THE PRESERVATION OF THE INTEGRITY OF THE BIOSPHERE

By Professor R. K. Macpherson

Delivered at a meeting of the Medico-Legal Society held on 29th May 1971, at 8.30 p.m. at the Royal Australasian College of Surgeons, Spring Street, Melbourne. The Chairman of the meeting was the President, Mr. Peter Balmford.

Whilst it is true that the Medical Directory of Australia, somewhat ungenerously I feel, lists the Medico-Legal Society of Victoria under the heading 'Miscellaneous', I can assure you that my most recondite researches have revealed nothing that was not to the credit—to the very great credit—of the Society. Perhaps I should not particularize further lest I lay myself open to a charge of fulsomeness, but perhaps at least passing mention should be made of Sir Robert Menzies's public approbation of the Society and its works in the Arthur E. Mills Memorial Oration for 1955.[1] You will agree, I am sure, that approbation from Sir Robert Menzies, like approbation from Sir Hubert Stanley, is praise indeed.[2]

The title of my talk tonight, as our Chairman has already told you, is "The Preservation of the Integrity of the Biosphere". Why and how this evolved from my original brief, if I may use such an expression in this company, which was to talk on environmental pollution, I hope to make plain presently but perhaps a word or two might first be said about the term "biosphere" which may sound a little strange in some ears. Though undoubtedly an up-and-coming word, it is, as scientific terms go, by no means new. It is said[3] to have been first used by an Australian geologist, Edward Suess, in a book on the genesis of the Alps published in 1875 but it appears to have been largely neglected until used by a Russian, Vernadsky, as the title of two lectures published first in Russian in 1926 and then in French ("La Biosphere") in 1929. It would seem to have been derived by analogy from the term "atmosphere" and refers to that narrow zone restricted to the interface between the atmosphere on the one hand

1 R. G. Menzies, "Medicine, Politics and the Law" (1955), *Medical Journal of Australia*, II, 149-153.

2 Thomas Morton, "A Cure for the Heartache" (1764?-1838). V. ii.

3 G. E. Hutchinson, "The Biosphere" (1970), *Scientific American*, 223 (3), 45-53.

and the hydrosphere and the lithosphere on the other in which all life exists on this planet. As for its "integrity"—Dr. Lewis and Dr. Short tell me that the prime meaning of "integritas", from which it is derived, is "the undiminished or unimpaired condition of a thing" and that is precisely the idea that I wish to convey.

But to return from my etymological excursion which was probably quite uncalled for in this company (and if so I apologise) and to proceed with the matter in hand.

The first point to be made, and I think it an important point, is that what I have to say on this occasion will of necessity be greatly different from what I would have said in response to a similar invitation a year ago or even less.

Then I would have felt called upon to preach on the dangers of pollution—even if I had called it "the degradation of the biosphere"—and you would have had your feelings harrowed by terrible tales of a world engaged in a gadarene-like rush to destruction. You would have gone home sated with horrors—the rising level of DDT in human mothers' milk; strontium 90 in the bones of suckling infants; methylmercury in fish; sea birds drowned in oil; once beautiful lakes now little better than gigantic cess pools; the Meuse Valley disaster in 1930, that at Donora in 1948 and, finally, the great smog in London in 1952 when 4,000 people are thought to have died from the effects of air pollution. The list can be indefinitely prolonged. I might even have been overcome by emotion and throwing discretion to the winds spoken of pollution on our own Sydney ocean and harbourside beaches though I trust, as a visitor, good manners would have prevented reference to Melbourne's bathing resorts. I understand another visitor has not been so reticent, but he is of another and more outspoken generation and indeed is considered to have inherited a certain directness of speech from his father.

But now suddenly all is changed. These horrors still exist but to dwell on them would be merely preaching to the converted. In the community at large too, the battle would seem to be won and to persevere would be to commit the crime of overkill and to promote a reaction which is to be avoided at all costs. The dangers of over-emphasis are already apparent. Only a few weeks ago an eminent scientist[4] and former Vice-Chancellor, on the occasion of his receiving an honorary Doctorate of Science

[4] Sir Philip Baxter, *The Sydney Morning Herald*, 17th April, 1971, p. 8.

very properly exhorted his audience of science graduands to adopt a rational attitude to the problems of environmental pollution. However, he went on to add, and I quote from a press report, "You have a role to play, in the community which will distinguish you from the agitators, demagogues and the ratbags who now tend to hold the pollution stage and whose out-pourings constitute a pollution of reason itself".

This most intemperate outburst in what was essentially a plea for temperance may well have been indeed a mere *obiter dictum* seized upon by the press, but it will serve to make my point, even if I find it a little distressing. One might expect such emotional words from the pulpit, but not from a scientist and, of course, from the Bench never—well hardly ever. But perhaps having been a vice-chancellor leaves its mark upon a man.

Nevertheless I am tempted to speculate on the reasons for this sudden change of heart in the community at large. My own interest in the environment goes back a very long way. More than half a century ago as a child I knew that area of south-eastern Queensland now known as the "Gold Coast". I knew it as a land of clean clear deep creeks and rivers richly stocked with fish and the hills clad in dense rain forests of superlative beauty. Even at this distance in time I can recall the smell of cold salt air in the very early morning with a slight tang of wood-smoke and the sound of gently lapping waves as I hopefully fished for my breakfast. As I grew up I saw the forests felled, the creeks silted up and a great barrenness come upon the land. As I grew older and came to know other parts of the State I was deeply moved by the deterioration of the countryside that followed in the wake of the felling and ring-barking of trees—this was known as "improving the property"—and the consequent erosion and the evil results of over-stocking. When as a young adult, filled with missionary zeal I attempted to talk about these things I was soon discouraged. When mentioned in conversation they provoked a marked unease in the listener. I recognized the embarrassment as having much in common with that provoked in me by the earnest evangelical who enquired, "Have you been saved?" It suggested, I felt, an unhealthy, perhaps even morbid preoccupation with a matter best left unmentioned. Now such topics can be discussed at any dinner table. This change in attitude no doubt is partly due to a greater enlightenment—the product of the inevitable evolution of social values, which manifests itself in many ways.

In my youth the pavements were richly decorated with notices, "Do not expectorate—Penalty £2"—a handsome sum in those days. Similar notices adorned trains, trams and buses. They have largely vanished, people simply do not spit in public any more. And the reason is not because people no longer chew tobacco or because respiratory disease is less common—I pause here to pay due respect to any thoracic surgeons or chest physicians present—but that spitting in public is now regarded as offensive and intolerably anti-social behaviour. I am credibly informed that the worthy inhabitants of Edinburgh no longer cry "Gardey-loo" and throw their slops into the street. The reason is, undoubtedly, that this too would be regarded as grossly anti-social behaviour not to be tolerated in a more enlightened age.

A more sober illustration of the change in our way of thinking is provided by a serious and thoroughly well-intentioned book[5] published in 1947 on the problems of pollution arising from the use of coal. Treating of colliery spoil banks which, besides their ugliness, have other unpleasant and even deadly characteristics as at Aberfan, the author says—"Collieries near the coast are able to dispose of their refuse in the most effective way of all, by pumping it in the sea." In this year of grace 1971 it is true that we still treat the sea as our ultimate garbage can but no thoughtful person would for one moment commend it as the most desirable course of action.

The last example illustrates well the rapidity of our change of attitude—a change that is far too fast to be attributed solely to the slow evolution of social attitudes. I think that a much more important factor is that the problem has, with explosive suddenness, become too large to escape attention. It can no longer be swept under the carpet. Just as there has been a population explosion so also has there been a pollution explosion—the two, of course, are interconnected.

Man the only true begetter of pollution has been on this planet about a million years or so. It is hard to say just when his now alarming increase in numbers began—perhaps a thousand years ago—but it was only some two hundred years ago that there was added to this growth in numbers a sudden increase in his capacity to destroy the ecosystem of which he forms a part.

Man, the hunter, probably disturbed his ecosystem to a minimum degree, but even here there is room for doubt. He may well

[5] A. Marsh, "Smoke—The Problem of Coal and the Atmosphere" (1947), p. 382. London, Faber and Faber Ltd.

have used fire as a means of securing game in grasslands or open forest country and thereby changed his environment. When he became a herder of animals his impact on his environment became greater. It has been said that the Arab is not the son of the desert but the father of the desert—a reference to the possible disastrous effect which the goats he herded had on an environment in precarious equilibrium.

Man, the cultivator, produced a still greater change in his ecosystem; in clearing the ground and sowing his crops he replaced a diverse and self-supporting system by one single uniform plant population, vulnerable to attack by disease and insect pests and one which diminished continuously the productivity of the soil on which it grew.

The impact on his environment of man the tiller of the soil was, however, negligible compared with that of man the technologist and the age of technology, in the modern sense, is but a scant two hundred years old.

It was the inventions of Hargreaves and Arkwright and their like that marked the beginning of the Industrial Revolution in the eighteenth century and the production of more cloth meant an increased demand for soap and the alkali with which to make it—detergents you may note. The Le Blanc method for the manufacture of soda ash from common salt was invented in 1773. Hydrochloric acid, a by-product of the process, was allowed to escape into the atmosphere, and the chemical industry was born. The introduction of the steam engine to drive the recently-invented machinery increased the existing evil of coal smoke from domestic fires and the age of air pollution was upon us.

A more subtle and perhaps more serious outcome of the growth of technology was that so many of its products and by-products were non-biodegradable. Up to that time most pollution (including man himself) was organic and could be and was re-cycled—to re-appear again re-purified as fresh animal and plant life. As technology advanced there was a further important outcome—it made possible the unrestrained exploitation of the earth's resources with ever-increasing rapidity and an interference with the environment on a colossal and perhaps ultimately fatal scale. And that is the position in which we find ourselves today.

It is here that I wish to make my first substantive point and which, I hope, will serve to justify the title I have chosen for this address. Environmental pollution more particularly the

speed with which it has come upon us, is but a by-product, or a symptom if you will, of the unrestrained exploitation of the resources of the earth. A very unpleasant symptom I must admit and one that has caused the patient to plead for relief but it is only a symptom, the outward and visible signs of an underlying disorder. I am afraid it is also true that, as in other circumstances, the patient whilst pleading for relief from his symptoms may be unwilling to accept the fact that he has been the architect of his own misfortune and if he is to be cured he must mend his ways.

Environmental pollution more particularly with respect to possible therapeutic measures cannot be fruitfully dealt with in isolation. Any approach to an understanding of its causes and remedies involves consideration of our manner and rate of utilization of our admittedly finite resources and the means whereby our increasing numbers disturb our physical environment to a minimum.

If, as I take it, we can agree that the present state of affairs *vis-à-vis* our environment is unsatisfactory, that there is an obligation to prevent further deterioration and, if possible, effect some improvement, then two questions emerge—what should be done and who shall accept the responsibility for seeing that it is done.

At first sight it may seem that deciding what is to be done is a relatively simple matter. The problems are there for all to see and the prime causes of many are equally plain. For example it is clear that there is an absolute necessity to slow the present rate of growth of the human population, we might even consider that it is necessary to do a little better than the Z.P.G., zero population growth, that is now being talked about so much especially in America. It may be noted in passing in this connection that there is talk in the United Kingdom today of the licensing of babies.[6]

Superficially it would appear equally obvious that if we all decide to make our motor cars last twice as long as we do at present—admittedly we may at first run into trouble with that basic concept of the affluent society, inbuilt obsolescence—then, not only would the demand for the raw materials of which motor cars are made be halved, but there would also be only half the derelict automobiles to dispose of. Both these ends would contribute materially to the quality of the environment. It all seems so simple. It seems we know all the answers. We talk glibly about bio-

[6] *The Sydney Morning Herald*, 20th May, 1971, p. 5.

degradability, recycling of resources, ecosystem (today there are no zoologists and botanists only ecologists)—even technicalities such as "biochemical oxygen demand" are now familiar words. I made the point at the beginning of my talk that at least the informed half of the world is aware of the threats to the quality of our existence if not to existence itself, and if the answers appear plain, why not just get on with tidying up the mess?

Well, if we are going to do that we must really want to do it. We must want to do it to the extent that we are willing to forego something else to achieve it, even to abandoning the aspirations and ambitions that we hold most dear—we might even have to abandon our motor cars. Such radical change calls for education in its broadest and deepest sense. Something in the nature of a religious conversion such as Chairman Mao seems to have achieved in China—a change in social goals of the utmost profundity.

Beliefs that are now honestly and sincerely held must be countered and shown to be false. From the outside we may look in horror at the mining company that wishes to tear a great chunk out of one of our all too scanty national parks to mine coal or limestone or mineral sands. Those who are responsible, however, honestly believe that what they are doing is right, correct, proper and in every way laudable. They do it in the name of progress and talk of the development of the nation's resources. They used to speak of "exploitation of resources" but the message seems to have got through to them that exploitation is a dirty word—very bad for the public image. This gives me great hope. I feel in time this battle may eventually be won and it must be won if we are to survive.

But what shall we do with the incorrigibly wicked who persist in preaching false doctrines—the manufacturer of detergents who urging the use of salt of tripolyphosphates as a builder for detergent formulations, says, "Under certain special conditions of temperature and pH it [polyphosphates] can become a nutrient for algae (*sic*) growth. There is no intention here to evaluate this situation. It is at present a minor factor. However, some people for various reasons, are beating the drums to draw attention to this defect".[7]

At this stage perhaps someone in the audience is becoming a

[7] J. W. McCutcheon, "New-type builders for heavy duty detergents." *Detergents and Emulsifiers*, 1969. Annual, pp. 7-12.

little impatient and is wondering whether I am aware that there is such a thing as legislation. I would assure him that I am, and furthermore in the context of our present troubles legislation I would insist is one of our main hopes of salvation.

There is much that I should like to say on this subject but I hesitate. I am aware of the pitfalls which beset the path of the layman who presumes to meddle in legal matters. I know that the profession itself also has strong views on this subject which are enshrined in such aphorisms as, "He who conducts his own defence has a fool for a lawyer" and I must confess I can see a lot of wisdom in that charming couplet that states—

> There is no one who brings so much grist to the mill
> As the clever old lady who makes her own will.

Nevertheless, such I feel is the justice of my cause that I intend to stick my neck out—well, just a little way out. The first point I should wish to make arises from what I have said just now on education—no law can be made effective unless it is acceptable—that at least to the majority it appears just, reasonable and sound in principle. You can't convert people just by legislating, and I would quote in support of my contention the late unlamented Volstead Act in the U.S.A. A wise law on the other hand can and should serve as a guide to standards of conduct. Laws are not exclusively restrictive and punitive but they must be enforced and they must have teeth. It is useless to send a toothless hound to pull down a stag.

To illustrate let me refer to the very first legal order relating to public health in Australia. It is of added significance because, interestingly enough, it deals with environmental pollution.

Government and General Orders
22nd October, 1795
Public Nuisances

> It having been represented to the Governor that the people who have been allowed to occupy huts on each side of the stream which supplies the town of Sydney have opened the paling and made paths to the water from each hut, and have built pigsties at the rear of them, by which in rainy weather a quantity of filth must run into the stream, His Excellency thinks it necessary to give this notice: That, after this Order, any person found using a path from the house to the stream, or keeping hogs in the neighbourhood thereof, or opening a

passage through the paling, will be removed, and the house pulled down.[8]

It is clear that this order was not effective or not enforced and similar orders were published in 1796, 1797, 1798 and 1799. In 1800, however, a penalty of twelve months imprisonment with hard labour was imposed for the offence of polluting the Tank Stream. We hear no more of the matter so we assume either putting some teeth into the order made it effective or it was abandoned. I hope the former.

On the other hand the punishment must be reasonable, the severity of a law provides no measure of its efficiency as the long history of attempts to control pollution by coal-smoke in England illustrates.

In 1306 in the reign of Edward I an offender was put to death for creating a smoke nuisance by burning sea coals in London—how the heads would roll if such a penalty was enforced today in Sydney!—but it seems to have been without effect because the following year a commission of oyer and terminer—someone may care to correct my pronunciation of Norman French—was appointed with instructions "to enquire of all such who burnt sea coal in the city or parts adjoining and to punish them for the first offence with great fines and ransoms and on the second offence to demolish their furnaces".

Indeed the Clean Air Act of 1956 seems to have been much more effective and there is nothing whatever about torture or summary execution in it. I cannot, however, agree with Sir Napier Shaw[9] that, "dealing with the question by legislative penalties for excessive smoke, appeals more naturally to lawyers and law givers than to the other classes who still form the majority of mankind". If we can judge from past experience enlightened legislation has been a *sine qua non* in the control of environmental pollution.

In England by 1830 noxious chemical fumes chiefly from the Le Blanc process had become an unacceptable nuisance, and numerous Acts were passed to regulate the escape of gases into the atmosphere. In 1863 these were consolidated into the Alkali etc. Works Regulation Act, and this Act, as amended on numerous occasions since, is still the major implement for the control of

[8] J. H. L. Cumpston, "Health and Disease in Australia" (1928), Vol. 1, 15-16.

[9] N. Shaw and J. S. Owens, "The Smoke Problem of Great Cities" (1925), p. 279. London, Constable and Company Ltd.

air pollution in Britain. The first legislative control became possible because in 1830 Gossage knocked a hole in the bottom of a disused windmill, stuffed it with branches down which water trickled thus effectively absorbing the hydrochloric acid. This became a valuable by-product of the process and someone has remarked, "It once took a law to take the acid out of the atmosphere, now it would take another law to make them put it back in again."

I hope that has served to make my point because I am anxious to retreat to firmer ground and deal with matters on which I feel more confident.

I wish to speak now of something which constitutes the major impediment to a solution and it can be summed up in one word "ignorance".

By this I mean that we are often unable to foresee the results of actions undertaken often with the best intentions. For example it is now alleged that the construction of the Aswan Dam contrary to it being the salvation of Egypt as expected has led to a decrease in fertility of the soil, an increase in its salinity, an increase in schistosomiasis and a fall in the sardine catch in the Eastern Mediterranean. I know that it is also alleged that this is false propaganda spread by the U.S.A. because the dam was built with Russian aid but it is true that similar giant schemes have had unforeseen, unfortunate results.

Most physical and biological systems in the biosphere are in equilibrium and only a slight nudge upsets the equilibrium in the-house-that-Jack-built fashion. Increased sewage in the upper reaches of the Danube increased the bacterial population in the river with a resultant increase in the population of rotifers which encouraged a proliferation of the larvae of *Simulium damnosum* and the adult flies attacked cattle grazing on the banks of the lower reaches of the river in such enormous numbers that there was a disastrous fall in meat and milk production. The outcome was completely unforeseen. I could multiply such cases at great length but I shall consider only one more.

The increased consumption of fossil fuels has increased the amount of carbon dioxide liberated into the atmosphere and at the same time loss of green vegetation has reduced the rate of photosynthesis. The present CO_2 content of the atmosphere (320 ppm) represents an increase of about 10 per cent in the last one hundred years but in the next one hundred years it is expected that the amount will at least double. Because the temperature of

the earth remains roughly constant the heat flowing in from the sun must equal the heat lost by the earth—that is a state of equilibrium exists. Carbon dioxide, however, has absorption bands in the infra red and can be expected to produce a glass-house effect. It is, therefore, postulated that the end result may be a disastrous rise in temperature of the world as a whole. However, another school of thought postulates that the deposits of reflecting particulate matter and water vapour in the upper atmosphere by jet aircraft will reduce the solar flux with consequent falls in temperature and the next ice age will be upon us. Which is right? The answer is we just don't know enough to do the sums involved. This is but one of the great question marks hanging over our heads at the present time. On a lesser meteorological scale we may note that even the mechanism of the production of oxidants in Los Angeles type smog is still imperfectly understood.

Sometimes one feels that every technical advance is a jump in the dark. The battle of DDT rages about our ears. A W.H.O. Expert Committee[10] has probably rightly decided that the case against DDT is as yet not proven but that care should be taken and further extensive tests conducted. However, in its press releases W.H.O. chooses to base its plea for the continued use of DDT on the grounds that if it is not used many thousands will die of M.T. Malaria. This I consider yet another case of the emotionalism which seems to dog so much of the debate on environmental pollution.

Perhaps I have made a case for more research and I need say no more but merely murmur rabbits and prickly pear to show how easily the balance of nature may be upset by just the tiniest of nudges, and hurry on to consider who shall do these things that we are agreed, I hope, should be done; and truly there is no lack of parties to the case.

First there are the International Bodies headed by the United Nations, about half a dozen of its offices and its specialized agencies, I.L.O., F.A.O., U.N.E.S.C.O., W.H.O., W.M.O. and I.A.E.A. together with an indefinite number of other international organizations such as I.C.S.U., S.C.O.R., S.C.A.R.

On a national level, the proliferation of authorities is intense. There is the N.H. & M.R.C. and I can count about seventeen of its committees who are involved. The C.S.I.R.O., about twenty-five of its divisions are concerned. There is a round dozen or so of

[10] W.H.O., "Pesticide Residues in Food," *Wld Hlth Org. Techn. Rep. Series* (1970), No. 458.

Commonwealth Departments and Instrumentalities; quite a number of national committees such as the Australian Transport Advisory Council. Mention must also be made of the Senate Select Committees on Air Pollution, Water Pollution, Aircraft Noise and Wildlife Conservation, the first three of which have already presented substantial reports.

And so we go on down through the States and Municipal authorities to the very grass roots and I find that a recent Commonwealth Inter-Department Conference has listed no less than one hundred and ten societies in Victoria and a lesser number in the other States who are concerned in some way with the protection of the environment.

Whilst it is good to know that there is this degree of interest it is not without its disadvantages and some degree of rationalization and definition of spheres of influence seems called for.

The Alexandria Canal which drains about five square miles of South Sydney is the responsibility of no less than six authorities. The Department of Public Works owns the Canal; the Maritime Services Board polices pollution; the Water Board owns the storm water channels which feed it; the Department of Health is responsible for the sources of pollution; and the South Sydney and Marrickville Councils preside over the gutters and drains emptying into it. Perhaps this explains why it is Sydney's dirtiest waterway, black, stinking, and absolutely lifeless.

For once I would disagree with King Solomon and insist that in a multitude of counsellors there is confusion. However, at the risk of adding to the confusion, I do think we must examine the question of responsibility. The United Nations insist that there is a strong case for international control on the grounds that pollution knows no international boundaries. The wind bloweth where it listeth and the smoke with it; one river may flow through several countries and serve as a boundary between others; and, above all, there is the question of the seas—pollution of the oceans of the world being a matter of even more pressing urgency perhaps than pollution of the atmosphere. Byron's claim that "Man marks the earth with ruin, His control stops with the shore" no longer holds good. Whilst the United Nations and other international organizations may have good claims for a voice in those matters that do require international co-operation or agreement for control, for example the pollution of international water-ways, or for monitoring, as is the case of radioactive contamination of the atmosphere, on the whole its role

either in the prevention of pollution or the exploitation of natural resources is circumscribed.

Pollution always arises from a point source and salvation lies in control of the source and this is a domestic matter. The setting up of pure air and pure water standards is an interesting exercise by which we may judge the success of our efforts but the setting up of emission standards is the means at hand to effect control and this calls for national or local legislation.

Perhaps my views in this matter are an expression of personal prejudice but I am more than a little cynical about adherence to international agreements when national interests are involved. There is an international Whaling Commission and about five years ago a law was passed to protect sperm whales in their breeding ground. The Russians, the Norwegians, and the Japanese refused to observe it. They were the only nations whose operation would be affected by it.

I am old enough to remember Abyssinia and the imposition of sanctions and I don't think international morality has improved much in the last generation. There is in existence the Antarctic Treaty 1959 designed to secure that "Antarctica shall continue forever to be used exclusively for peaceful purposes and shall not become the scene or object of international discord". So far it has functioned admirably and all the nations concerned have given due heed to its fourteen articles. However, cynic that I am, I wonder what would happen if someone stumbled on the world's richest goldmine or uranium deposit or some other highly desirable and much to be coveted source of wealth or power in Antarctica. This might lead, if not to international discord, to just a little lack of harmony.

Political issues are, however, a matter which I do not wish to pursue. What I do wish to emphasize is the doctrine of personal responsibility—your responsibility and my responsibility. There is not a bus ticket that falls to the ground but someone dropped it. There is not a tree cut down but someone wielded the axe. There is not a drain that pollutes a watercourse or the ocean itself but some one person or corporate body is responsible.

But, you may argue, is there not one or perhaps more groups of people who have a greater responsibility than others—scientists or technologists for example? Can we not leave the matter to them? "They got us into this mess it's up to them to get us out of it", is an argument that is often heard. The same argument is often more rationally expressed in the optimistic hope that *dies*

irae will never come. In the past advances in technology and further scientific discoveries have come to our rescue, there is no need to assume that the future holds less scientific progress in store to provide us with the means of escape. What the answer is I do not know. But if as Talleyrand said, "War is too serious a matter to be entrusted to the generals," then I would affirm that our survival is too serious a matter to be entrusted to the scientists. Generals we must have to cope with the tactical situation and scientists we must have for much the same reason. You will have noted, however, that scientists, particularly atomic scientists, though claiming to be rational men are apt to plead in the dock that they did not intend the consequences of their actions and that I think is not a very sound defence.

There are, however, two classes of men whose responsibility does in my opinion extend, because of their professional calling, beyond their own personal responsibilities and I refer to the medical and legal professions and it is for this reason that I was especially glad to be invited to address this Society.

Medicine is and always has been fundamentally concerned with the bodily welfare of man and the quality of his life. I know that in many ways the profession has a deplorable record of ignorance and misdirected energy.

It is easy to point the finger of scorn at the pointless iatrogenic suffering caused by its blisters and emetics, its purges, clysters and blood letting in the past and more recently by tonsillar rape in children and colopexy in the neutrotic but it has always striven to the best of its ability to improve the lot of mankind and relieve its suffering. It has triumphed in the past over such great scourges as plague, smallpox and typhus. It should not rest upon its laurels but should seek a place in the forefront of the present battle, which will undoubtedly be the great public health problem of the twenty-first century.

To me the obligations of the law are equally plain. Some of the reasons for this assertion I have already given and here it may suffice to state that enlightened legislation is the chief guardian of the Public Health. I am sufficiently old-fashioned to believe that there is a real entity, the Public Health, to be spelt with capital letters but without inverted commas. It is the wisdom and the commonsense of the law that I would especially emphasize in the present context. Because our knowledge is in so many ways defective and it is so difficult to see the outcome of so many adventures on which we embark that we must be guided by what

seems prudent in the circumstances and the prudent man is a concept familiar in law.

My time is running out and I should like to end on an optimistic note because I am, though you might not have received that impression, essentially optimistic about the outcome of the war. So far I seem to have done nothing but cry, "Woe, destruction, ruin and decay" but all is not lost, the gloom is not entirely unrelieved. Despite all that has been said, much of the earth is a cleaner, healthier place than it was a century or so ago. If one reads Edwin Chadwick's "Report on the Sanitary Conditions of the Labouring Population of Gt Britain" written in 1842,[11] his account of the filth in which the industrial labouring classes in Great Britain lived a century and a half ago is so revolting that a stench appears to rise from the very pages as you read and finally you close the book saying, "I can take no more." Life, I must insist, IS better now.

When one sees the miracle that has been wrought in the United Kingdom by the implementation of the Clean Air Act of 1956 and the further Act of 1968, there is revealed at once what willingness and wise legislation can achieve. Today we can again stand on Westminster Bridge and say with Wordsworth, "Earth has not anything to show more fair. All bright and glittering in the smokeless air."

By the year 1850 the River Thames, and not that other drain built by Tarquinius Priscus, deserved the title *Cloaca Maxima*, and it was and has been until just recently absolutely lifeless. Now fish are returning and perhaps in the future to say that, "Life ran gaily as the sparkling Thames" may have some meaning.

The first means ever employed by man to escape the effects of environmental pollution was to get up and walk away from it all. When one camp site became unbearably contaminated, primitive man moved on to another. The same method has been employed in varying forms ever since. Armies have marched and countermarched throughout history not so much for tactical and strategic reasons as to escape from the pollution of the environment that they themselves caused. Once the army became stationary it was apt to be destroyed by the filth of its own creating. Quintus

[11] E. Chadwick, "Report on the Sanitary Condition of the Labouring Population of Gt. Britain." Ed. Flinn, M. W. (1842), Edinburgh, University Press.

[12] *Lib. V.*, 32. See E. A. Parkes, A Manual of Practical Hygiene Intended Especially for Medical Officers of the Army and for Civil Medical Officers of Health. Fourth edition (1873), p. 657. London, J. & A. Churchill.

Curtius notes[12] that Alexander the Great preserved the health of his army by frequently changing his encamping grounds. Many a besieged city has been saved not by the fortitude and the valour of the defenders but by epidemic disease in the besieging army.[13]

I have often wondered why in the divers laws and ordinances which Moses is said to have devised for the regulation of the conduct of the Israelites, many of which were intended to protect the health of the people, there is so little reference to environmental sanitation. Indeed the only one that I am aware of is the familiar reference in the Book of Deuteronomy—"Thou shalt have a place without the camp . . . and thou shalt have a paddle upon thy weapon".[14] Two possible explanations for this apparent anomaly present themselves to me—either the nomadic existence led by these people made sanitation relatively unimportant or the lack of sanitation forced a nomadic existence upon them. I think in view of the geographical environment that the first is the more likely.

Squalor as well as hunger—they are both products of overpopulation—can be the driving force behind human migration. Some of us may be here tonight because our forebears sought to escape the unpleasantness of life in nineteenth-century industrial Europe.

It does not need much imagination to see in the Apollo missions to the Moon—the first move towards the exploration of other planets—the expression of this same urge to escape the consequences of our actions by seeking "fresh woods and pastures new". It would be strangely ironic if this were so.

I began my talk tonight by speculating on the reasons why the civilized world as a whole has so suddenly become conscious of the dangers of pollution and of the urgent necessity for man to adopt a responsible attitude to the ecosystem in which he lives. My own belief, and enquiry seems to show that others share this view, is that if one single event has been of dominating importance in awakening in us a realization of our present plight it was the first Apollo mission and the picture, widely published at the time, of the earth as seen from space. This brought home to many people for the first time the fact that the earth was finite and not infinite. That it was all the human race possessed, that we must if we are to survive, care for it, cherish it and husband

[13] C. L. Heizmann, "Military sanitation in the sixteenth, seventeenth and eighteenth centuries," *Annals of Medical Hitsory* (1917), I, 281-300.

[14] Deuteronomy, xxiii, 12-13.

its resources by every means within our power—in short preserve the integrity of the biosphere.

Discussion

MR. J. FRAZER: I would, first of all, like to congratulate Dr. Macpherson on an excellent address. His words convey to me an understanding of the depth and gravity of a problem which all too often is dismissed as something for someone else to be concerned about. Having worked on pollution problems for some twenty years in a State with 21 million people, and with perhaps the most rapidly expanding economy of any area in the world's history, his message had very special meaning for me. Dr. Macpherson noted the importance of legislation, and I would like to take just a few minutes, if I may, to give you some highlights of the environment protection legislation which was recently enacted here in Victoria.

It is a significant and a very comprehensive piece of legislation. The Environment Protection Act of 1970 is an Act providing for a programme of comprehensive management of liquid, solid, gaseous and radioactive wastes being discharged into the environment of Victoria. It also provides for control of litter, and water, air and land pollution and objectionable noise. Passed by Parliament in December of 1970, it calls for strong measures to stop pollution, but more importantly, it provides a means of preventing pollution before it happens. This prevention is accomplished by a procedure whereby environmental policy is established for the various segments of Victoria's environment, and another procedure whereby all waste discharges must be licensed, and these licences may be subjected to any conditions or limitations the State may wish to impose in order to protect the quality of the air, land and water environments. A licence application may be rejected, and a licence that has been issued may be amended, suspended or revoked by the State at any time. What this means is that a waste discharger can never obtain a permanent right to degrade the environment. This licensing process will enable the State to know what wastes are being discharged, and will enable the State to manage all wastes going into the environment. The Act also has provisions whereby products, facilities, vehicles, fuels and other matter may be controlled to prevent damage to the environment. The Act has many other features, but I do not wish to take up your time with a detailed review of them. The Act is comprehensive. It provides for prevention of pollution. It provides for stiff penalties if pollution does occur, and nobody is exempted from its provisions. This

is not a biased view at all, since I had only very little to do with its preparation, but it is very good legislation, I think. Because it will be extensive in its effects and coverage, the Government plans to implement it in two stages. The first stage is under way, and parts of the Act have been proclaimed establishing the two principal administrating bodies, the policy-making functions, and some of the housekeeping functions. The licensing, enforcement and other aspects of the Act will be proclaimed and implemented as soon as necessary procedures and preparatory work can be effected so that this licensing and enforcement work can proceed in an orderly and efficient manner. I commend the Act to you. It will have a most favourable impact on environmental protection. We are presently working on its implementation, and there is considerable pressure being exerted for us to exert haste in implementation of the Act. We want the implementation to be sound, efficient and effective. We cannot accomplish this by rushing into the licensing and enforcement aspects without the means, and without the carefully adopted procedures. To do so would result in chaos, which could well render the Act inoperative for a longer period of time, possibly permanently. In his talk, Dr. Macpherson claimed again that legislation is one of our main hopes. I would agree, and we have taken this step in Victoria, but I must also say that no pollution legislation is worth any more than the paper upon which it is written unless it is efficiently implemented and fully, equitably and impartially enforced. There must be a comprehensive programme of implementation. An effective programme must have, first, in my view, public support. It must have the public behind it. Secondly, it must have Government support. By that, I mean it must have the support morally and financially of Government. It must have good leadership, and that leadership should be insulated from the day to day political influences that have often plagued pollution control problems elsewhere. It must have an effective stamp. It must make effective use of technology and research, and it must involve itself in long range planning. We cannot just control pollution *per se*. We must manage wastes. There must be means of financing the process of managing wastes. There must be strong and impartial enforcement of the Act, and I might add efficient enforcement, and there must be a constant information and education programme so that the public understands what Government is doing in the way of environmental protection.

Professor Macpherson stated that punishment for pollution

must be reasonable, and the severity of law provides no measure of its efficiency. In one sense, I agree with this, but in another sense, with Dr. Macpherson's permission, I would disagree a little bit. Two aspects of many pollution control laws and their implementation have commonly resulted in ineffectiveness. One is low fines, and the other is the complex, costly and arduous courses required by many pollution control laws to bring the polluter into Court and successfully fine him. Low fines are no deterrent to polluters. In fact, they make a mockery out of pollution control laws. Complicated procedures to bring polluters to task result in nothing more than the building up of administrative frustrations, and ultimately result in little or no enforcement. High fines with judicial but strong, expedient and efficient enforcement result very quickly in developing an atmosphere whereby the would-be-polluter finds it more comfortable to be a good environmental citizen. In this respect, severity of the law can be a measure of its efficiency.

So much for the legislative picture. Let me touch on a couple of other points in Professor Macpherson's presentation in way of amplification and in way of placing them in a little different light. In one point he stated, "Why not just get on with the tidying up of the mess," and he went on to say "Well, if we are going to do that, we must rely on you to do it. We must want to do it to the extent that we are willing to forgo something else to achieve it, even to abandoning the aspirations and ambitions that we hold most dear." To me, herein lies a most significant point. How bad must things get before our society is willing to substitute environmental quality and protection for material benefits? This is not to say that they are mutually exclusive, but environment protection must become an accepted integral part of the cost of living, of the economy, and of our way of life. It certainly is not at the present time. As Professor Macpherson indicates, it will require major changes in our thinking. It will also require Governmental machinery and expenditures unheard of today. The road ahead is not an easy one. Professor Macpherson is cynical in his treatment of international control of pollution. I share his cynicism in respect to existing attitudes and existing institutions. They do little to stimulate confidence in them as a means to solve global environmental problems, but at the same time, I recognize and counsel that effective international controls must be developed. Here again, it will require some major changes in thinking, as Professor Macpherson has noted.

He has highlighted the conflicting views of scientists on the far-reaching effects of increased carbon dioxide and particulate matter on the world's climate. I was pleased to see that he did not treat this conflict as indicative of scientific nonsense, as some less intelligent but prominent speakers have chosen to do recently. There is an important message in this controversy which we should face up to, and it is simply that man now has the capability of altering the world's environment, and, perhaps, has the inability to prevent a global disaster. The longer responsible people fail to see this message and scoff at such analyses as "the work of the alarmists pressing the emotional panic button", the longer we still sustain the inability to prevent environmental disasters. This does not mean that we should accept such predictions without critical review.

My last thoughts relate to Professor Macpherson's reference to environmental pollution having resulted from unrestricted exploitation of the resources of the earth, and that we should be willing to accept the fact that we have been the architects of our own misfortune, and if we are to cure the problem, we must mend our ways. He also noted, I believe, that the medical and legal professions have some responsibility beyond their own positions. Let me cast these thoughts to you in a little different way. Medical science is a significant contributor to the present environmental problem. I will have a word with the lawyers later! If that startles or angers any of you, let me clarify it. As a biologist, I am fully aware that no non-human animal population can continue to expand forever without destroying himself or itself. Man, through his greater intelligence, has been able to overcome the diseases and the famines and the other disasters which normally control over expanding animal populations. Medical science has played a significant role in developing this unnatural situation in the human population. Do not misunderstand me. I prize good health and longevity as much as anyone, and I am much indebted to medical science and the medical profession for the good health I enjoy today, but looking to the progression of this unnatural situation, the medical profession needs to show more of a responsibility for the environmental health as well as the physical health of future generations. As for the legal profession, I would simply pose that you ask yourselves these two questions. "1. What have we done to encourage environmental law?" And "2. What legal roadblocks to environmental protection have we helped to remove lately?"