Pollution Division)	Co-ordinates national survey of air pollution, techniques etc	Research & monitoring rather than control
Freshwater	DOE	Directorate General Water Engineering (DGWE)	Oversees sewage schemes Advice to local authorities	Pollution control only part of duties
Radioactivity	DOE	DGWE Radiochemical Divn. Radiochemical Inspectorate	Advice and monitoring of Radioactive Substances Act 1960	
	Ministry of Agriculture Fisheries & Food	Fisheries Division (Radiobiological Lab) Atomic Energy Branch	Monitoring discharges into inland and coastal waters	
	Dept of Energy	Nuclear Installations Inspectorate (NII)	Safety of nuclear plants, fuel processing, etc.	67 staff
Toxic Waste Disposal	DOE	DGWE Toxic Wastes Divn.	Advice, monitoring etc.	
Work Environment	Dept of Employment	Factory Inspectorate	HSWA (1974)	Also now NII, Alkali Inspectorate, etc.

Adapted from Ch. III of the 4th Report of the Royal Commission on Environmental Control

APPENDIX C

UK Threshold Limit Values: Departures from ACGIH Figures

UK Technical Data Note 2, which is regularly revised, reprints by permission and in its entirety the TLV list published by the American Conference of Government Industrial Hygienists. The introduction to TDN2 gives details of the different UK values for certain substances. The Factory Inspectorate has stated that TLV's published in TDN2 are to be seen as a guide and not as fine lines between what is safe and what is dangerous, the best working practice being to keep all airborne contaminants to a minimum, irrespective of their TLV's. There are UK departures in respect of asbestos, mica, talc, other non-siliceous mineral dusts, cotton dust and vinyl chloride. Details for asbestos and vinyl chloride have been given above.

APPENDIX D

UK Laws, Regulations, Codes of Practice, etc. in respect of certain occupational hazards.

(Main source for Laws and Regulations: Redgrave's Factories Acts 22nd edition). Selected to give a reasonably comprehensive idea of the provisions under which the Factories Inspectorate (now Health and Safety Executive) could proceed. These provisions were essentially taken over by the HSWA (1974), especially Section 2.

Mercury

Factories Act 1961

S82 - Notification of Industrial Diseases Requirements, Factories (Notification of Diseases) Regs. 1966 (S1 No. 1400)

2 - includes mercury, bringing in organic compounds.

The Felt Hats Manufacture Regs. 1902
(probably no longer in effective use)

TDN21 deals with mercury and TDN2 contains TLV's.

Asbestos

The Asbestos Regulations 1969 (S1 1969 No. 690) in force 14 May 1970 revoke Asbestos Industry Regulations 1931. Regulation 5 relates to obligations; 6 to notifications; 7 stipulates a requirement to provide exhaust equipment, to test it weekly etc; 8 stipulates respiratory equipment and protective clothing where reg. 6 is impracticable; 9-12 relate to cleaning of areas subject to asbestos dust.

Various Technical Data Notes supplement these regulations, e.g. TDN13 Hygiene Standards for Airborne Asbestos Dust Concentrations for use with the Asbestos Regulations 1969; TDN 35 Control of Asbestos Dust; TDNs 24, 42 etc. More general action might be possible via the Depost of Poisonous Waste Act 1972, as amended by the Control of Pollution Act 1974.

Vinyl Chloride

The Code of Practice for Health Precautions: Vinyl Chloride, published in temporary format in February 1975, cites the following relevant legal authorities: HSWA 1974 (Sections 2, 16, and 17); the Factories Act 1961 (Section 63); the Alkali etc. Works Regs. Act 1906 and Orders 1966 and 1971 (7, 9, 27).

HSWA (17) does not make an individual who fails to observe a code of practice liable to either civil or criminal proceedings, but any such failure which a Court judges to be relevant is admissible in evidence.

The Factories Act 1961 (63) - see under Fumes below
The Alkali etc. Act (7) - establishes a requirement to use bpm
and (27) - generalizes bpm to include use, supervision and maintenance of bpm equipment

(In a House of Commons reply of 15 May 1974, it was stated that action to control or prohibit known occupational carcinogens had hitherto been taken by means of the following Regulations:

- Patent Fuel Manufacture (Health & Welfare) Special Regulations 1946
- Mule Spinning (Health) Special Regulations 1953
- Carcinogenic Substances Regulations 1967
- Ionizing Radiation (Unsealed Sources) Regulations 1967
- Ionizing Radiation (Sealed Sources) Regulations 1969
- Asbestos Regulations 1969

Lead

Factories Act 1961

S74) Prohibition of employment of women and young persons (WAYP) in certain processes connected with lead manufacture.
S75) Provisions as to employment of WAYP in processes involving use of lead compounds, as amended by the Employment Medical Advisory Service Act 1972. (includes a provision for a 3-monthly medical examination under an order of 1921).

The Factories (Notification of Diseases)Regulations 1966 (S.I. 1966 No. 1400)

2) Applies to lead poisoning

Factories Act 1961

S128) Employment of WAYP in places other than factories in processes connected with lead manufacture or involving the use of lead compounds.

S129) Use of lead paint in connection with buildings (includes continuation in force of the Lead Paint Regulations 1927).

The Lead processes (Medical Examinations) Regulations 1964 (SI 1964 No. 1728)
provides for haemoglobin estimations, the appointed doctor having the discretionary responsibility of seeking a further estimation if the haemoglobin content is below 13 g/100 mL (males) or 12 g (female).

The attached Schedule covers 11 separate sets of Regulations issued between 1907 and 1950 plus a 1921 Order relating to WAYP. Six of these are given below. The others relate to dyeing (1907), enamelling (1908), lead coating (1909) indiarubber manufacture (1922), and electric accumulator manufacture (1925).

Factories Act 1961

S130) Power to take samples of paint
S131) Prohibition of employment of WAYP in painting buildings with lead paint.

The Lead Compound Manufacture Regs. 1921
(includes provision for a weekly medical examination)

The Lead Smelting and Manufacture Regs. 1911
(includes provision for a monthly medical examination)

The Lead paint Regs. 1927

The Vehicle painting Regs. 1926

The Paints and Colours Manufacture Regs. 1907

The Pottery (Health & Welfare) Special Regs. 1905

The Shipbuilding and Ship-Repairing Regs. 1960

Other sections of the 1961 Act also apply in various limited ways (63, 64, 76, 78, 82, 131). A Code of Practice was published in 1973 with annexes to follow, and Technical Data Note 16 for example, relates to Prevention of Industrial Lead Poisoning. TDN2 contains TLVs for lead.

Fumes (including NO_x)

Factories Act 1961

S4) Ventilation: "Effective and suitable provision shall be made for securing and maintaining by the circulation of fresh air in each workroom the adequate ventilation of the room, and for rendering harmless,so far as practicable, all such fumes, dust and other impurities generated in the course of any process or work carried on in the factory as may be injurious to health".

This relates to the circulation of fresh air, S63 (qv.) to the prevention of impurities. The nature and extent of the obligation imposed by S4 have been much discussed by the Courts. it appears that "practicable" has a stricter meaning than the "reasonably practicable" used elsewhere in the Act, yet less than "physically possible". "Reasonably practicable" has been held to require the anterior weighing of cost and benefit. The onus lies with the employer to demonstrate that compliance is not "reasonably practicable".

S30) Dangerous Fumes and Lack of Oxygen (relates to work in a space).

S63) Removal of dust or fumes: "all practicable means shall be taken to protect the persons employed against inhalation... and in particular, where... practicable, exhaust appliances shall be provided... as near as possible to the point of origin of the dust or fume or other impurity... "

(This in the case of fumes etc. "likely to be injurious or offensive to the persons employed", likely to be, that is, as seen by a reasonably well-informed factory occupier).

Regs. for the removal of fumes in particular trades
- The Electric Accumulator Regs. 1925

- Construction (General Provisions) Regs. 1961
- The Chemical Works Regs. 1922
- The Vitreous Enamelling Regs. 1908
- The Felt Hats Manufacture Regs. 1902
- The Indiarubber Regs. 1922
- The Iron and Steel Foundries Regs. 1953
- The Non-Ferrous Metals Regs. 1962
- The Shipbuilding and Ship-Repairing Regs. 1960 (Pt.v)
- The Tinning of Metal Hollow-ware etc Regs. 1909

The Chemical Works and Shipbuilding Regs are probably of greatest importance as regards NO_x. The latter, in that there is no clause relating to offence, appears to be weaker than S63 of the Factories Act.

Various Technical Data Notes apply, especially TDN2 giving TLV's.

Radiation

The Ionizing Radiations (Sealed Sources) Regs. 1969

SI 1969, No. 808, revoking the 1961 equivalent.
The Schedule gives the MPDs for ionizing radiations other than a-particles, in any calendar year.

75 rems - hands, forearms, feet, ankles (not more than 40 in any calendar quarter)
15 rems - eye lenses (8 in any quarter)
30 rems - other parts of the body (15 in any quarter)
1 rem - in pregnancy
3 rem (1.3 female) - calendar quarter sum to parts of the body other than eyes, hands, forearms, feet, ankles; the total cumulative dose never to exceed 5 (age - 18).
5 rems - the figure at which a worker becomes classified, with provision for an annual medical inspection, special arrangements for protection etc.

The same schedule applies to
The Ionizing Radiations (Unsealed Radioactive Substances) Regs. 1968, (SI 1968 No. 780) revoking the Factories (Luminising) Special Regs. 1947.
SIs 1731 (1971) and 1821 (1974) involve changes in ministerial responsibilities, amendments following the HSWA etc.

APPENDIX E

UK Pollution Prosecutions 1973

(adapted from J.M. McLoughlin Environmental Legislation UK, for Environmental Resources Ltd.)

Legislation	No. of Proceedings	Persons found guilty
Public Health Act 1936	386	269
Civic Amenities Acts 1967	877	825
Clean Air Acts 1956/68	154	143
Rivers (Prevention of the Pollution Acts) 1951/61	137	130
Motor Vehicles Regs. 1973 (smoke etc. emission)	908	843

APPENDIX F

Factory inspectorate Prosecutions 1972-4
(adapted from appendices 10-12 of Annual Report)

Prosecutions under Special Regs	Number of Informations/ Convictions 1972	1973	1974
1969) Ionizing Radiations (Sealed Sources)	35/34	46/45	77/78
1968) Ionizing Radiations (Unsealed Sources)	2/1		20/20
1969) Asbestos	44/40	19/15	45/39
1907) Paints and Colours	1/1		
1925) Electric Accumulator	12/12	1/1	
1962) Non-ferrous metals	18/18	10/10	10/10
1960) Shipbuilding etc	13/12	23/19	12/12
1927) Lead Paint			2/2
All Special Regs	1549/1442	1709/1523	1818/1657
All completed in the year	3607/3386	3983/3725	4038/3720
Number of persons or firms involved	1547	1782	1826

APPENDIX G

Code of Federal Regulations: Title 40: Part 50
National Primary and Secondary Ambient Air Quality Standards
(under section 109 of the CAA 1970)

	Primary	Secondary
SO_2	80 $\mu g/m^3$ (aam) 365 $\mu g/m^3$ (24 h once ann.)	1300 $\mu g/m^3$ (3 hrs once ann)
Particularates	75 $\mu g/m^3$ (agm) 260 $\mu g/m^3$ (24 h once ann.)	60 $\mu g/m^3$ (agm) 150 $\mu g/m^3$ (24 h once ann.)
CO	10 mg/m^3 (8 h once ann.) 40 mg/m^3 (1 h once ann.)	same
Photochemical Oxidants	160 $\mu g/m^3$ (1 h once ann.) (corrected for NO_x and SO_2	same
HC	160 $\mu g/m^3$ (3 h once ann.) 6-9am)	same
NO_x	100 $\mu g/m^3$ (aam)	same

aam - annual arithmetic mean
agm - annual geometric mean
ann - annually

APPENDIX H

Threshold Limit Values for Chemical Substances in Workroom Air Adopted by ACGIH for 1976

Preface: Chemical Contaminants

Threshold limit values refer to airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect. Because of wide variation in individual susceptibility, however, a small percentage of workers may experience discomfort from some substances at concentrations at or below the threshold limit; a smaller percentage may be affected more seriously by aggravation of a pre-existing condition or by development of an occupational illness.

Simple tests are now available (J. Occup. Med. 15: 564, 1973: Ann. N.Y. Acad. Sci., 151, Art 2: 968, 1968) that may be used to detect those individuals hypersusceptible to a variety of industrial chemicals (respiratory irritants, hemolytic chemicals, organic isocyanates, carbon disulfide). These tests may be used to screen out by appropriate job placement the hyperactive worker and thus in effect improve the 'coverage' of the TLV's.

Three categories of Threshold Limit Values (TLV's) are specified herein as follows:

(a) Threshold Limit Value-Time Weighted Average (TLV-TWA) - the time-weighted average concentration for a normal 8-hour workday or 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.
(b) Threshold Limit Value-Short Term Exposure Limit (TLV-STEL) - the maximal concentration to which workers can be exposed for a period up to 15 minutes continuously without suffering from (1) intolerable irritation, (2) chronic or irreversible tissue change, or (3) narcosis of sufficient degree to increase accident proneness, impair self-rescue, or materially reduce work efficiency, provided that no more than four excursions per day are permitted, with at least 60 minutes between exposure periods, and provided that the daily TLV-TWA also is not exceeded. The STEL should be considered a maximal allowable concentration, or absolute ceiling, not to be exceeded at any time during the 15-minute excursion period. STELs are based on one or more of the following criteria: (1) Adopted TLVs including those with a 'C' or 'ceiling' limit. (2) TWA-TLV Excursion Factors listed in Appendix D. (3) Pennsylvania Short-Term Limits for

Exposure to Airborne Contaminants (Penna. Dept. of Hlth., Chapter 4, ARt. 432, Rev. Jan. 25, 1968). (4) OSHA Occupational Safety and Health Standards, Fed. Reg. Vol. 36, No. 105, May 29, 1971. The TWA-STEL should not be used as engineering design criterion or considered as an emergency exposure level (EEL).
(c) Threshold Limit Value-Ceiling (TLV-C) - the concentration that should not be exceeded even instantaneously.

For some substances, e.g., irritant gases, only one category, the TLV-Ceiling, may be relevant. For other substances, either two or three categories may be relevant, depending upon their physiologic action. It is important to observe that if any one of these three TLVs is exceeded, a potential hazard from that substance is presumed to exist.

The TLV-TWA should be used as guides in the control of health hazards and should not be used as fine lines between safe and dangerous concentrations. (Exceptions are those substances in Category (c) which have been designated 'C' or Ceiling limit.)

Time-weighted averages permit excursions above the limit provided they are compensated by equivalent excursions below the limit during the workday. In some instances it may be permissible to calculate the average concentration for a workweek rather than for a workday. The degree of permissible excursion is related to the magnitude of the threshold limit value of a particular substance as given in Appendix D. The relationship between threshold limit and permissible excursion is a rule of thumb and in certain cases may not apply. The amount by which threshold limits may be exceeded for short periods without injury to health depends upon a number of factors such as the nature of the contaminant, whether very high concentrations - even for short periods - produce acute poisoning, whether the effects are cumulative, the frequency with which high concentrations occur, and the duration of such periods. All factors must be taken into consideration in arriving at a decision as to whether a hazardous condition exists.

Threshold limits are based on the best available information from industrial experience, from experimental human and animal studies, and when possible, from a combination of the three. The basis on which the values are established may differ from substance to substance; protection against impairment of health may be a guiding factor for some, whereas reasonable freedom from irritation, narcosis, nuisance or other forms of stress may form the basis for others.

The amount and nature of the information available for establishing a TLV varies from substance to substance; consequently,

the precision of the estimated TLV is also subject to variation and the latest Documentation should be consulted in order to assess the extent of the data available for a given substance.

The committee holds to the opinion that limits based on physical irritation should be considered no less binding than those based on physical impairment. There is increasing evidence that physical irritation may initiate, promote or accelerate physical impairment through interaction with other chemical or biologic agents.

In spite of the fact that serious injury is not believed likely as a result of exposure to the threshold limit concentrations, the best practice is to maintain concentrations of all atmospheric contaminants as low as is practical.

These limits are intended for use in the practice of industrial hygiene and should be interpreted and applied only by a person trained in this discipline. They are not intended for use, or for modification for use, (1) as a relative index of hazard or toxicity, (2) in the evaluation or control of community air pollution nuisances, (3) in estimating the toxic potential of continuous, uninterrupted exposures or other extended work periods, (4) as proof or disproof of an existing disease or physical condition, or (5) for adoption by countries whose working conditions differ from those in the United States of America and where substances and processes differ.

Ceiling vs Time-Weighted Average Limits

Although the time-weighted average concentration provides the most satisfactory, practical way of monitoring airborne agents for compliance with the limits, there are certain substances for which it is inappropriate. In the latter group are substances which are predominantly fast acting and whose threshold limit is more appropriately based on this particular response. Substances with this type of response are best controlled by a ceiling 'C' limit that should not be exceeded. It is implicit in these definitions that the manner of sampling to determine noncompliance with the limits for each group must differ; a single brief sample, that is applicable to a 'C' limit, is not appropriate to the time-weighted limit; here, a sufficient number of samples are needed to permit a time-weighted average concentration throughout a complete cycle of operations or throughout the work shift.

Whereas the ceiling limit places a definite boundary which concentrations should not be permitted to exceed, the time-weighted average limit requires an explicit limit to the excursions that are

permissible above the listed values. The magnitude of these excursions may be pegged to the magnitude of the threshold limit by an appropriate factor shown in Appendix D. It should be noted that the same factors are used by the Committee in determining the magnitude of the value of the STELs, or whether to include or exclude a substance for a 'C' listing.

'Skin' Notation

Listed substances followed by the designation 'Skin' refer to the potential contribution to the overall exposure by the cutaneous route including mucous membranes and eye, either by airborne, or more particularly, by direct contact with the substance. Vehicles can alter skin absorption. This attention-calling designation is intended to suggest appropriate measures for the prevention of cutaneous absorption so that the threshold limit is not invalidated.

Mixtures

Special consideration should be given also to the application of the TLVs in assessing the health hazards which may be associated with exposure to mixtures of two or more substances. A brief discussion of basic considerations involved in developing threshold limit values for mixtures, and methods for their development, amplified by specific examples are given in Appendix C.

Nuisance Particulates

In contrast to fibrogenic dusts which cause scar tissue to be formed in lungs when inhaled in excessive amounts, so-called 'nuisance' dusts have a long history of little adverse effect on lungs and do not produce significant organic disease or toxic effect when exposures are kept under reasonable control. The nuisance dusts have also been called (biologically) 'inert' dusts, but the latter term is inappropriate to the extent that there is no dust which does not evoke some cellular response in the lung when inhaled in sufficient amount. However, the lung-tissue reaction caused by inhalation of nuisance dusts has the following characteristics: (1) The architecture of the air spaces remains intact. (2) Collagen (scar tissue) is not formed to a significant extent. (3) The tissue reaction is potentially reversible.

Excessive concentrations of nuisance dusts in the workroom air may seriously reduce visibility, may cause unpleasant deposits in the eyes, ears and nasal passages (Portland Cement dust), or cause injury

to the skin or mucous membranes by chemical or mechanical action per se or by the rigorous skin cleansing procedures necessary for their removal.

A threshold limit of 10 mg/m^3, or mppcf, of total dust 1% is recommended for substances in these categories and for which no specific threshold limits have been assigned. This limit, for a normal workday does not apply to brief exposures at higher concentrations. Neither does it apply to those substances which may cause physiolgic impairment at lower concentrations but for which a threshold limit has not yet been adopted. Some nuisance particulates are given in Appendix E.

Simple Asphyxiants - 'Inert' Gases or Vapors

A number of gases and vapors, when present in high concentrations in air, act primarily as simple asphyxiants without other significant physiologic effects. A TLV may not be recommended for each simple asphyxiant because the limiting factor is the available oxygen. The minimal oxygen content should be 18 percent by volume under normal atmospheric pressure (equivalent to a partial pressure, pO_2 of 135 mm Hg). Atmospheres deficient in O_2 do not provide adequate warning and most simple asphyxiants are odorless. Several simple asphyxiants present an explosion hazard. Account should be taken of this factor in limiting the concentration of the asphyxiant. Specific examples are listed in Appendix F.

Physical Factors

It is recognized that such physical factors as heat, ultraviolet and ionizing radiation, humidity, abnormal pressure (altitude) and the like may place added stress on the body so that the effects from exposure at a threshold limit may be altered. Most of these stresses act adversely to increase the toxic response of a substance. Although most threshold limits have built-in safety factors to guard against adverse effects to moderate deviations from normal environments, the safety factors of most substances are not of such a magnitude as to take care of gross deviations. For example, continuous work at temperatures above $90\frac{3}{4}$F, or overtime extending the workweek more than 25% might be considered gross deviations. In such instances judgment must be exercised in the proper adjustments of the Threshold Limit Values. Brief & Scale (AIHAJ, 26, 467, 1975) have proposed formulae for calculating the TLV Reduction Factor for Novel Work Schedules, i.e., 10-h workday.

Biologic Limit Values (BLVs)

Other means exist and may be necessary for monitoring worker exposure other than reliance on the Threshold Limit Values for industrial air, namely the Biologic Limit Values. These values represent limiting amounts of substances (or their effects) to which the worker may be exposed without hazard to health or well-being as determined in his tissues and fluids or in his exhaled breath. The biologic measurements on which the BLV's are based can furnish two kinds of information useful in the control of worker exposure: (1) measure of the individual worker's overall exposure; (2) measure of the worker's individual and characteristic response. Measurements of response furnish a superior estimate of the physiologic status of the worker, and may be made of (a) changes in amount of some critical biochemical constituent, (b) changes in activity of a critical enzyme, (c) changes in some physiologic function. Measurement of exposure may be made by (1) determining in blood, urine, hair, nails, in body tissues and fluids, the amount of substance to which the worker was exposed; (2) determination of the amount of metabolite(s) of the substance in tissues and fluids; (3) determination of the amount of the substance in the exhaled breath. The biologic limits may be used as an adjunct to the TLV's for air, or in place of them. The BLV's, and their associated procedures for determining compliance with them, should thus be regarded as an effective means of providing health surveillance of the worker.

Unlisted Substances

There are a number of reasons why a substance does not appear in the Threshold Limit list; either insufficient information is available or it has not been brought to the attention of the Threshold Limits Committee from which a limit can be developed, or it is a substance that could be included in the Appendices E and F pertaining to Nuisance Particulates and Simple Asphyxiants. Substances appearing in these appendices serve as examples only; the appendices are not intended to be inclusive.

"Notice of Intent"

At the beginning of each year, proposed actions of the Committee for the forthcoming year are issued in the form of a "Notice of Intended Changes". This Notice provides not only an opportunity for comment, but solicits suggestions of substances to be added to the list. The suggestions should be accompanied by substantiating evidence. The list of intended Changes follows the Adopted Values in the TLV booklet.

Legal Status

By publication in the Federal Register (Vol. 36, No. 105, May 29, 1971) the Threshold Limit Values for 1968 are now official federal standards for industrial air.

ASBESTOS	5 fibres/cm^3 longer than 5 μm as determined by the membrane filter method at 400-450 X magnification (4 mm Objective) phase contrast illumination (all forms - "a more stringent TLV for crocidolite may be required"; human carcinogen "cigarette smoking can enhance the incidence of bronchogenic carcinoma...")
LEAD	0.15 mg/m^3 (inorganic fumes and dust, also lead arsenate)
MERCURY	0.05 mg/m^3 (all forms except alkyl) 0.01 mg/m^3 0.001 ppm (alkyl compounds). Possibility of cutaneous absorption noted.
NITRIC OXIDE	30 mg/m^3 (25 ppm)
NITROGEN DIOXIDE	9 mg/m^3 (5ppm) Ceiling Value
NITROUS OXIDE	an asphyxiant
VINYL CHLORIDE	510 mg/m^3 (200ppm) Notice of Intended Change attached: human carcinogen awaiting reassignment of TLV pending further data acquisition: "no exposures or contact by any route - respiratory, skin or oral, as detected by the most sensitive methods", (and as determined by "the best practicable engineering methods"), to be permitted.

The 1976 ACGIH list also gives tentative short-term exposure limits. (Differences from TLVs above: Mercury, alkyl compounds, 0.003ppm/-0.03mg/m^3; mercury, all other forms, 0.15 mg/m^3 nitric oxide, 35ppm/45 mg/m^3).

APPENDIX I

SOME APPROXIMATE CURRENT BUDGETS (in $ millions)

NRC	$274
OSHA	$128
NIOSH	$ 37
NCI	$688
NIEHS	$ 46
CPSC	$ 37
EPA	$718
FDA	$223

APPENDIX J

Swedish TLV's

A Swedish list of some 70 TLV's was published by the national Institute of Occupational Health in 1969. This was based on the US ACGIH list. A revised version was published by the NBOSH in October 1974, the revisions being based on Swedish experience as well as on NIOSH-OSHA and ANSI information, on the Arbeitsstoffkommission der Deutschen Forschungsgemeinschaft of West Germany, and on the Czech Threshold Value Committee. Excerpts follow:

	ppm	mg/m^3	
Asbestos	-	2 fibres/mL	(1 fibre/mL as from July 1976)
(excluding crocidolite, which could be used only according to the instruction of the Labour Inspectorate)			
Vinyl Chloride	1	3	
	5	15	ceiling value
(subject to transitional regulations under Notice 1974:30 of the Board)			
Mercury	-	0.05	Also vapour
	-	0.01	Alkyl compounds
Lead	-	0.1	
Nitrogen dioxide	5	9	ceiling values

These are 8 h twa's, the ceiling values being for 15-minute periods. As an "approximate guide", the TLV should not be exceeded for more than 15 minutes per hour, or by more than

25% for TLV's above 100 ppm
50% for TLV's between 10-100 ppm
100% for TLV's between 1-10 ppm
200% for TLV's below 1 ppm

The NBOSH and the Labour Inspectorate can advise in regard to sampling, analysis and evaluation. The TLV document states that

> "There is... great variation in individual sensitivity... From the medical point of view, there is no absolute or distinct border line between injurious and non-injurious concentration... It must be emphasized that the limit values must not be used as some kind of acceptable values... The aggregate exposure to a number of substances during the lifetime of a man may be significant with regard to his health... The margin of safety in the limit values varies from substance to substance".[38]

APPENDIX K

The Nordic Grouping

The five Scandinavian countries are, on a wide range of matters, in close contact with each other. The Nordic Council provides for parliamentary co-operation and the Nordic Committee of Ministers for inter-governmental co-operation. This committee has a secretariat in Oslo and works mainly through 14 committees of officials. One for Questions concerning the Working Environment was established in June 1973. It has since set up two working groups, the Steering Group for Occupational Safety Regulations, and the Working Group for Occupational Health. The former now co-ordinates the drafting of occupational regulations, a division of work between the five countries being implied. A Documentation Centre was established in September 1975 to provide on request information and assistance on a joint basis to Occupational Safety authorities in each of the Nordic countries.

A Nordic Environment Protection Convention was signed by the five countries in February 1974.

APPENDIX L

Abbreviations used in the text

AAAS	American Association for the Advancement of Science
ACGIH	American Conference of Government Industrial Hygienists
ACRS	Advisory Committee on Reactor Safeguards
AEC	Atomic Energy Commission
AEA	Atomic Energy Authority
AFL-CIO	American Federation of Labor-Congress of Industrial Organizations
AIA	Asbestos Information Association
ANSI	American National Standards Institute
ASLB	Atomic Safety and Licensing Board
ASTM	American Society for Testing and Materials
bat	best available technology
BCME	Bis chloromethyl ether
bpm	best practicable means
CAA	Clean Air Act 1970
CBI	Confederation of British Industries
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cmt	carcinogenic/mutagenic/teratogenic
CO	Carbon Monoxide
CPA	Control of Pollution Act 1974
CPSC	Consumer Product Safety Commission
DGWE	Directorate General Water Engineering
DOE	Department of the Environment
EEC	European Economic Community
EMAS	Employment Medical Advisory Service
ENEA	European Nuclear Energy Agency
FAO	Food and Agricultural Organisation
FBEP	Franchise Board for Environment Protection
FDA	Food and Drug Administration
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
FRC	Federal Radiation Council
GAO	Government Accounting Office
HEW	Department of Health, Education and Welfare
HC	Hydrocarbons
HCl	Hydrochloric Acid
HSE	Health and Safety Executive
HSWA	Health and Safety at Work Act 1974
IAEA	International Atomic Energy Agency
IARC	International Agency for Research on Cancer
ICRP	International Commission on Radiological Protection

IHU	Industrial Hygiene Unit
IISs	Inflationary Impact Statements
ILO	International Labour Office
LAs	Local Authorities
MAFF	Ministry of Agriculture, Fisheries and Food
MCA	Manufacturing Chemists Association
MPC	Maximum Permissible Concentration
MPD	Maximum Permissible Dose
MRC	Medical Research Council
NAAQS	National Ambient Air Quality Standards
NACOSH	National Advisory Committee on Occupational Safety and Health
NAS	National Academy of Science
NBOSH	National Board of Occupational Safety and Health
NCAB	
NCHS	National Centre for Health Statistics
NCI	National Cancer Institute
NCRP	National Committee on Radiation Protection
NEP Act	National Environmental Policy Act
NEPB	National Environment Protection Board
NIA	Nuclear Installation Act
NIEHS	National Institute of Environmental Health Sciences
NII	Nuclear Installations Inspectorate
NIOSH	National Institute for Occupational Safety and Health
NIRP	National Institute of Radiation Protection
NRC	Nuclear Regulatory Commission
NRC	National Research Council (distinguish by text)
NRPB	National Radiological Protection Board
NTIS	National Technical Information Service
OECD	Organization for Economic Co-operation and Development
OSHA	Occupational Safety and Health Administration
OSH Act	Occupational Safety and Health Act
OSHRC	Occupational Safety and Health Review Commission
PCB	Products Control Board
PCB	Polychlorinated biphenyls (distinguish by text)
ppm	parts per million
PPP	Polluter Pays Principle
PVC	Polyvinyl chloride
RSAC	Radioactive Substances Advisory Committee
SI	Statutory Instrument
SIP	State Implementation Plan
TDN	Technical Data Note
TLV	Threshold Limit Value
TUC	Trades Union Congress
twa	time weighted average
UNEP	United Nations Environmental Programme
VCM	Vinyl Chloride Monomer
WAYP	Women and Young Persons
WHO	World Health Organization

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