The Ecologist

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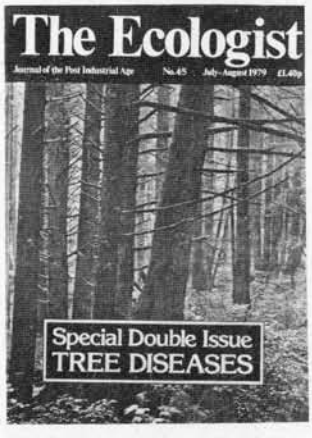

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Editorial

Feature Articles

Cover by Mike Frost
Photo: Keystone Press. Members of the Royal Navy Mine disposal unit carrying a drum of poisonous chemicals away from the beach at Polperro, Cornwall. 100 drums washed ashore, but only 9 were disposed of.

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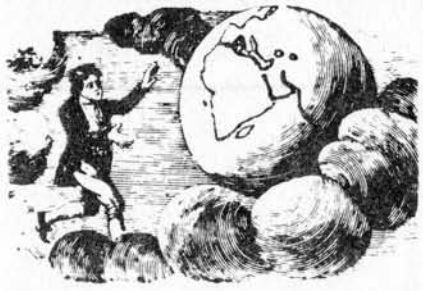
Editorial



The Nineteen Eighties

The changes that have occurred in our society during the 1970s have not led me to modify the predictions I made ten years ago regarding the medium (thirty years) to long-term future of this country, which were published in the last chapter of my book *Can Britain Survive?* published in 1971

To predict the exact time-scale of these developments however, and hence how far they will have progressed by the end of the next ten year period, is very much more difficult. Nevertheless this is how I see the 1980s:-

The changes that will most affect the direction of our society must be those that affect our attitudes. For it is attitudes that determine how we behave and hence our attitude to life — within a given set of physical constraints — determines how we live.

During the 1980s there is likely to be a very substantial change in our attitudes to just about everything, in particular our more basic values.

At the beginning of the 1970s most people still believed in the omnipotence of science and technology. In the preceding decades we had seen the invention of antibiotics, synthetic fibres, DDT, the supersonic jet and, of course, man had caught up with science fiction by landing on the moon. All this lent additional credence to this myth.

But disillusionment is beginning to set in. It is not that we have lost faith in the incredible ingenuity of our scientists, indeed living as we are at the dawn of the age of genetic engineering and of micro electronics, we know that our scientists are likely to continue to astound us with their seemingly limitless ingenuity. If we are disillusioned it is for a very different reason:- it is that we are coming to realise just how totally irrelevant all these incredible achievements are to the solution of the real and desperately serious problems that confront our society today — problems such as unemployment, famine and malnutrition, the growing epidemic of cancer and heart disease and above all the soil erosion and desertification that in the next thirty years are likely to reduce the world's agricultural land by a quarter. "C'est magnifique", might be a suitable reaction to the achievements of our scientists, "mais ce n'est pas la guerre".

In the eighties, this attitude can only harden, indeed as more of the undesirable side-effects of these achievements become ever better documented, a reaction will set in against science and indeed against scientists. As Dr Schumacher used to say, we must choose between science and wisdom and it is wisdom that we shall be seeking in the next decade. This choice will affect everything we do because it is science and the technology it engenders that, more than anything else, including the decisions taken by our politicians, have determined the shape of our modern society.

At the same time we shall see the gradual abandonment of our other closely associated values and beliefs. Thus a reaction has already set in against individualism which we are beginning to realise to be but a euphemism for the social isolation and anonymity of our mass society and instead people are frenziedly searching for their roots — trying desperately to establish for themselves some sort of social identity. Hence the present trend towards the accentuation of ethnic differences, a reversal of the previous trend towards social homogenization. On the positive side this must lead to the development of regionalism, indeed the recent set-backs encountered by the Scottish and Welsh Nationalists are certain to be reversed during the 1980s — a healthy trend towards a more decentralised society. On the negative side it may well lead to worsening race relations.

We are also likely to see a strong reaction against the materialism of our modern world. It has already begun to set in amongst middle class youth who are displaying growing concern for nature, aesthetics and the things of the spirit. During the industrial age we were told that all these things were of little account largely because our scientists could not quantify them; they were not seen by our economists as making any contribution towards Gross National Product nor were hey an obvious source of votes for our politicians.

As Weber and Tawney pointed out, an aspect of social behaviour whose nature is largely determined by attitudes, rather than by the more easily quantifiable variables that monopolize the attention of our economists, is economic behaviour. It is probably the attitudes engendered by the welfare state that have above all reduced Britain's economic competitiveness and hence its material prosperity. Indeed a society cannot hope to compete economically if its citizens have been taught to take prosperity for granted — and assured that, even if they make no effort of any kind, the State will see that their standard of consumption remains relatively unaltered.

The new attitudes that will develop during the 1980s are not likely to be any more favourable to our economic competitiveness, because people will come to attach ever less importance to the benefits that a successful economy can provide.

Attitudes that are more favourable to economic competitiveness have, on the other hand, been developing very rapidly in other countries, in particular in those that are coming to be called the

NICS or Newly Industrialised Countries such as Taiwan, Singapore and South Korea.

Competition from these and from other countries such as Japan, France and Italy for whom the industrial way of life is still a relative novelty is likely to lead to the steady decline of our manufacturing industries that were once the basis of or material prosperity.

The textile industry is already dying, as is ship building and also machine tools. Import penetration is growing fast, indeed the market for shoes in this country has been largely taken over by the Italians; that for cutlery by the South Koreans; and even a seemingly peripheral market such as that for shrubs and ornamental trees is now firmly in the hands of the Dutch. Much more serious is the plight of our motor industry which is losing ground every year. If British Leyland is forced to close down most of its operations as seems probable, this enormous market will also largely be taken over by foreign companies. The fact that Japanese, Italian and German cars are better designed, better manufactured, better marketed and better serviced than ours is simply symptomatic of the fact that attitudes (both on the part of our management and of our workers) are no longer those of a successful industrial nation.

The notion that the micro-electronics revolution will be of benefit to us is sheer wishful thinking. To succeed in this field we would need above all the most ingenious engineers. British engineers are indeed among the world's most ingenious but it is the Americans who are likely to benefit from their ingenuity for they will offer them much more exciting jobs at a very much higher salary. Also there is little reason to suppose that we can mass-produce high precision electronic devices better than can the Japanese. If there is anything to go by it must be our record in the manufacture of transistor radios. It is a poor one.

We will be tempted to protect our declining industries by introducing more and more protectionist measures. Indeed the reaction against free trade is likely to be a radical one, for Free trade must favour the most efficient and the most competitive. Such measures can only encourage other countries to do the same, which must lead to a reduced level of world trade. This would only be tolerable if our government took the necessary measures to encourage self-sufficiency and this it is unlikely to do, though self-sufficiency is likely to become a key value among a large section of the population, but this I shall come back to later.

The level of international trade is likely to be reduced for another reason. In the last thirty years every country in the world has sought desperately to 'develop' and 'industrialise'. We have encouraged them to do so and by doing this have signed our own economic death warrant. Material prosperity in this country was achieved by importing raw materials and selling finished products, a formula that was very effective so long as it was applied by one or two countries only, but which cannot work once every country in the world is trying to do the same thing. They cannot all import raw materials, for who will export them? Every country will now require the raw materials it produces for use in its own manufacturing industries. Nor can they all export finished products for if every country manufactures its own why should it import other peoples'? What we are likely to see is a tremendous pressure on raw materials which will grow as the world's limited economic sources become depleted together with a massive world surplus of manufactured goods only the most competitive of which are likely to find a market.

World trade is likely to be affected in still another way. Our planet cannot support its present population of 4.5 billion people even in the short-term. Official forecasts of a world population of 6-7 billion by the end of the century are naive and irresponsible. During the 1980s world population would indeed increase by an extra five or six hundred million people if it proved possible to feed them, but it will not be. There is practically no useful land left to bring under the plough and few farmers in the Third World can now afford the increasingly expensive chemical inputs required to increase yields any further.

At the end of the 1980s the world population is unlikely to have increased above the present level, famine will have seen to that. Half a billion people are in fact likely to die of starvation or rather from the infectious diseases to which starving people tend to succumb.

The main causes of starvation are population growth, soil erosion, desertification and international trade, and it is the latter which is the easiest to deal with. At present a vast proportion of the agricultural land in Third World countries is used to produce food for export and the foreign currency earned in this way is spent on manufactured goods, increasingly high technological installations such as dams, and power stations and also armaments — none of which they have yet learnt to produce themselves. As famine becomes more widespread however, so will Third World countries have to spend more and more of their foreign currency to buy food and it cannot be long before they realise that it is to their advantage to produce the food themselves. To do this however would mean correspondingly reducing their exports of cash crops and would have the effect of depriving industrial countries of all sorts of commodities such as rubber, coffee, sugar, jute and much of the feed for our livestock. It would also considerably reduce the market for our finished products, as Third World countries would no longer have the foreign currency with which to pay for them.

Inflation must also continue to soar. It will increasingly be of the new type — that which is reconcilable with economic stagnation — and which is due to long-term rather than to short-term maladjustments between supply and demand.

This "structural inflation" as it might be referred to (on a parallel with "structural unemployment") largely reflects ever less propitious conditions for the economic process (changing attitudes, increased competition, growing pressures on scarcer energy and mineral resources, water shortages, land shortages,

capital shortages etc.)

Energy must remain a critical question during the eighties though in the early part of the decade we might well find an oil glut leading to a price cut. This might occur partly because of increased production spurred on by rising prices but also because of the world decline in economic activity. The OPEC countries might well become desperate to maintain their current income without digging into reserves that they have been accumulating for a rainy day, and this will force down the price of oil still further. As a result there is likely to be reduced investment in North Sea oil and a reduction in oil exploration which will seriously aggravate the much more serious oil crisis that is likely to occur later on in the decade.

It is difficult to see the medieval regimes of Saudi Arabia and the Gulf States surviving into the late eighties. The process of modernisation or 'westernisation' which they have set in motion cannot but cause all sorts of serious social problems which must lead to a revolution of some sort, perhaps along the lines of that which has just occurred in Iran, but which in any case must seriously threaten Western oil imports from this the richest oil producing area of the world.

The crisis is likely to be exacerbated by the predictable failure of Western Governments to introduce the indispensable crash programme of energy conservation of the sort proposed in this country by Gerald Leach in his *Low Energy Future for Great Britain*. This must provide the only road to energy salvation, the only one that does not require long-term research and technological development for which there is not time, and massive capital outlays which we cannot afford.

The nuclear industry is likely to make but a small contribution towards filling the energy gap. Indeed if there is one thing one can be certain of, it is that the 1980s will see the end of the nuclear adventure. It is indeed extremely unlikely that any nuclear power stations will be built after this ten year period.

The Austrians have already voted against building nuclear reactors. Every year an ever greater proportion of the population of most European countries joins the ranks of the anti-nukes. In most states of the USA it is now politically impossible to build a nuclear power station and in that country the nuclear industry is as good as dead. Efforts to go ahead with our nuclear programme are likely to be impeded at each level by the anti-nuclear movement. Uranium miners will increasingly refuse to mine uranium, dockers will refuse to load it on to ships, sailors to transport it and workers in nuclear installations to process it into fuel, use it to produce energy and reprocess, stock or dump the wastes.

Accidents must continue to occur. One can predict at least one major accident within the next ten year period. It is in France that it is likely to take place. In this country the nuclear programme is being given such high priority that even the most serious technical hitches are not allowed to interrupt the present crash building programme. If a pressurised water reactor somewhere doesn't free its entire contents of radioactive material into the atmosphere in the next few years, we will be very lucky. However, once the Superphoenix breeder reactor starts operating at Greys Malville in about 1983, the risks will be of a different order of magnitude. Many nuclear scientists regard this experimental device — because that is what it is — as unworkable and a major accident as unavoidable. When it occurs and it releases its contents of 4.6 tons of plutonium into the atmosphere, perhaps some 500 times more than that released by the bomb that exploded at Hiroshima, the consequences will be too horrible to contemplate. This of course will mean the end of the nuclear adventure. No government will be able to build another such plant — public opinion would not allow it. In any case, as is becoming increasingly apparent, the breeder reactor is a very poor breeder. Its spent fuel must be retreated and more plutonium is probably used during retreatment than is gained during the lifetime of the reactor. This means that with or without accidents the nuclear industry has no future.

Clearly all responsible people will have realised well before the end of the 1980s that there is no alternative to oil, at least on the scale required to power an expanding world economy. This means that economic growth is simply no longer feasible. It also has another consequence. So far, to each new problem that has confronted us, we have applied ever more sophisticated technological solutions requiring increasing energy inputs. This shall no longer be possible. For the first time for many decades we shall be forced to apply solutions to our problems that make use of less rather than more energy. Because of the capital shortages already referred to, these solutions will also have to make use of less capital. This means setting our society on a very different course. In particular it will mean making use of our singularly neglected biospheric resources constituted by living things. The human family for instance is such a resource, and it will be found that if reconstructed it would be able to provide for itself many of the services that, in the last decade have had to be provided by elaborate, costly and energy-intensive state services. A forest is another such resource. Not only does it provide timber for building, for making furniture and also for fuel, but it also harbours wildlife, controls run-off to rivers, thereby preventing floods, and provides a multitude of other free services. During the 1980s one can predict a massive rebirth of forestry with a possible doubling or trebling of the existing forested areas in this country.

With a declining economy, a high rate of inflation and growing unemployment, wages — if they were determined by market forces — would inevitably fall, but they are not, they are largely determined by trade-union pressures and political exigencies.

This means that many classes of workers will simply price themselves out of the market. This is already happening to farm workers in the US and elsewhere. In the UK very few farmworkers would remain in employment if they were granted the £100 a week salary that they are at present demanding. From the farmers' point of view this creates serious problems today since the price of the machinery and chemicals

that have, up till now, been introduced to replace labour, is increasing just as fast.

This means a reversal of trends towards higher agricultural yields and high production as it must become economic to aim at achieving lower yields by reducing expenditure on machinery, chemicals and labour.

Some labour is nevertheless required and this will have to be obtained outside the formal economy. There will undoubtedly be a return to the family farm which must now come into its own since it does not have to pay a formal salary to its various members. It must also make the commune movement more attractive. This development however will be slow. In the meantime farmers will tend to employ people who are officially unemployed and thereby have access to unemployment benefits which makes it possible for them to work for a lower wage. In Italy this is already occurring on a massive scale. In general, if the system is unworkable then more and more things will take place outside it — not just agriculture.

Learning to live outside the system will become a necessity in view of the massive rise in unemployment that can be expected in the 1980s.

More and more people, in particular women, will seek jobs — two or more jobs per family will in fact be required if people want to maintain present lifestyles in ever less propitious conditions.

On the other hand, less and less jobs will be available because of our declining industry and because of increasing automation. As the micro electronics revolution gets under way we shall soon see, to quote the present French Minister of Industry "a countryside without farmers . . . factories without workers, offices without employees and hospitals without doctors." Inevitably this must mean unemployment on an unprecedented scale.

As the numbers of unemployed escalates so will it prove increasingly difficult to provide them with unemployment benefits, the sums required being simply too massive. In any case, unemployment benefits are unlikely to increase as rapidly as inflation which must lead the unemployed to find alternative methods of sustaining themselves. Indeed if the unemployed are to survive they will have to learn to live with unemployment. To do this will mean building up an informal sector of the economy. More and more people will work unofficially. Payments in general will increasingly be made under the table, people will tend to produce their own food and make the things which they would previously have bought. All sorts of new associations will be formed within the informal economy and communes during the eighties should really come into their own. Indeed as the formal economy contracts — as it ceases to provide opportunities for investment, consumer goods and services that people can afford and employment on a socially significant scale — so must the informal economy correspondingly expand. The only alternative, it might be appropriate to point out, would be revolution.

To maintain control the government will have to become increasingly authoritarian. Only an authoritarian regime, indeed a police state, would be able to implement the planned nuclear programme in the face of increasing public opposition.

As things get worse, however, one can expect an increasing polarisation between the main political parties. The Conservative Party may well move further to the right and the Labour Party will clearly move further to the left. The formation of a Centre Party consisting of moderate Conservatives, Liberals and moderate Labour seems more and more likely. It will attempt to hold the balance between the two extreme groups and may indeed do so for a while. This Party of the Centre may well win the next general election. Hopefully the growing successes of the Ecology Party at local and national elections will encourage the Centre Party to adopt many of its ideas. These will appear increasingly attractive since they provide the only set of solutions to our worsening problems that do not involve massive expenditures of energy, resources and capital that in any case will not be available.

If its leaders remain closed to ecological ideas, then it is possible that the Ecology Party will become an important political force, its power-base being derived from the young, from women, who seem very much more concerned about the future than are men, (except Mrs Thatcher) and from those living within the informal economy.

In the meantime, the USSR during the 1980s must be in for a rough time, its role of provider of petroleum to its satellites will be compromised as economic sources of oil are depleted. There is probably a lot of oil in Siberia but it is very expensive to extract and to transport. The USSR will also be plagued by recurrent food shortages which could well be seriously aggravated by the growing instability of world climate — that is largely the result of atmospheric pollution. Another of its problems will be the massive costs of its armaments programme and of its overseas adventures. In Angola, Ethiopia and Afghanistan the USSR has backed the wrong side: the degenerate urbanised minority against the much more virile tribal peoples who must win out in the long run.

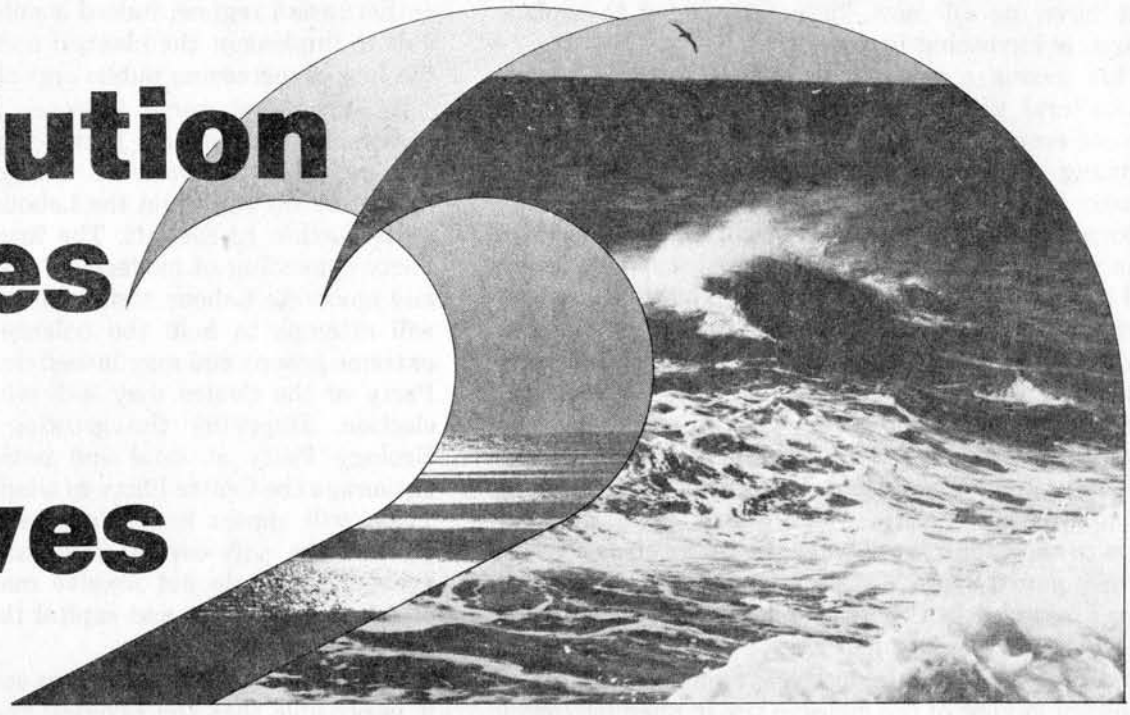
Russia's growing troubles will also encourage increasing agitation among ethnic minorities within the Soviet Union in particular the Asiatic ones.

Their European satellites are also likely to make life very difficult for them. The massive Russian Empire will be well on the way to disintegration by the end of the eighties. The trouble is, so will the USA and the rest of Western society. It is not clear what the Russians could gain by conquering the West, though this does not mean that they might not try to do so, as such a move — the ultimate 'pork barrel' operation — might be forced on them by an all powerful military pressure group.

What is certain is that a nuclear war would trigger off, among the survivors, the final and most extreme stage of the reaction against Science, which will have provided — in this case as in all the others we have considered — the tools of our destruction.

Edward Goldsmith

Pollution Rules the Waves



S. Pritchard &
A. De Bièvre

A simple technical fix could prevent much oil pollution. Why do the Oil Companies resist implementing it?

In 1861, the first large shipment of oil was due to cross the Atlantic when the ship's crew rioted and their numbers were replaced by waterfront bums who were in no position to object to the dangerous cargo. Its safe passage established the trade, and today the bulk transport of oil and chemicals accounts for over half of seaborne cargo. That's progress all right, except for one by-product — pollution of the seas — which now costs well over £500 million a year in waste and poses the greatest threat to amenities, wildlife and people's livelihood in coastal areas.

The recent spate of offshore well and tanker disasters has highlighted the serious damage and disruption caused by massive spills. The worst tanker casualty to date happened when the *Amoco Cadiz* grounded on the Brittany coast in March 1978. This supertanker lost a 220,000 tons of oil onboard, and the stricken hulk ha to be destroyed and sunk by French Navy divers, ye the *Amoco Cadiz* was supposedly equipped and operated according to the highest international standards of seaworthiness. That proved of little comfort when things went radically wrong, and the world's most impressive anti-pollution battle did not help very much either. Thousands of soldiers, seamen and civilian volunteers, employing a vast panoply of modern physical and dispersant remedies, still did not prevent Europe's worst-ever coastal pollution catastrophe.

The offshore drilling well that ran wild in the Gulf of Mexico last June, *Ixtoc Un*, has released (to date) 1½ million gallons of oil a day and has caused the world's biggest oil spill ever seen, reaching the Texas coastline, 500 miles away. Putting an end to this wayward well's oil losses, however, may not avert longlasting effects on the area's ecological system, apart from the immediate harm done to wildlife and fisheries.

Other countries have had similar unhappy memories in the wake of tanker accidents in the last dozen years since the *Torrey Canyon* disaster of 1967. And it is a matter of utmost concern to environmentalists throughout the world that the marine pollution problem may worsen rather than improve.

Independent Tankers Add to the Problems

The energy crisis and tanker-glut add further mischief to all the other familiar causes of marine oil pollution disaster. Accidents are bound to affect tankers contributing to traffic in ports and shipping lanes en route from new production sites such as the North Sea oilfields or offshore wells elsewhere. Also, the supertanker boom seems over — a fact which might strike most people as good riddance in the expectation that the mastadons of the oil majors would be consigned to the scrapyard, retired, or used for storage. But to stem losses in their shipping operations, which now run into nearly $ 100 million for some companies, the giant oil companies have reverted increasingly to the unfortunate habit of hiring independent tankers for the occasional one-trip charter contract. These independent tankers are notoriously poor in safety and antipollution standards and exist solely to profit by speculation in the fluctuations in the world market for oil. In the midst of the worst slump for world shipping since the Second World War, the smaller carriers gradually are taking over more of the demand in current operations and new shipbuilding — a trend which wipes out the only comforting statistic provided by superships: a reduction in the net number of oil tankers plying the seas.

Floating Disasters

Meanwhile, there are still a great many existing supertankers which should give us cause for concern. As Noel Mostert's deservedly popular accounts of their story reveal, these ships were pushed into the oil trade long before safeguards about their use were considered, and, apparently, before their real environmental and financial liabilities were appreciated properly. These vessels continue to endure in sizes far in excess of available berthing and drydocking facilities, to carry power plants of questionable reliability, and to present fire hazards and navigational risks of horrifying potentialities.

Controls

Since hazards in seafaring can never be eliminated absolutely, it is apposite to ask what progress has been made recently in minimizing the consequences of the inevitable accidents. Advances have been made in improving ships' design, construction, equipment and operation; in financial compensation for damage caused by polluting vessels; and in remedial technology and procedures which are intended to mitigate the effects of spills wherever they may occur.

At least on paper, governments have agreed on protective rules to limit the size and to control the placement of tank compartments in order to reduce the quantity of oil likely to spill from a breached tanker. But target dates for the implementation of these rules have been repeatedly deferred, and the present shipping recession makes it highly unlikely that new or refurbished tankers will soon replace the present generation of carriers. The Inter-Governmental Maritime Consultative Organization (IMCO), a specialized agency of the United Nations where such agreements are formulated, hopes that 1979 will be the year when enforcement of revisions to the Safety of Life at Sea Convention will be made compulsory worldwide. That would require tankers to install and use inert gas systems (which dramatically reduce the risks of spontaneous combustion during the washing of empty tanks), modern radar sets, emergency gear, and collision avoidance aids. Improvements in seafarers' licensing and training systems and certification have also received priority, since investigations have found that 90 per cent of all tanker accidents are caused by human error.

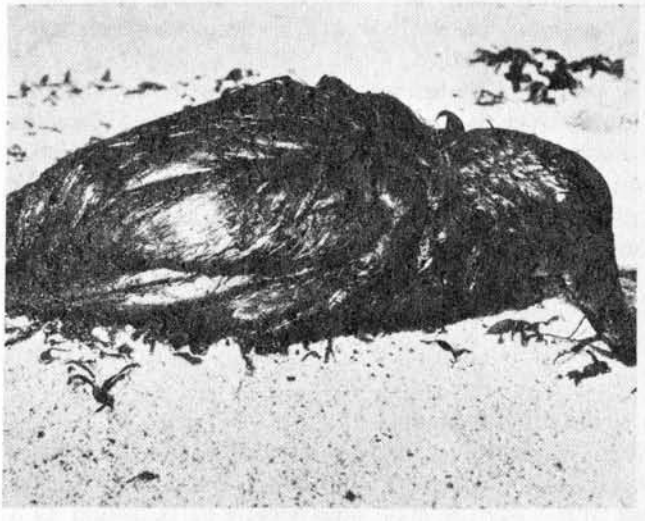
Liability Raised

It will be some time before we can reap the benefits of such preventive measures. Meanwhile, through the move widespread compensation of the (human) victims of marine oil pollution and the more liberal application of palliative measures, we must do as much as possible to alleviate the damage caused. A recently-activated International Oil Pollution Fund raises the 1969 liability limit of oil shippers from US $ 38 million to US $ 57 million (at June 1979 rates) for any single incident. This can by no means suffice to cover the economic losses directly or indirectly incurred by a major spill. The French government, for example, have lodged compensation claims of $ 300 million for clean-up and damages in a US Federal Court.

Clean-up Technology is a Mess

Remedial technology, which is big business, seems a boon almost entirely of benefit to those who are — in the most literal sense — the muckrakers. In the oil pollution sphere, that picture is complicated further by the fact that the most widely-used techniques — booms, skimmers, detergents and the like — have been developed, manufactured and marketed by the oil companies, an irony that will not escape our readers. The ugly fact of the matter is that their development started at a time when the industry was experiencing difficulties in preventing pollution at the source, and whilst some would attribute their promotion and use to human ingenuity, others take the view that they are indications of priorities gone wrong.

When actually used against a major oil spillage, sophisticated devices like booms and skimmers have often proved limited by the geographical circumstances or by the weather and usually provoke questions about further disruption and aggravation of local environmental damage. It is not so much that mechanical devices are ineffective, for when properly manned and deployed they are preferable to chemical countermeasures, but the nature of the choice in the two types of remedial methods, in a sense, introduces a false dichotomy into the picture. Considering the devastation of a local environment after a major incident and the depreciation of amenities from oiled beaches, the attempts by local authorities to restore their area to normality by manual or mechanical aids, elicit mixed feelings since it is the victims rather than the culprits who must do the work and, in the case of unattributed sources of pollution, pay for the clean-up costs.



Environment

Chemical Dispersants

As for the supposedly "less toxic" effects of chemical dispersants which are used to herd or sink oil slicks, doubts have often been expressed about their theoretical merits and the method of their application. Refinements by the oil industry of these products have come about largely in response to the proven damage they have inflicted in the areas where they have been massively applied. Ecological monitoring of Cornish beaches, which were sprayed by dispersants during the *Torrey Canyon* incident in 1967, show that moderately-sprayed rocky shores took about 5-8 years to recover, and other places which received the brunt of dispersant

treatment have taken longer and are still not fully recovered. Thus, the layer of oil that might have disappeared naturally within a year was exchanged for slippery thickets of one or two species of seaweed of much greater persistence. In awareness of the dangers of dispersants to marine life, the French banned dispersant treatment ashore and limited their application only to oily seas no less than 50 metres in depth during the *Amoco Cadiz* alert. Were it not for the fact that Britain took the lead in developing dispersants and the government have stockpiled substantive quantities throughout the country as their first line of defence against any emergency, chemical counter-measures might be banned altogether, for their effectiveness in actual practice have been repeatedly called into question.

Deliberate Discharges

Accidents apart, we are faced with the problems posed by deliberate discharges of oil and chemical wastes from tankers deballasting and cleaning at sea. It is generally agreed that over 10,000 tons of hazardous chemicals are dumped at sea in this manner, and a United Nations panel of scientists drew up a list of some 200 substances which have varying degrees of effects on the environment according to bio-accumulation, damage to living resources, hazard to human health and the reduction of amenities. It is in the North Sea where the major concern now lies, for the area lies at the heart of the world petrochemical trade and correspondingly receives the major share of noxious liquid residues from chemical tankers. The twenty year monitoring programme of the North Sea has indicated that plankton, the basic staple of life at sea, show definite signs of decline and progressively delayed seasonal reproduction.

Oil pollution by tankers ranges from counts of one million to over five million tons per year, which makes the costs of accidental pollution pale in comparison. However, the effects of intentional pollution are not as clearly defined in peoples' minds as the consequences of spectacular accidents, mainly because the problem manifests itself in less dramatic forms and generally takes place without any publicity or identifiable source.

An Avoidable Problem

Seaside visitors who have not witnessed the consequences of oil pollution may count themselves lucky. Most of us, say officials, now accept oil pollution as a holiday probability, like bad weather, sunburn or overcrowding. Tary lumps and fresh slicks increasingly have recurred in locations close to shipping or other spots where winds, tides and currents sweep the pollution ashore. Apart from the nuisance and the expense in beach cleansing measures suffered by the public, the toll of chronic pollution upon seabirds must be counted in tens of thousands per year.

Yet the problem is largely avoidable. Once a tanker has discharged its cargo, dregs remaining in the tanks and lines could be cleaned and the contaminated washings transferred to port reception facilities for decanting and use. Port conservation of tanker wastes was an accomplished practice in some refineries during the 1920s and by Allied shipping during the Second World War, but since then the trend has favoured faster tanker turn-around in harbour and tank-washing at sea.

That it is still quite possible for the industry to clean ships in ports today may be seen in the latest international treaty which governments have accepted in principle but have not yet implemented. The 1973 Marine Pollution Convention bans waste-discharge at sea by ships travelling within designated special areas like the Baltic and the Mediterranean, and from chemical tankers laden with the dregs of highly toxic chemicals. Given other circumstances, tankers would have to select one of two alternatives: to discharge their wastes at sea under well-defined conditions or, again, to transfer wastes into port reception facilities. Other propositions in the 1973 Convention and its 1978 Protocol promise to reduce the potential waste-water problems of tankers of certain tonnages by some 25 - 50 per cent when the requirements for purpose-built or specially-designated ballast tanks are implemented.

Why No Action?

In all, the great riddle that defies answer is why these measures have not been implemented despite mounting public concern throughout the world over the increasing difficulties which nations are experiencing in trying to cope with ever-larger and ever-more-frequent oil spillages at sea. Governments can be criticized for delaying their ratification of agreements which have been discussed fully and settled in international conferences. Individual shipmasters also receive blame, notwithstanding the fact that they often serve as convenient scapegoats in court proceedings and boards of inquiry. Unwary consumers and the public in general should not escape censure, either, since it is clear that the sooner we import less oil, the sooner we shall reduce the pollution problem.

Industry must take Blame

The preponderant responsibility for marine oil pollution today, however, must fall on the oil industry itself, for it is the oil majors who control the greater part of the shipping and reception operations that lead to deliberate oil spills. All that governments can do is to pass laws and to monitor the more conspicuous violations, but it is the industry which must implement the regulations and it is due to their directives (or lack of them, as the case may be) that shipmasters have little option other than to wash tanks at sea. For their part, however, bulk liquid shippers and receivers, mainly the oil companies themselves, have shown how they are capable of mounting diversionary tactics and deceptive ploys which draw attention away from their malpractices and bad husbandry.

Deceptive Argument

One outstanding example is the industry's sponsorship of policies which have effectively replaced international legislation with "new" standards that might almost have been designed to guarantee the continued pollution of our oceans and our shores. The rules to

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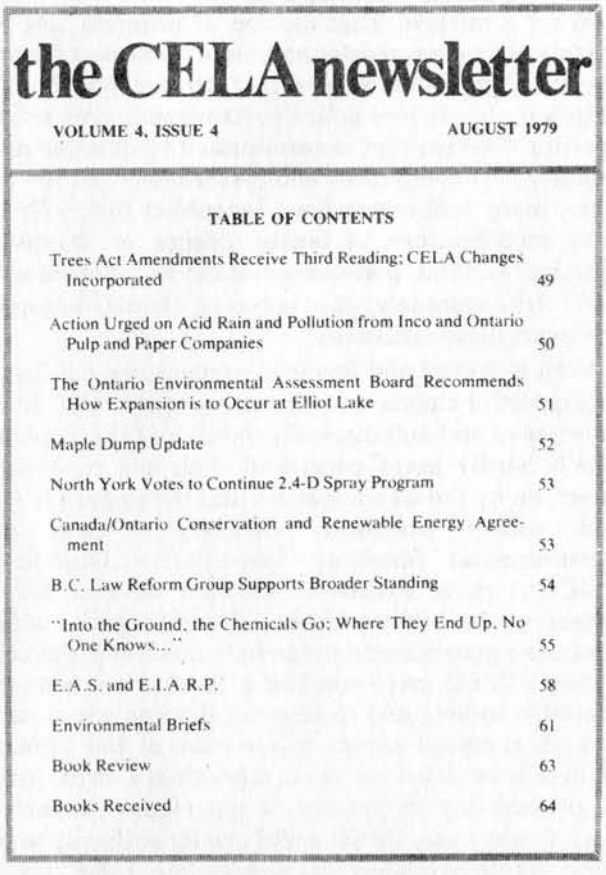

the CELA newsletter

VOLUME 4, ISSUE 4 AUGUST 1979

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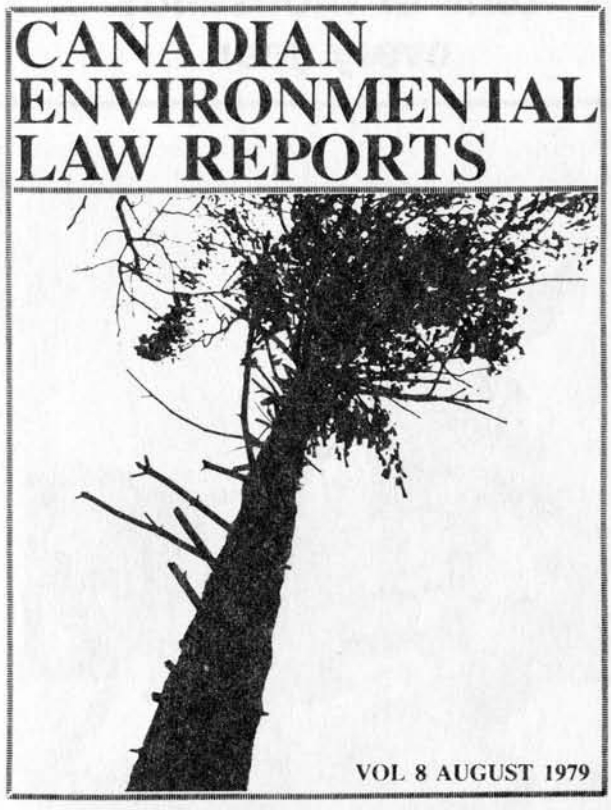

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The toll of chronic pollution upon seabirds must be counted in the tens of thousands every year.

Nato - Environment

regulate intentional pollution are now based on what is known as the "Load on Top" (LOT) method, which refers to various procedures resulting, ideally, in the partial retention of cargo dregs. The LOT method replaced a conditional ban on mid-ocean oil dumping by new large ships, because LOT sponsors reasoned that they simply could not meet the environmental standards required by the international rules set in 1962. Different reasons were given for the industry's abdication of responsibility in meeting the mid-ocean ban — the policy of Suez Canal authorities; the growth in tanker sizes (after the Canal closed for traffic); the recalcitrance of refineries in accepting mixed LOT cargos with a high salt content; and the lack of port facilities to process LOT slops.

Rather than adopt a policy that would conserve tanker dregs, however, industry launched one of their most successful public relations campaigns — to sell the LOT method as the "cure" and the "breakthrough" everybody had waited for, and indeed expected, after the 1962 world agreement on total tanker waste retention onboard. A decade later, the fight against pollution was finished, insofar as the LOT champions were concerned. Over 90 per cent of all tankers in service now claim to be following the system. Officials and industry leaders figured that LOT had staved off millions of tons of oil pollution annually. *Time* Magazine featured the United Nations Environment Director's report citing oil pollution as an environmental success story.

Industry Thwarts New Legislation

What a mirage! That illusion of progress has been dissolved by ever-greater and more numerous discoveries of oil pollution at sea and on the beaches. Not surprisingly, current policy controversies now reflect a growing international determination to improve and to monitor LOT compliance and performance. At the same time, many authorities have redoubled their efforts to seek modifications in tanker design or compulsory practice of total port-conservation as alternatives to LOT. Unfortunately, the industry seems determined to thwart these initiatives.

Both technical and financial excuses are put forward in support of claims that industry would find it difficult to improve and automatically monitor LOT compliance, which hardly seem consistent with the oft-repeated assertion by the oil companies that the system is easily and widely practised. Officials of the Inter-Governmental Maritime Consultative Organization (IMCO), where maritime pollution policies are discussed at the highest level, privately express concern over the appeals being made by oil industry publicists. Indeed, IMCO has compiled a thorough inventory of available meters and monitoring devices which can do the job required except in the case of the lighter or white oils (which do not form more than a small fraction of present-day shipments of petroleum products by sea). In any case, IMCO could use its authority to postpone implementation of monitoring rules for any special products, were that the crux of the technical problem. As far as company economics are concerned, "The costs of installing appropriate monitoring devices on ships would be peanuts to the industry," one IMCO official told us.

COW

The major oil companies have now launched a new process called "Crude Oil Washing", or "COW", which rivals the previous LOT campaign in its imaginative attempt to stymie the efforts of people who want to force the industry to adopt one or both of the only other possible alternatives, radical transformation of port reception facilities or tanker refurbishing. The COW system depends upon high pressure cleansing of empty tanks by streams of washing oils. It is an extremely hazardous process, since a dirty oil tank has an inherently explosive atmosphere. Spontaneous combustion of explosive gases still in the tanks becomes a real possibility unless the tanks have been rendered inert beforehand with exhaust gases drawn from the ship's boilers. There can be no doubt that in responsible hands the system does work, but COW's safety and effect rely upon two factors which have already received widespread criticism — crew and boiler efficiency. Only two companies, British Petroleum and Exxon, have had experimental trials in implementing the COW process, yet once again the world is being asked to accept industry assurances that all appropriate

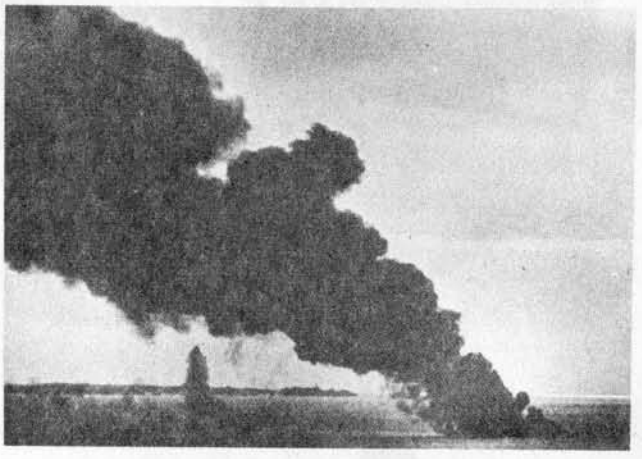
carriers will develop and maintain suitable training and operating standards at a level which will reduce the likelihood of tragic accidents occurring solely through maladroit use of COW. It has been said, of course, that opponents of COW have exaggerated its dangers, but it is worth noting that tank washing at sea is known to have caused at least three explosions aboard supertankers in the years 1969 and 1970 alone.

Cheap and Effective Alternatives

The alternatives to COW, i.e., tanker and port modifications, remain less hazardous and more effective. Although these alternatives appear to be more costly, closer examination shows that cost is by no means a critical problem. The conversion or construction of tankers with permanently segregated ballast tanks certainly would revive the world shipbuilding industry, which is presently in the doldrums. As an alternative to retrofitting ships with segregated ballast tanks, carriers could simply designate existing tanks for permanent ballast use, a more easily implemented environmental protection measure. Reduced ballasting aboard tankers, another feasible remedy which could be implemented at once, has the welcome advantage of reducing fuel costs without any compromise with safety.

In the end, of course, the environmental argument is as much a social and political matter for debate as it is economic or technical. If the oil companies are hoping for public fury on marine pollution to abate, they are sorely misguided. People do not wish to become used to pollution: they want to get rid of it.

Cornish beaches sprayed with detergents following the Torrey Canyon disaster in 1967 have still not fully recovered.



Human Populations

Part 2:

Will global economic catastrophe prove the only effective means of controlling pollution?

(Part one of this article appeared in our Nov/Dec issue)

by Edward Goldsmith

The first reason why pollution control is so ineffective is that pollutants cannot simply be made to disappear. Once they are there, they are there, for as the first law of thermodynamics teaches us, matter cannot be destroyed.

This means that pollution control largely consists in transferring pollutants from where they can do a lot of damage to areas where they can do less. One method of doing this is to concentrate them in one spot by stocking them, for instance, in metal containers or pouring them down disused mine shafts or other holes in the ground, but this cannot assure their complete isolation from life processes. This is especially so since industrial processes are now on such a massive scale. Consider the case of hazardous chemical wastes. In the US ninety-two billion pounds are generated each year. In the UK the figure seems to be about three million tons.[94] There is a limited number of holes into which these substances can be poured and as the more suitable ones are filled up ever less suitable ones have to be made use of.

According to the Environmental Protection Agency (EPA) there are now about 32,000 potentially dangerous chemical dumps throughout the US of which 638 are thought to pose "significant imminent hazards to human health"[95]. In the view of Douglas Costle, administrator of the EPA 80-90 per cent of the hazardous wastes currently generated are not being disposed of in ways that will meet forthcoming health and safety standards. In the UK ninety per cent of notified wastes are still disposed of as landfill. Of the remainder half is deposited at sea and only about one per cent is treated chemically or incinerated.[96]

How does one know that these chemicals will stay where they are put and that they will not leach out to contaminate the world of living things? The answer is that we don,t know. To begin with we do not even know very much about the functioning of the world of living things itself.

This was the main theme of a recent meeting of the Marine Technology Society. On the subject of marine ecosystems, most participants agreed that there were still more questions than answers, and what is more "there is no programme for resolving a long shopping list of unknowns."[97] The same can undoubtedly be said for the state of knowledge of terrestrial ecosystems, or even of the workings of biological organisms.

How then can we know how pollutants are transported within these living systems? The answer is that we cannot.

Indeed as Dr. Dybern[98] writes "Our knowledge of transport and mixing processes, as well as of chemical and biological reactions in the oceans, is insufficient to permit the identification of any area where pollutants may be introduced with the assurance that they will not be carried within one generation comparatively undiluted to a region important to man."

The more we learn about this issue the more these fears seem to be amply justified. Thus, according to an article in the Marine Pollution Bulletin (1973) concentrations of chromium, copper, lead, nickel and zinc are ten to one hundred times greater near waste disposal areas than any other waters in the Atlantic area off New York.[99]

At Maxey flats, Kentucky, where some two-thirds of all US commercial low-level nuclear wastes were buried during 1963-74, floods caused a considerable amount of nuclear waste, including over eighty kgs of plutonium and unknown amounts of some three hundred odd other nuclides to be carried off within a period of ten years by run-off, groundwater and wind — according to Lovins, "by every normal route

plus a few new ones'' to distances over a hundred metres from the site.[100]

As Lovins concludes, this raises ''serious questions about our knowledge and concepts of plutonium mobility in the environment, to say nothing of management.''

This also makes one consider what is likely to happen to the vast quantities of low-level radio-active wastes that have been dumped in the middle of the Atlantic in the last twenty years. Britain alone, since 1949, has released four thousand tons of such wastes into the sea. Its alpha activity according to Mr. Shore ex-Secretary of State is about 10,500 curies and its beta and gamma activity about 560,000 curies.[101]

The US government, between 1946 and 1970, has dumped 114,500 barrels of radioactive waste materials into the Atlantic and Pacific.[102] Already reports indicate that levels of radioactivity in the vicinity of the dumps are much higher than predicted[103] and according to Robert S. Dyer, an oceanographer working with the US Environmental Protection Agency, traces of plutonium from these ocean dumps have been detected off the US Atlantic and Pacific coasts.

The problem is particularly acute when it comes to the disposal of high level radioactive wastes.

We must remember that some fission products (caesium 139 and strontium 90 for instance) must be isolated for not less than 600 years, by-products such as americium and plutonium 239 for half a million years or more, other actinides even longer. There is no man-made structure in which these substances can be contained that can survive for such a long period. To vitrify them, i.e. build them into glass cylinders, does not solve the problem. All the evidence suggests that the heat generated by the radionuclides will eventually shatter their glass containment which in any case must deteriorate with age. It must be remembered that during the long period in which the wastes must be isolated there will almost certainly be revolutions and civil wars, not to mention earthquakes, floods, possibly even a new ice age. Without any question the earth itself or the oceans, as Professor Tolstoy pointed out in his testimony at the Windscale Inquiry ''will be their only possible repositories.''

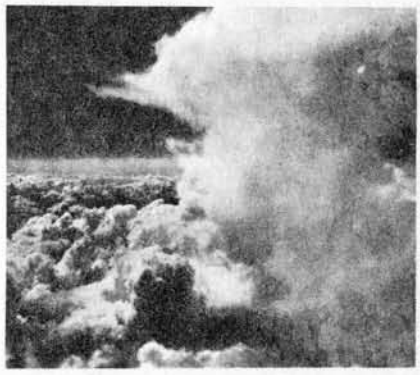
To give an idea of how fruitless has been the search for a reasonable solution to the problem, James Schlesinger, when Chairman of the AEC made the fantastic suggestion that we could dispose of radioactive wastes by shooting them off in rockets to the sun, but as John T. Edsall the Nobel Laureate[104] pointed out ''he did not say what would happen if some of them fell back to earth by mistake, nor did he estimate the consumption of energy and of material for the rocket casings that this would involve. Others have suggested burying the radioactive wastes in the ice of Antarctica, where their heat would cause them to melt their way down until they hit bottom; but in fact we do not know what will happen to the ice of Antarctica over the next half-million years, and must regard the safety of the scheme as highly dubious. Actually, there is as yet no proper solution to the problem of radioactive wastes, and there is none in sight.''

The other principal way of dealing with pollutants — in particular low-level pollutants — is to disperse them into the environment in the hope that they will become so diluted as to cause no biological damage. This may have made sense when industrial activities were limited to certain areas which meant that they gave rise to but local problems. Today however pollution is a global problem. The world is unfortunately finite, not only in its ability to provide us with resources but also in its capacity to absorb the pollutants we generate on an ever more massive scale.

CO_2 and Climate

One such pollutant is CO_2. Of course, it is not poisonous to living things. On the contrary without its presence in the atmosphere there would be no living things, since the carbon used to build up plant tissue is derived from it, via photosynthesis. But however beneficial a substance may be, once there is too much of it in the wrong place, it becomes a pollutant and thereby interferes with the functioning of living things as do more obviously toxic substances.

Since the beginning of the indus-



Science Journal

trial age we have increased the atmosphere's contents of CO_2 by ten per cent, and we are continuing to increase it at the rate of 0.2 per cent per annum. How long can we go on in this direction? The SCEP Report states that the doubling of carbon dioxide levels might increase surface temperatures by 2°C, some climatologists are even less optimistic. Dybern[105] for instance considers that by the year 2000, ''the increase of carbon dioxide in the atmosphere will probably be large enough to have some climatic effects on a global scale. However, it is expected, that by this time fossil fuels will be exhausted.'' What is more, according to Professor Flohn[106], 'recent investigations have indicated that the ''greenhouse effect'' of CO_2 is further enhanced by other man-made trace gases, such as the halocarbons (freons) with an atmospheric residence time of forty to seventy years and N_2O (from fertilisers), as well as CH_4 and NH_3'. Even if the further use of freons is prohibited, Flohn assures us that ''the combined warming effect of these gases will nevertheless reach about fifty per cent of the CO_2 alone. Due to long residence-time of the infra-red absorbing gases and their fairly rapid mixing, they will soon take the leadership in the anthropogenic impacts on climate on a global scale.''

We also seem to be releasing heat into our atmosphere directly from the combustion of fossil fuels at a rate that is increasing by more than five per cent per annum, and also ever-increasing quantities of dust, which is already reducing the amount of sunlight in some American cities by as much as seventeen to twenty per cent.

More and more climatologists are beginning to accept that the increasingly severe climatic perturbations we are already witnessing today

have been caused, partly at least, by man's industrial activities. What is certain is that we cannot go on systematically modifying *the chemical composition of the atmosphere indefinitely*. At some point in time, some positive feedback mechanism must be triggered off, causing climatic changes sufficient to transform living conditions on this planet and possibly render much of it unsuitable for human habitation.

Dispersal and dilution are thereby clearly not a means of controlling emissions of CO_2, N_20, freons etc., nor of heat and dust into the atmosphere. Global atmospheric pollution by these substances can, in fact, be said to be out of control.

Krypton — 85

Releases of radioactive substances into the atmosphere are also justified on the same grounds — and with no better justification. Consider the case of Krypton-85, a radioactive substance released by nuclear installations throughout the world. At Windscale no efforts are made to contain it in any way, the theory being that it will be diluted in the atmosphere in which it will only be present in harmless quantities. Dr. William Boeck,[107] Professor of Physics at Niagara University and Chairman of the Krypton-85 working Group of the International Commission of Atmospheric Electricity, pointed out, at the Windscale Inquiry, what is the real fate of the Krypton-85 released in this way. According to him, it will cross England and enter the air space of other countries. Every month or so afterwards, a portion of the same Krypton-85 released will recross the UK on its way around the world. The rest will have spread to the north and south to other countries. The result of this disposal by export will be the contamination of the global atmosphere. Before there were nuclear reactors, and before nuclear bombs were used in the 1940s, the atmosphere was almost entirely free of Krypton-85. The total amount present on the land, in the oceans, and in the atmosphere was probably no more than twelve curies. The Windscale plant alone, however, will release almost fifteen million curies every year, while during its lifetime the plant is likely to introduce 230 million curies into the environment, that is about twenty million times the natural background level. Imagine what would be the effect on the environment if and when there are ten or twenty such plants functioning in the world.

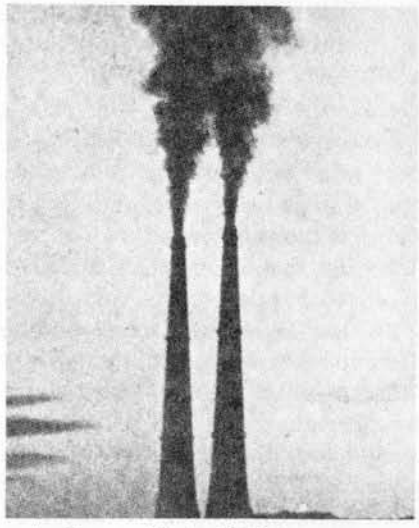
According to Boeck, if these releases continue unchecked, the background of radioactivity in the lower levels of the atmosphere must grow with a corresponding increase in the cancer rate and in the rate of mutations.

There is also the possibility that it might lead to some sort of global climate change, and in particular that it might modify global rain patterns, some agricultural areas becoming deserts while some deserts are turned into agricultural land.

It must be noted that Krypton-85 is only one of the dozens of different radioisotopes emitted into the environment in a routine manner by a growing number of nuclear installations throughout the world — and in each case, we continue to be told that they will be diluted in such a way as to become quite harmless to living things.

Exporting SO_2

Sulphur-dioxide, produced by various industrial processes,also tends to be released into the environment in increasing amounts via chimney stacks. The method normally used to reduce emissions is to raise the height of the chimney stacks in such a way as to disperse this substance into the environment and hence dilute it to a point where it is no longer damaging. But is it



actually so diluted? This was answered in 1976 by a committee set up to measure the long range transport of air pollutants by OECD.[108] It was found that roughly thirty per cent of the SO_2 emitted in an area was deposited locally via rainfall, fifty per cent was 'dry deposited' and the balance, about twenty per cent was transported elsewhere often to other countries. In this way each country in Europe appears to be constantly importing and exporting SO_2 pollution, some such as Britain being net exporters, while others like Scandinavia being net importers.

Efforts to disperse and dilute SO_2 from British factories thereby leads, among other things, to the pollution of distant lands where, as in Scandinavia, it is almost certainly stunting forest growth and is known to be acidifying lakes; 10,000 Swedish lakes are almost devoid of any fish life and another 10,000 are badly affected.[109]

IMPORTS AND EXPORTS OF SULPHUR EMISSIONS (1) in 1974 (Dry plus wet; 10^3 tons of sulphur)

Participants in OECD study	Total received from all areas	Total Emitted to all areas		Total received from all areas	Total Emitted to all areas
Austria	300	221	**Surrounding areas**		
Belgium	200	499			
Denmark	200	499			
Federal Republic of Germany	1,250	1,964	Czechoslovakia, German Democratic Republic, Italy, Poland and other areas	11,000	—
Finland	400	274			
France	1,000	1,616			
The Netherlands	150	391			
Norway	250	91			
Sweden	500	415	Total Emitted to above areas	17,000	—
Switzerland	100	76			
United Kingdom	1,000	2,883(3)			

The Dispersal of Heavy Metals

Efforts to dilute emissions of heavy metals into the environment are proving equally unsuccessful. Its advocates go out of their way to show that man's contribution to mercury, for instance, is insignificant compared to that which has accumulated naturally (15,000 tons a year for instance compared to thirty-five million tons). This argument is a very naive one as it fails to take into account that the mercury released by man is not immediately diluted evenly throughout the world's oceans. As Anthony Tucker[110] points out "it takes tens of thousands of years for metallic marine pollutants to disperse uniformly: contamination therefore builds up in those waters into which pollutants are discharged, in this case, estuaries, coastal areas and nearby shallow continental shelf areas. Because these areas are also the most highly productive of the entire ocean, the dangers are real and immense. Relatively small quantities of contaminants can disrupt the life processes in the sea's most important areas and may already be doing so."

Mercury accumulated in a pool at a nitrogen factory in Japan

Oil Pollution

The argument that oil pollution is rendered harmless by dilution is equally untenable. At a recent United Nations Environment Programme (UNEP) meeting in Paris[111] it was pointed out that six million tons of petroleum are dumped each year into the world's oceans. Accidents of one sort or another are responsible for another four million tons, while at least another six million tons are introduced into the seas as the unburnt residue of diesel oil from ships' funnels. The French paper *Le Monde*,[112] however, recently pointed out that this is nothing when compared with the total volume of water contained in the world's oceans — roughly 10^{18} tons or 1.4 billion cubic kilometres. The ratio between these masses of oil and water is equal to 10^{11}, which means that the mass of oil discharged into the sea every year is only one hundred-billionth of the mass of water.

But this is irrelevant, because to quote a UNESCO report "petroleum is made up of hydrocarbon molecules which are hydrophobic — i.e. insoluble in water and remain concentrated on the surface. But petroleum always contains between five and ten per cent of oxydised molecules or organic detergents containing oxygen, which are semi-absorbent and penetrate into the water by their oxygen-bearing extremity. . . The American physicist Irving Langmuir has shown that these semi-absorbent molecules spread out to form an extremely thin layer onto which the rest of the petroleum spreads in turn, thus creating what he calls a 'duplex layer' on the surface of the sea, whose thickness is determined by the proportion of oxygen-bearing molecules. If the ratio is five to one hundred, the duplex layer will be 400 angstroms thick, that is to say 1/25,000th of a millimetre . . .

This may seem infinitesimal, yet one cubic metre of petroleum discharged into the sea would cover twenty square kilometres of water. The total surface of the world's oceans is some 300 million square kilometres, so the ten million tons of oil discharged into the sea every year *are enough to cover 200 million square kilometres or two-thirds of the world's oceans.*"

Biological Amplification

The principle of dilution has nevertheless been defended by some of our most distinguished experts. Sir Robert Robinson[113], Nobel Laureate in organic chemistry, for instance, discounts the threat of lead pollution to oceanic plankton in a letter to *The Times*. "Neither our prophets of doom nor the legislators who are so easily frightened by them are particularly fond of arithmetic.." He then sets out to show by simple arithmetic that the dilution of lead in the oceans would be so great that lead pollution could not possibly occur. Not only does he ignore the fact that lead would be unevenly distributed in the oceans, but he fails to take into account the workings of a phenomenon referred to as biological amplification. Clams oysters and molluscs in general feed by filtering enormous volumes of water. When doing this, they separate trace contaminants within the water and sometimes concentrate them by a very large factor. Some fresh water molluscs for instance can concentrate manganese by a factor of 300,000 and the chlorinated hydrocarbon insecticide by up to 70,000 times.

Table 2 shows estimated concentration factors for different pollutants in aquatic organisms.

Unfortunately these factors are

Estimated Concentration Factors in Aquatic Organisms — **Table 2.**

Radionuclide	Site	Phyto-plankton	Fila-mentous Algae	Insect Larvae	Fish
Na^{24}	Columbia River	500	500	100	100
Cu^{64}	Columbia River	2,000	500	500	50
Rare earths	Columbia River	1,000	500	200	100
Fe^{39}	Columbia River	200,000	100,000	100,000	10,000
p^{22}	Columbia River	200,000	100,000	100,000	100,000
p^{33}	White Oak Lake	150,000	850,000	100,000	30-70,000
Sr^{30}-Y^{96}	White Oak Lake	75000	500,000	100,000	20-30,000

Source: Eisenbud, 1963 (reproduced from SCEP).

largely ignored by government and industry who are only concerned with the short-term economic and political considerations. As Anthony Tucker[114] points out "In spite of protestations of concern, the official and industrial view appears still to be that provided stacks are high enough and pipes are long enough dilution will be adequate and, in any case, somebody else will get the effluent.

Solving one Problem by Creating Another

If pollutants cannot be isolated from the biosphere and can no longer be dispersed into the environment what then can be done with them? The answer, one would expect, would be to eliminate them by means of specialised pollution control-devices. As we have seen however, such elimination is in theory impossible. However sophisticated the control device, it cannot enable us to defy the first law of thermodynamics. All it can do is displace the problem in some way. Air pollutants for instance can be transformed into water pollutants or liquid wastes into solid wastes but they cannot be made to disappear altogether. If, in order to control sulphur-dioxide emissions one wants to do more than raise the height of chimney stacks, then the most commonly used expedient is to install 'scrubbers'. These, however, do little more, in effect, than transfer the pollutants from the air to our waterways. To quote Denis Hayes,'[115] "such displacement is generally better than doing nothing, but the net resulting benefits are sometimes small after all costs are considered."

He points out for example, that scrubbing sulphur-dioxide from the effluent of a 1,000-megawatt coal-fired power plant would require a capital investment of 100 million dollars, use up more than three per cent of the electricity the plant produces, and give rise to 40,000 cubic feet of sludge every day. As much as ninety per cent of the sulphur-dioxide in the stack gases could be eliminated, but then the resulting sludge would simply be transferred to our water-supply where it would probably cause just as much damage. But then, as Denis Hayes points out "Microbial action on the sludge might even convert the sulphur into hydrogen sulphide, thus making it again a source of air pollution."

In the UK we pride ourselves on having largely eliminated smoke from our cities, as a result of which there has been no recurrence of the famous London smog that in 1953 was held responsible for killing as many as three thousand people. But how has this been achieved? It has meant first of all producing smokeless fuel or 'furnacite' which is achieved by heating ordinary coal so as to drive off the tar and smoke-producing constituents. One of the main plants doing this is situated near Mountain Ash in North Wales. It is here that the smoke is released that would normally pollute the atmosphere of our big cities. Charles Maclean who was sent there by *The Ecologist*[116] describes what the area looks like as a result.

> "The town of Mountain Ash squats forlorn in the Aberdare valley set between hills like miners' knees. The surface of the earth is broken and bleeds dust from its open wounds. The grass is black with coal-dirt and the people all smell of soap. A shroud of yellowish smoke hangs over the town: sulphurous fumes fill your nostrils and permeate the atmosphere."

This has not been the only cost of controlling smoke in our big cities. As pointed out by Pestel and Mesarovic,[117] smoke previously prevented nitrogen-oxide and sulphur-oxide from combining with the moisture in the air to form nitric acid and sulphuric acid. The resulting increase in the level of these substances in the emissions from our chimney stacks has now seriously increased the acidity of precipitation, which, as already mentioned is stunting plant growth and acidifying rivers and lakes in Scandinavia.

Take too the case of the catalytic converter in which our faith is largely pinned for reducing pollution from car exhausts. It seems to eliminate certain pollutants but only at the cost of creating others. David P. Rall,'[118] director of the National Institute of Environmental Health in the U.S. points out that the catalytic converter "converts the sulphur in gasoline to sulphuric acid mist, which is probably one of the most toxic agents in air pollution." What is more "the converter releases this mist at ground level rather than distributing it throughout the atmosphere which may also increase exposure to it."

William Balgord, [119] a chemist with the New York State Department of Environmental Conservation has also found that the catalytic converter emits tiny metal containing particles that could be taken into the lungs with no one knows what results.

A further problem is that pollution controls are often cumbersome and difficult to use. Thus, though farm-workers are repeatedly warned to use respirators when they handle certain dangerous chemicals they rarely do so and then only for a short period of time after which, in the interests of convenience and comfort they simply give up. Often too controls cease to work after a while and no longer perform the functions they are supposed to. The difficulty of getting people to make use of pollution controls is illustrated by an Environmental Protection Agency (EPA) study which found that only a third of the used 1975 motor cars in the US complied with all federal emission standards and half failed all the standards.[120] Similar results have been obtained in California.

How much Pollution can be Displaced?

Even then pollution control devices cannot ever displace 100 per cent of the pollutants generated by a given industrial process, but only a proportion of them. This point was made very clearly by Meadows and his colleagues in *The Limits to Growth*. The main constraint is cost. To displace a small proportion of the pollutants is relatively cheap but the cost of displacing every additional increment increases exponentially. Thus, to eliminate up to thirty per cent of the waste from a sugar refinery would cost about two dollars a kilo of wastes eliminated. To eliminate ninety-five per cent, however, would cost 1,600 dollars per kilo at 1972 prices and to eliminate 100 per cent nearly 2,400 dollars (assuming this to be possible).

What is important however is that even if it were possible to achieve an eighty per cent reduction in total pollution levels, in a growing world

economy, this would only enable us to gain a little time. If the world economy were growing by three per cent per annum, economic activity and hence pollution levels would double every twenty-four years. This means that after thirty years the total amount of pollution generated would have increased by five times and would thereby be the same as it was before pollution controls had been installed, unless, of course, we had been willing, in the meantime, to meet the prohibitive costs of displacing a still higher proportion of the pollutants generated which, in a growing economy, would still only provide us with another few years grace.

We must also remember that we are dealing with very large amounts of incredibly dangerous substances, such as mercury, lead or radioactive materials. In such cases, it is simply not sufficient to displace forty or fifty per cent of the amounts released into the environment. In the long run ninety-nine per cent efficient controls on plutonium emissions for instance, would probably be insufficient to prevent catastrophic damage to living things on this planet.

Escape Routes

The more we know about pollution control and its problems, the more it becomes apparent that the only effective means of controlling a pollutant is not to generate it.

In some rare instances, this philosophy has prevailed in official circles, and particularly harmful pollutants have actually been banned, but this has been done largely for show — and the net effects of the ban have been very disappointing.

One reason is that nobody knows in what products the banned chemicals are in fact used.

Professor Wurster describes how the US government has reacted to the dikscovery of the harmfulness of DDT. After a great deal of dithering, it eventually decided to ban it. However, "the US Department of Agriculture has a habit of cancelling certain uses or registrations of various pesticides."

They mostly cancel those that are no longer used, which makes good publicity and does not change usage patterns at all. They have hundreds and hundreds of such registrations, and, when enough public pressure builds up, they cancel fifty or one hundred, and then the newspaper headlines say "Department of Agriculture bans forty-seven uses on thirty-two different vegetables", which sounds great. But it doesn't do anything, it's a completely useless step. The intricacies of Federal Law are such that the effect of cancellation in any event is to do essentially nothing, because what it does is to initiate an administrative procedure that goes on virtually for ever, without any conclusion. "There has never been a cancellation proceeding that has gone to termination, except when the manufacturers agreed to it."[121]

The only effective means of controlling a pollutant is not to generate it.

In Britain the situation is far worse since pollutants are rarely banned at all. Instead, when the Government can no longer avoid doing so, manufacturers are asked to apply a voluntary limitation to the use of offending chemicals. This has very little effect, as we shall see. Thus the Government has asked for a voluntary limitation of the use of the known carcinogens aldrin and dieldrin in this country with very little effect, consumption fell to begin with but is now increasing again, while their use for non-agricultural purposes, mainly for wood preserving has never ceased to increase.

Pressures from Industry

Thus one of the greatest victories ever scored by environmentalists in the US was the passing of The Delaney Amendment[122] which makes it illegal to add known carcinogens to food. Pressure is now building up however in the US to change the law and permit the addition of known toxins to food. This pressure is being applied by the food industry in general, by the partisans of saccharin in particular and now by a committee of the National Academy of Sciences which recently wrote a shameful report in which it described food safety regulations in the US as 'rigid and unsuitable for modern times.' It is incredible that so august a body as the National Academy of Sciences should actually regard it as desirable that known poisons should be added to the nation's food. It gives an idea of the incredibly powerful pressures that must have been exerted on it. The arguments are interesting. Peter Hutt a prominent food industry lawyer, argued that motor cycle riding and boxing are greater hazards than eating poisons in our food and that so long as these sports are permitted there can be no valid argument for banning hazardous food additives. Hutt argues that to regulate the use of food additives means imposing significant limitations on individual freedom. He even suggests that it is unconstitutional. Traditionally the argument has been that preventing the addition of poisons to our food is an infringement of the freedom of manufacturers. In the US, this argument has now been rejected by the courts, so the argument has shifted. It is now seen to be an infringement of consumers rather than manufacturer's freedom.[123]

Scapegoats

In any case efforts by environmentalists and specialised agencies in the US tend to be directed towards the banning of specific chemicals rather than whole families of chemicals. This is a grave mistake. To ban DDT for instance, which, as already pointed out, has been partly achieved in the US, is not sufficient since DDT is a member of a group of synthetic chemicals known as chlorinated hydrocarbons whose properties are very similar and which are thereby effective against insects for much the same reasons. They can be assumed to have similar side effects on birds and mammals. Many are already known to be even more poisonous than DDT, including aldrin and dieldrin which have now been banned by the EPA, and on the use of which, as we have seen, largely ineffective voluntary limitations have been imposed. The use of others, however, remains totally

unrestricted.

Asbestos crocidolite or 'blue' asbestos has also been singled out as a scapegoat. As McGinty points out "claims by the industry that only blue asbestos causes mesothelioma has been shown to be little more than wishful thinking." [124]

The same is true of coal-tar based colourants that are used in food-stuffs. A number of these have been shown to be carcinogenic and their use restricted, at least in the US and Canada, but no action has been taken against the family of coal-tar derivatives as a whole, which as Ross Hume Hall[125] points out are all likely to be carcinogenic.

The same is true with regard to detergents. Phospate detergents have been the scape-goats. But there is no reason to suppose that the N.T.A. and other detergents that have replaced them are any less environmentally destructive.

Anthony Tucker[126] writes "it now seems that the real battle should be against detergents per se and, since the doctrine of super-cleanliness is all oervasive even if based on advertising gimmickry rather than biological good sense, this is a battle in which it will take time even to make a convincing start."

Exporting Polluting Industries

As already pointed out, pollutants are rarely banned in the global environment as a whole, but only in specific areas where the damage caused happens to have been well documented. As a result the banning of a pollutant in one area simply leads to the transfer of the activities that generate this pollution to other areas. Thus, the recent legislation to reduce pollution levels in inland waterways has simply led to an increase in the dumping of chemicals into the sea. The British firm, John Hudson Ltd, commissioned a £500,000 waste ship which can dump waste into the North Sea at the rate of 1,500 tons in five minutes. The company announced at the time that it planned to dump about 400,000 tons of industrial effluent a year. It hoped in this way to pick up waste from companies in France, Belgium, Holland and Germany, as well as Britain. "In May", said chief engineer David Durston, "a ban on all dumping in the Rhine comes into effect. We really hope to pick up some lucrative business then. The wastes", he continued, "will be dumped in the outer Thames estuary and elsewhere in the North Sea off the coast of the Continent."[127]

The export of polluting industries to the Third World where, in general, controls are far less stringent, is already occurring on a considerable scale.

The Maryland Public Interest Research Group has cited figures on US imports of asbestos textiles as a sign of this trend, and warned that the large vinyl chloride industries and others may soon follow.

Mexico, Brazil, Venezuela and Taiwan supplied fifty per cent of US asbestos textile imports in 1973 — whereas nine years earlier none was obtained from these sources.

The US has been a major asbestos and textile producer owing to its proximity to massive deposits in Quebec and also because of the size of the US market. These countries have no such advantages. On the other hand they have less stringent laws governing the use of hazardous materials.[128]

The same trend is apparent in Japan. The Toyama Chemical Company, for instance, has shifted its Mercurochrome plant (mercurochrome contains twenty-five per cent mercury) to South Korea. The export of pollution from Japan to South East Asia is now on such a scale that the Japanese Environmental periodical *Kogai* recently devoted a whole issue to this scandalous question.

Another activity that the Japanese are exporting is the retreatment of nuclear wastes. If British Nuclear Fuels have obtained permission to expand their nuclear waste retreatment facilities at Windscale, it is in order to enable us to import into this country such highly polluting activities.

Science Journal

A detergent is sprayed on spilt oil. It disperses the oil but destroys aquatic organisms.

A New Criteria and a New Methodology.

In Part 1 of this article I made it clear that it is not by making millions and millions of deceptively precise measurements that we can understand how pollution is affecting our environment. Such an enterprise to begin with is logistically impossible. It is the effect of pollution *taken as a whole* on living systems *taken as a whole* that we must consider. This is the conclusion of the SCEP report which is still by far the best study on global pollution problems. Its authors concluded that our "total pollution burden may be impossible to determine except by direct observation of its overall effects on ecosystems." This is also Schubert's conclusion. "It has become apparent" he writes, "that an overall approach is necessary if society is to control and minimise genetic and

toxicological risks to the population. It is unproductive and self-defeating to repeatedly deal with an individual chemical on an emergency basis simply because it happens to make the newspaper headlines. Repetition of such piecemeal consideration eventually distracts the public and government from the general problem of how to deal with the myriad of chemicals to which the population is exposed.''

Not only would this be logistically feasible but it would provide information on which we could act. At the moment, as we have already seen, we cannot take action to ban specific groups of pollutants suspected of being carcinogenic. At best, we can incriminate one or two individual chemicals which are then treated as scapegoats for the rest. Nor can we take action to prevent the release of poisons into our environment as a whole but only into certain parts of it, where the damage has been carefully documented by innumerable measurements, leaving us free to export the pollution to other areas where the effect of the pollutant is less well, and always will be less well documented.

On the basis of today's criteria it is possible for manufacturers to make out a case for the innocence of each one of the two million or so pollutants that they generate directly or indirectly, as a by-product of their activities, a case that can rarely be refuted on the basis of currently accepted methodology. *Yet we know that between them, these pollutants are among other things causing the death of several million people a year from cancer.* Though we cannot prove that individual pollutants are contributing to this damage, their guilt *when seen as a group is incontestable.* This principle not only applies to the study of how pollution affects natural systems *but to the study of natural systems themselves,* indeed to that of the biosphere as a whole. Jay Forrester, Denis Meadows and others have pointed out how the reductionist methodology of modern science does not enable one to understand the behaviour of natural systems. It must be remembered that natural systems are above all organisations which means that they are more than the sum of their parts, their identity and main characteristics being derived very largely *from the way in which these parts are organised.* This means that they cannot be understood simply by examining and measuring these parts individually and in isolation from each other, which is basically what our scientists are still trying to do, but only in the light of a general model reflecting not only their relationship to their component parts but also to the larger systems of which they in turn are part. Such a model need not be quantitative. What we are interested in are the generalities not the particularities, the theoretical principles involved not just a mass of indigested quantitative data. Also it is not by measurement that we can determine what are these principles. In the scientific world of today, *measurement has largely replaced thought.* Thinking, in fact, has gone out of fashion. If we want to understand how the world works and how we are to adapt to it we must learn to think again and not just with those great big clumsy machines called computers but with our heads which are infinitely more sophisticated pieces of equipment.

In the scientific world of today, measurements have largely replaced thought.

Let us do this and consider pollution for a moment in its total biospheric context, so as to determine what our attitude should be to it.

Theoretical Considerations

It has taken several thousand million years of evolution for the biosphere or world of living things, of which we are an integral part, to take on the shape we, — industrial man — found it in, and thereby provide an ideal habitat for man and the myriads of other forms of life that compose it.

During the course of this evolution, as Commoner[129] puts it, ''the chemical, physical and biological properties of the earth's surface gradually achieved a state of dynamic equilibrium, characterised by processes which link together the living and non-living constituents of the environment. Thus were formed the great elementary cycles which govern the movement of carbon, oxygen and nitrogen in the environment, each cycle being elaborately branched to form an intricate fabric of ecological interactions. In this dynamic balance, the chemical capabilities of living things are crucial, for they provide the driving force for the ecological cycles; it is the chemistry of photosynthesis in green plants, for example, which converts the sun's energy to food, fibre and fuel.''

The biosphere or world of living things of which we are an integral part, can function as a self-regulating natural system and maintain its basic structure, on which the very survival of its living components depend, only if the critical interrelationships between all its components — at all levels of organisation, including that of the atom or the molecule — are maintained.

Commoner further points out ''. . . the chemical processes which are mediated by the biochemical system represent an exceedingly small fraction of the reactions that are *possible* among the chemical constituents of living cells. This principle explains the frequency with which synthetic substances that do not occur in natural biological systems . . . turn out to be toxic''.

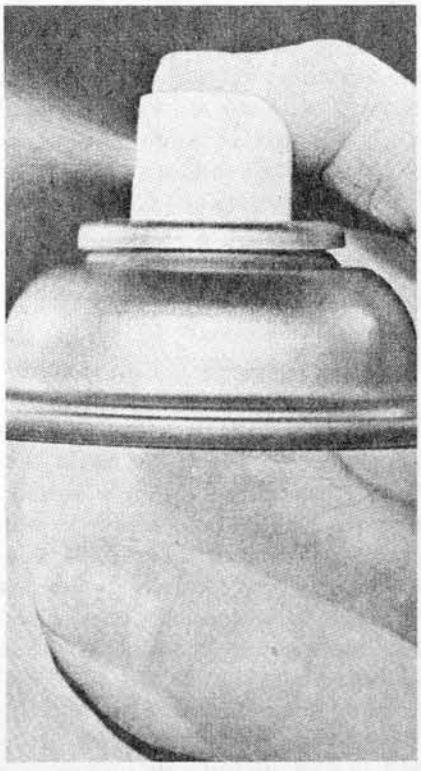
Commoner illustrates this principle thus:

(a) ''Of the approximately one hundred chemical elements which occur in the materials of the earth's surface, less than twenty appear to participate in biochemical processes, although some of those which are excluded, such as mercury or lead, can in fact react quite readily with natural constituents.

(b) Although oxygen and nitrogen atoms are common in the organic compounds found in living systems, biochemical constituents which include chemical groupings in which nitrogen and oxygen atoms are linked to each other

Science

The slightest probability of a pollutant's guilt must be sufficient reason to warrant its removal from the market...



Ed Carin — Environment

are very rare.

(c) Although the numerous organic compounds which occur in biochemical systems are readily chlorinated by appropriate artificial reactions, and the chloride ion is quite common in these systems, chlorinated derivatives are extremely rare in natural biochemical systems.

It is no coincidence that these chemicals are not found in living tissues. There is good reason for it. The organization that is the biosphere, has been able to evolve at the expense of eliminating possible reactions between these substances and living things. If any living systems once included them, then they have been eliminated by natural selection.

The consistent absence of a chemical constituent from natural biological systems is an extraordinarily meaningful fact. It can be regarded as prima facie evidence that, with a considerable probability, the substance may be incompatible with the successful operation of the elaborately evolved, exceedingly complex network of reactions which constitutes the biochemical systems of living things.''

Furthermore, such a theoretical consideration can be confirmed empirically.

Thus Mercury is one of those eighty elements not found in living tissue. There is at least one good reason for this. Biochemical systems have evolved a system of enzymatic catalysis in which sulphur-containing groups play a crucial role. These react with mercury introduced into a living system, and enzymes are inactivated, often with fatal results.

There is also a good reason why synthetic nitroso compounds in which nitrogen and oxygen atoms are linked do not occur either in living tissue. They appear to interfere with the reactions involved in the orderly development of cells, and give rise to cancer and mutations.

There is also a good reason why synthetic organo chlorine compounds such as DDT and PCBs are excluded from living tissue. They are often very toxic or produce long term damage such as cancer.

How does a living system succeed in excluding unwanted chemicals? The answer is that either these chemicals are not present in its environment in that form which would permit them to interfere with it, or the system develops subtle homeostatic mechanisms for maintaining low levels within it, even if the levels outside are higher. These mechanisms, however, have developed via the evolutionary process — hence very slowly. They can only deal with chemicals found in that form and at that level to which the system was exposed during its evolutionary experience. In general the more the environment changes as a result of man's activities, the less does it resemble that in which we evolved, and the less efficiently can our normal behavioural mechanisms enable us to adapt to it. Thus, while the human liver is capable of detoxifying those chemicals that it has learnt to detoxify over millions of years of human evolution it is incapable of detoxifying chemicals to which man has not been exposed during this period.

It is these considerations which led Professor Stephen Boyden[130] of the Australian National University to formulate his principle of phylogenetic maladjustment. He pointed out that since the evolutionary process is adaptive, it must be when subjected to that environment with which we have co-evolved that our biological needs are best satisfied. This means that any modification of our environment causing it to divert from that to which we have been adapted by our evolution must lead to phylogenetic or evolutionary maladjustments and the greater this diversion the greater these maladjustments must be. Boyden regards the so called diseases of civilisation, in particular cancer, ischaemic heart disease, diabetes, appendicitis, peptic ulcer, tooth caries and varicose veins, whose incidence can be shown to increase with per capita GNP, as being but the symptoms of phylogenetic maladjustment. Particularly significant is the fact that modern medicine has proved quite impotent to control these diseases and their incidence continues to increase along with per capita GNP, regardless of the money spent on scientific research and medical services.

Rationing of Pollutants

From the preceding analysis it should be clear that to avoid the rapid deterioration of the biosphere and the corresponding reduction in its capacity to support complex forms of life such as man, we must considerably reduce the total pollution load our environment is subjected to.

This cannot be done by examining individual pollutants by the reductionist method in controlled labora-

tory conditions, but only on the basis of a model that takes into account both theoretical and empirical factors and in terms of which the probability of the harmfulness of different chemicals can be established. The degree of probability required must vary with the extent of the damage that a specific pollutant is suspected of causing. For instance, if it could be implicated in causing cancer or mutations or in possible climatic changes, then clearly *the slightest probability of its guilt must be regarded as sufficient to warrant its removal from the market.*

The chemicals that must first be withdrawn are largely those which have been introduced in the last thirty years — during which time, as Commoner[131] has pointed out so convincingly, pollution levels in industrial countries have escalated in the US by between 200 and 1,000 per cent — totally out of proportion, as he points out, with the economic growth registered during this period and even more so with any possible benefits we might have derived from their use.

Foremost among these chemicals are the synthetic organics which must include the synthetic nitroso and organo chlorine compounds mentioned by Commoner.

There are some 9,000 of them mainly used as plasticisers, aerosol propellants, refrigerants, pesticides and herbicides. Total production rose from seven million tons in 1950 to sixty-three million tons in 1970 and is expected to rise to 250 million tons by 1985.

According to Epstein[132] "Very few, if any of these compounds are without toxic effects, either because of their own chemical properties, or because of chemicals discharged to the environment during their manufacture, or because of breakdown products, or because of some potentiating, synergistic effect when they come into contact with other chemicals."

Yet as Saffiotti[133] points out "only a small proportion of these substances are exhaustively tested against the possible hazards contingent upon wide dispersion in the environment."

These are only the most obvious ones, the list of all the toxic chemicals that we are releasing in an almost uncontrolled manner into our environment would be a much longer one; it would include the several thousand chemicals we add to our food during processing, few of which according to Ross Hume Hall[134] "have received more than a cursory examination," or have been rigorously tested for their ability to cause "birth defects, heart attacks, cancer and behavioural abnormalities."

It would include nitrites that are used so extensively as food preservatives, and nitrogen fertilizers, whose massive use is leading to an equally massive increase in the nitrate content of our drinking water. But banning the use of some substances would not be sufficient. Drastic reductions would be required in emissions of SO_2, N_2O and CO_2 to the atmosphere and this could only be done by correspondingly reducing our industrial activities.

It is doubtful in fact if pollution levels in our society could be reduced by any other means than deliberately reducing the level of our industrial activities. This would mean giving up the goal of 'material progress' and setting out to create a totally different non industrial society, one in which economic and political activities were carried out on a very much smaller scale.

What are the Prospects

On the basis of past experience we know that unless the Ecology Party were to form a government such a programme would never be adopted. Things are done in our industrial society to satisfy three sets of requirements, those of our industrialists who want higher profits, those of our trade unionists who want more jobs at an ever higher rate of pay, and those of our politicians who want more votes. Profits, jobs and votes, we know, are best obtained by maximising economic activities and hence pollution. We can thereby predict that the acceptable levels for different pollutants will remain as high as public opinion will allow polluters to keep them, that dangerous substances will not be banned unless they give rise to immediate visible large scale catastrophies such as at Minamata and even then they will probably only be banned locally and for a short period. The public's memory is notoriously short.

To justify its inaction, our government will make use of every subterfuge to persuade the public that pollution is under control. Thus, it will persuade successive committees of learned experts to fix unduly high permissible levels for the different pollutants in our environment. Measurements will continue to be conducted and interpreted in such a way as to allay public fears. Additive and synergic effects and the effect of decay products and impurities will continue to be disregarded. The accent will remain on short-term toxicological effects while long-term carcinogenic and mutagenic effects will continue to be played down. The absence of hard 'scientific evidence' to prove the harmfulness of particular chemicals will remain an obvious excuse for inaction — and as little money as possible will be spent on obtaining this evidence. Lack of funds and the adverse effect on our standard of living of spending too much money on pollution controls will be another. When action is taken it will be, as today, largely for cosmetic purposes. As Professor Kreith[135] writes "The government is more likely to be concerned with ameliorating the feelings of the public, of alleviating those factors that are visible and are the source of public controversy. For instance, when requests arise for cleaning stacks, industry may remove the steam which is visible, but disregard the more dangerous sulphur-dioxide, which is invisible but much more difficult to remove from the exhaust," — precisely as our government has done so far in the U.K.

It is doubtful if pollution levels can be reduced without cutting back our industrial activities...

When our government is forced by public opinion to pass legislation designed to prevent further environmental contamination, one can predict in advance that such legislation will either be so emasculated that it will have little effect or else it will never be implemented as has largely been the case with regards the 1974 Control of Pollution Act.

Conclusion Implications

For all these reasons one can assume that the vast bulk of the pollution generated by our industrial activities will find its way into our environment which means that total pollution emissions to the environment will, to all intents and purposes, reflect closely the level of industrial activity.

This conclusion is implicit in most of the serious forecasts of pollution trends in Europe. The Economic Commission for Europe[136] points out, for instance, that in spite of all measures taken to control the release of waste products of all sorts into the European environment, it is continuing to increase, at a rate of about five per cent per annum, while the quantities of inorganic waste released into the environment worldwide will continue to double every ten to twelve years.[137]

In another, little publicised, OECD report[138] it is admitted that the OECD area is rapidly reaching the point where it must choose between industrial expansion and clean air. The report predicted that emissions of nitrogen oxide and sulphur dioxide from the burning of fossil fuels would go on increasing unless there was a reduction in fuel consumption and by implication of economic activity.

Already, in one year, it appears, the European community has released into the environment one thousand five hundred million tons of waste, including ninety million tonnes of household refuse, 115 million tonnes of industrial waste, 950 million tonnes of agricultural waste, 200 million tonnes of sewage sludge and 150 million tonnes of waste from extractive industries.

The physical problem of disposing of such massive quantities of waste products is in itself a major one, and the danger to public health is already, the Commission admits, serious. Yet by the end of the century, if economic activity continues at the present rate, the quantities will have quadrupled — with wastes accumulating on the land, in rivers and waterways and in the atmosphere, and often too in biological organisms including human ones with inevitable detrimental effects on human health.

Pollution by radioactive materials must also increase in the same way. Already as Dr Spearing[139] points out merely "the 'low level' releases to the environment currently occurring contain long-lived radio-isotopes

Human Populations

On current trends, the 21st century family will fill 260 dustbins each year — five times as many as at present.

which are being discharged *at a rate exceeding the rate at which their radioactivity is decaying.* In consequence there is a gradual and insidious build-up of environmental radioactivity, and there is a very real risk of irreversible contamination of our planet to a degree that will impose a severe burden of human suffering on future generations quite possibly to the end of the story of human life on earth."

By the end of the century, if current plans materialise, the world will have a combined nuclear generating capacity of more than two million megawatts, a twenty fold increase over today[140] and this must mean a corresponding increase in the generation of nuclear wastes.

According to UNEP the total inventory of radioactive wastes that will by then have accumulated will be some two hundred times greater than at present.

As Sir Brian Flowers warns[141] "by the year 2000, a world nuclear power programme would have generated such large quantities of fission products (and actinides) that even if they were dispersed uniformly in the vast bulk of the oceans, the resulting concentration would be within one or two orders of magnitude of the maximum permissible concentration for drinking water. This would not be satisfactory because of the many food chains that would concentrate the radioisotopes and return them to man."

With regards marine pollution in general, one of the world's foremost oceanographers Dr Edward Goldberg[142] writes "our concern is the haunting possibility that levels of a toxic material can rise so high that exposure of organisms to such materials in the open ocean, as well as in the coastal ocean, may result in widespread mortality or disease."

". . .If these substances mix with the deep ocean, they will be transferred within a decade to zones below the mixed layer, where they may remain for thousands of years . . ." He concludes that we may leave future generations "the legacy of a poisonous ocean. . ."

Another consequence of the increased contamination of our planet must be the continued incidence of cancer. Already more than twenty-five per cent (fifty-one millions) of the two hundred million people living in the USA will get cancer. Thirty-four millions will die of it. As Epstein[143] points out "most of the people dying today are over forty or fifty years old and were thereby brought up in that period that preceded the general contamination of our environment by most of the known carcinogens in general use today. We can thereby expect that when today's children reach the age of forty or fifty, the cancer rate will be very much higher."

Frank Rauscher[244], Director of the National Cancer Institute agrees with this thesis. "Given today's environment" he writes, "we are living with a time-bomb that's going to explode in twenty or thirty years from now in the form of even more persons being stricken with cancer."

Indeed at the rate at which the

cancer rate is increasing today, it is only a matter of a few decades before this dreaded disease becomes generalised among the populations of industrial countries — a truly nightmarish prospect.

However, perhaps one of the most dramatic consequences of present pollution trends must be changing weather patterns. Professor Flohn[145] at the Second International Conference on the Environmental Future, went so far as to state "a global climatic catastrophe is unavoidable, if we continue to use energy at the current rate", a conclusion that was also that of the other eminent climatologists present. Indeed it is difficult to see how such a conclusion can be avoided if one accepts with Flohn that we are already "on the fringe when man-made changes" to the chemical composition of the atmosphere "are at the same level as natural ones" — and are, what is more, still increasing.

What Hope is there?

In the introduction of the Fifth Report of the Royal Commission on Environmental Pollution, Mr Crossland, who was then Minister of the Environment, congratulates its authors for showing that there was no substance to the predictions by environmentalists that our industrial activities were causing irreversible damage to our environment. In the same report, its principal author, Sir Brian Flowers concludes that pollution could never by itself limit economic growth. These statements, which reflect official opinion in this countries as well, could not be further from the truth. Indeed if global environmental pollution were to environmental pollution were to increase at the current rate for more than a few decades, economic activities like all other human activities, would be dramatically curtailed by the mere fact that our planet would have ceased to provide a suitable habitat for complex forms of life such as man and the other higher mammals.

In reality of course such a situation is unlikely to occur. Over the next decades our polluting activities are likely to diminish rather than increase. This, however, is not going to be because of any intelligent decisions taken either by our industrialists, our trade unionists or our politicians, but simply *because world conditions are becoming ever less propitious to the industrial process.* Capital, energy and resource shortages and the growing cost of controlling human societies that are biologically and socially ever less viable, must bring to an abrupt end the particularly aberrant episode in the history of human affairs that is the Industrial Era. Indeed, it is global economic catastrophe that is likely to provide the only effective method of pollution control.

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Down in the Dumps

by
Nicholas
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The problem of toxic waste disposal in Britain and the US.

When it comes to disposing of its wastes, industry has proved itself a most unneighbourly housewife. It's not so much that it keeps its own house in a state of continual squalor (though that charge could well be made) but rather that it insists on turning everybody else's backyard into a contaminated wasteland. Generating billions of pounds of hazardous wastes each year, it has shown little interest in their safe long-term disposal. Far too often, industry has chosen to follow the simple dictum that where toxic wastes are concerned, the best solution is to put them 'out of sight' and thus 'out of mind'. To do otherwise, it is claimed, would cost too much money and further fuel inflation.

Until the environmental movement found its teeth in the early sixties, the principal method of disposal was to dump wastes wherever it was most convenient — down the nearest mineshaft, into a local stream, onto a tract of derelict land — with the result that aquifers have been poisoned and seas rendered stagnant and lifeless. Even so, it took disasters such as Chesapeake Bay, Lake Ontario, the Rhine and, in particular, Minnemata — all grossly polluted through indiscriminate and intentional dumping — before Western governments were spurred into action and passed legislation to ensure proper disposal. That legislation has proved the Cinderella of the statute book, continually delayed for fear that its implementation might send industry reeling into another depression.

Worse still, the full extent of industry's past delinquency is only just coming to light. In the United States alone, it will cost some six billion dollars to prevent existing waste dumps from deteriorating into environmental Gomorrahs and a further forty billion dollars to ensure a total clean-up. Indeed, many US officials privately confess that the problem is now beyond control and that it is only a matter of time before the toxic time-bomb beneath America explodes.

In Europe, as in Britain, little effort has been made to delve into industry's murky past — the British Department of the Environment does not even have an inventory of sites used in the sixties and early seventies to dump toxic wastes — whilst the Third World, forever anxious to attract new industry and foreign exchange, continues the time-honoured practice of allowing industry to do what it likes with its wastes.

Meanwhile evidence is steadily mounting that the present methods of disposal — in the main landfill — are far from satisfactory. Even more alarming, it appears that industry (particularly in the United States) is turning to illegal tipping rather than pay for the running costs of a proper waste disposal programme. The tragedy is that safe methods of disposal, such as high temperature incineration, do exist — at a price. Whether that price can be paid without bankrupting businesses throughout the Western world remains to be seen. One thing is certain however: if the money isn't forthcoming, widespread contamination of the environment isn't just a possibility — it is inevitable.

The United States

For years the residents of Love Canal, a quiet suburb of Niagara City, complained of noxious fumes in their basements, fumes that they believed originated from a disused toxic waste dump beneath their housing estate. For its part, the local health authority showed little interest in the problem and still less desire to investigate. Two years ago, however, the residents' worst fears were confirmed. The prolonged rains and heavy snows of the winter of 1977 caused water to seep into the dump-site, causing it to overflow and forcing the chemicals out into

the soil. A thick black sludge began to appear on the surface, covering gardens and oozing into basements. An immediate inquiry was ordered and three months later Governor Carey of New York State announced that all 235 families would have to be evacuated. Shortly afterwards, President Carter declared Love Canal a federal disaster area, the first-ever instance of a National Emergency being caused by chemical pollution. Recently still more families had to be moved when it was discovered that the toxic waste was migrating farther afield via underground streams.

"Today the site looks like a war zone," reports Thomas Maugh of *Science*. "The houses nearest the landfill are boarded up and empty, surrounded by an eight-foot high Cyclone fence to keep tourists and looters away. Still other houses are also boarded up and empty, their owners having fled the unknown. Here and there throughout the surrounding neighbourhood, newly erected green signs mark the pick-up points for emergency evacuation in case there is a sudden release of toxins. An ambulance and fire engine stand by in the area at all times as construction workers struggle to seal off the flow of chemicals and render the area safe once again — it not exactly inhabitable."

Model City

Love Canal takes its name from William T. Love, a nineteenth century entrepreneur who planned to build a model city near Niagara Falls. Part of his ambitious scheme involved digging a seven mile canal which would connect the upper and lower levels of the Niagara River in order to exploit the Falls for cheap hydroelectricity. Work on the canal began in the summer of 1895 but before it could be completed, economic recession put pay to Love's dream, his backers deserted him and the project was abandoned.

In the early Twenties, the partially dug section of the canal was bought by the appropriately-named Hooker Chemical Corporation and used as a dump for toxic wastes. Almost 22,000 tons of chemicals were buried there before the site was eventually capped with clay and covered with earth in 1953. Hooker Chemicals then sold the canal to the Niagara Falls Board of Education for one dollar, on condition that they were absolved of all responsibilities for the future state of the land. An elementary school was built on the site, along with a housing estate and it appears that at some stage during this building programme, the clay cap sealing the dump-site was severely damaged. Hence the leaching of chemicals.

How Contaminated?

The true extent of the subsequent contamination of Love Canal is only just beginning to emerge. An initial study, ordered by Dr. Robert Whalen (who was New York's Commissioner for Health at the time the crisis first blew up) identified 82 different chemical compounds — twelve of them known or suspected carcinogens. Subsequent investigations have revealed 200 other compounds, only half of which have been identified. It is estimated that at least ten per cent of these chemicals will prove carcinogenic, mutagenic or teratogenic.

"We really don't know what's down there," Tom Quinn, the officer in charge of the clean-up programme, told *The Observer*. "There's no record of what was dumped or how much of it. This land is dead forever. The trees, grass and flowers in the gardens will all eventually go. Nothing will remain."

Niagara Falls Gazette

Extremely Toxic

Studies now reveal that the Love Canal area had three times the normal rate of miscarriages and three and a half times the normal rate of birth defects — most notably cleft palate, mental retardation and club foot. Worst hit are streets in the Southern section of the canal where high concentrations of benzene, a known inhibitor of cell division, have been found. It also appears that thousands of kilograms of dioxin — a few kilograms of which caused untold damage after being released in the chemical explosion at Seveso, Northern Italy — were dumped in the canal. That in itself would account for the high incidence of liver damage amongst adults in the area. Still more frightening, three other Hooker Chemical dumps around Niagara Falls are now suspected of being public health hazards and, indeed, one may have contaminated local water supplies.

Love Canal is being recapped with a new layer of clay. Meanwhile the authorities are totting up the financial costs of the disaster: 30 million dollars already spent on cleaning up the area; 4.5 million dollars on rehousing residents; and a further 2 billion dollars worth of lawsuits in the offing. For a supposedly safe dumping site, that's quite a sizeable post-dated cheque to issue to a small community.

Pockmarked by Cess-Pits

Love Canal shocked America. The more so when a recent Senate Committee revealed that 90 per cent of all the toxic wastes generated last year in the United States were disposed of 'improperly, unsafely and irresponsibly'. Indeed the Environmental Protection Agency (EPA) has been forced to admit that there are over 300 waste dumps which are known to be immediate health hazards, but it denies that it has the money (some 1.5 billion dollars) to clean them up. A recent report, commissioned by the EPA, estimates that anywhere between 1,200 and 34,000 other sites are likely to cause significant environmental problems at some stage in the not too distant future. The report, undertaken by Fred Hart Associates of New York, also revealed that 75 per cent of all landfills are 'in areas particularly susceptible to contamination problems' — in wetlands, on floodplains and over major aquifers.

The Senate Committee was convened to look into the considerable delay over enactment of the 1976 Resource Conservation and Recovery Act, a bill which is intended to regulate the proper disposal of toxic wastes.

"The threat posed by hazardous wastes may be the environmental sleeping giant of this decade," Representative Albert Gore, who chaired the Committee, told the hearings. "America has been pockmarked with thousands of cancer cesspools — the EPA drags its feet to avoid facing the magnitude of this threat."

"In America last year," he went on, "an estimated 92 billion pounds of hazardous wastes were dumped into the ground. This amount increases by 8 per cent each year. Rusting and busted 55-gallon drums are not a sensible final resting place for powerful poisons and carcinogenic industrial chemicals. Already many sites have caused tragedy, leaking toxic substances into our environment and water supplies.

"Delays in action are costly. Each month EPA delays, nearly 8 billion pounds of hazardous wastes are generated. By the time EPA expects the regulations to be in place, an estimated 160 billion additional pounds of hazardous waste will have been produced and disposed of in an *ad hoc* fashion."

A Catalogue of Disasters

Included in the record of the Senate hearings was a series of articles by Michael Desmond of the *Buffalo Courier-Express*. When the Love Canal story broke, Desmond was assigned to document the full extent of America's waste disposal problem. He travelled 5,200 miles criss-crossing the country to visit hazardous chemical dumps. The reports he filed read like science fiction. We learn:

- That chemical warfare waste dumped in lagoons at the Rocky Mountain National Arsenal near Denver contaminated 30 square miles of underground water and rendered 6.5 square miles of farmland sterile. When the Arsenal tried to empty the leaking lagoons by pumping out the wastes and injecting them into deep wells drilled two miles into the earth, a series of earthquakes erupted in the area. It is thought that the wastes lubricated the rocks and caused the tremors. The Defence Department estimates that it will cost 78 million dollars to clean up the mess:
- That a 'midnight hauler' sprayed 120,000 litres of waste oil contaminated with PCBs along the verges of 250 miles of highway in North Carolina. The State must now dispose of 40,000 tons of contaminated soil:
- That an area of 100 square miles in Louisiana was contaminated with hexachlorobenzene which had been dumped illegally on farmland. Cattle grazing in the area were subsequently poisoned:
- That pesticides dumped illegally in a sewer at Louisville, Kentucky, contaminated the sewage system. Thirty-five sewage workers had to be taken to hospital with chest-pains, sore throats and blisters. For the next two months, 100 million gallons of raw sewage a day was pumped into the Ohio River:
- That 15-29,000 fifty-five gallon drums of various chemicals were left rusting, split and ruptured at a dump in Lowell, Massachusetts, after the Silresium Chemical Company went bankrupt in 1978. During the plant's operation, pollution standards were repeatedly violated: among other things, chemicals were discharged directly into Lowell's sewage system and into the Merrimack River — a source of drinking water for several towns downstream. High concentrations of tuolene (a nerve poison) and trichloroethylene (known to cause liver damage) have been detected in the soil and groundwater. A report by Fred Hart Associates, commissioned by the EPA, detailed evidence of extensive and repeated spills of chemicals throughout the plant; of chemicals leaking into adjacent properties on all sides of the site; and of containment dykes which had been breached, rendering them useless for preventing dis-

charges. Owing to a fire, which broke out in the building where all the records were kept, the clean-up operation (expected to cost over 1.5 million dollars) has been made almost impossible because nobody knows exactly what has been dumped at the site. One batch of drums is simply described as 'miscellaneous hydrocarbons':

- That over a period of six years, a Houston disposal firm dumped 70 million gallons of toxic wastes into an *unlined* sand pit. "The odour would gag a maggot," one resident told Michael Desmond. In 1973 a heavy flood flushed the waste from the site into the San Jacinto River:
- That tons of heavy metal sludge and acids were dumped into a series of pits near Los Angeles. Five years ago, the site was closed and the owners disappeared. In 1977, heavy rains filled the pits to overflow. A million gallons of wastes were immediately pumped directly into a local stream to prevent their flooding a nearby housing estate. Even so, various chemicals leached into the well of an elementary school a mile and a half away:
- And that General Electric dumped more than 600,000 pounds of PCBs into the River Hudson between 1950 and 1976. The River is now so thoroughly contaminated that various stretches will have to be dredged and the sediment incinerated — at a cost of nearly 240 million dollars. Meanwhile commercial fishing has been banned and the company has been found guilty of violating water quality standards.

EPA: Covering-up?

The Environmental Protection Agency has a lamentable record when it comes to cracking down on illegal dumping. For whatever reason — fear of offending industry or perhaps even of discovering the very magnitude of the problem — no effort was made prior to the Senate Hearings to assess the threat from old dumps. Indeed, the EPA department charged with doing so, a section of the Division of Hazardous Waste Management, had no budget to police disused dumps and only two members of staff, both of whom had to type their own letters and reports for want of a secretary.

Hugh Kaufman, manager of the department, has accused his superiors at EPA of intentionally covering-up the dangers of many known dumps and of stymying efforts to search for other dumps that might prove health hazards. One case involved Summit National Services, a waste disposal firm from Deerfield, Ohio. In 1976, the Summit site was inspected by the Ohio Office of Land Pollution Control after it was learnt that two loads of 'C-56' had been delivered to the plant. 'C-56' is the code-name used by a particular chemical company in Michigan for Hexachlorcyclopentadiene (HCP), a compound used in the manufacture of the pesticides Kepone and Mirex. The investigators not only found leaking barrels all over the site, but, more important still, that Summit had n o facilities whatsoever for handling 'C-56' and that substantial contamination of local water courses had taken place. The Office of Land Pollution Control recommended that the local EPA office place an immediate ban on further dumping on the site. That recommendation was ignored.

It was two years before Kaufman's department even heard of the case. He contacted the regional EPA office requesting a new investigation and was told in no uncertain terms to get off its back. "The local office refused even to visit the facility or to let headquarters staff visit," he reveals. "They told us to stay out of the region." Kaufman also discovered to his consternation that the Ohio office had several other far more serious cases of hazardous waste dumps on file but that it had no intention of investigating them. Still more disturbing, when Kaufman told his superiors of the incident they sided with the regional office and ordered him off the case.

A Small Case of Poisoning

Perhaps the best documented case of an EPA cover-up comes from a small hamlet some six miles outside Toone, Tennessee. Late in 1964, the Velsicol Chemical Corporation, a Chicago-based company, began disposing of pesticide wastes in a shallow burial site near the hamlet. As early as 1967, a US government geological survey found evidence of contamination of local aquifers and cautioned against further use of the facility. Despite this the site was expanded and dumping activities were stepped up. Today nearly a quarter of a million 55-gallon drums lie rusting at the landfill and local wells have been found to be thoroughly contaminated with at least six suspected carcinogens, including Carbon Tetrachloride, Aldrin, Dieldrin, Chlordane and Benzene.

The concentration of carbon tetrachloride was 2,400 times the maximum daily dose recommended for workers by the National Institute of Occupational Safety and Health (NIOSH). When Carbon Tetrachloride was discovered in Cincinnati's water supply (at levels 48 times lower than at Toone) the EPA immediately warned against drinking the water without boiling it first. No such warning was given at Toone, nor were the residents told that Carbon Tetrachloride could be absorbed through the skin. Indeed it was only *after* the Senate hearings that EPA even got around to 'advising' against the use of local well water for bathing or washing clothes and dishes.

Woodrow and Christine Sterling are one family who have been particularly badly affected by the incident and it is largely through their efforts that the case has received wide publicity in the States. At first the Sterlings showed a touching faith in the integrity of the authorities. Even after tests on their well water revealed positive evidence of contamination, the family continued to drink from it because of repeated assurances from both Velsicol and local health officials that it was safe to do so. "We drank the water for months," Mrs Sterling told the Senate hearings. "We did not stop because we were not told to stop."

About this time, Mr Sterling's sister, who lived next door, became pregnant and she too continued to drink the local water. Her baby was born two months premature without a stomach wall so that its intestines hung outside its body. "I was there

at the delivery," recalls Mrs Sterling. "I asked the doctor if the chemicals in the water had anything to do with it but he would not take a stand." Subsequently a Velsicol official visited the Sterlings to assure them (again) that the water was safe to drink. When Mrs Sterling offered him a glass to drink he refused; "I might die before I get back to Memphis."

Stonewalling

Official obduracy and a general reluctance to get involved in the case was something that the Sterlings were to encounter time and time again. When, for instance, they asked local EPA officials to give them a breakdown of the known effects of the chemicals found in their well water, they were told that it was impossible to provide firm details "because there hadn't been enough research". In another incident, blood samples taken from three families in the area remained frozen because the health authorities couldn't find "a laboratory to undertake the appropriate tests".

Throughout the case, Velsicol claimed that there was no evidence to link the poisoning of the wells with their activities at the dump site. In this, the company was supported (albeit tacitly) by the EPA. Official indifference to the case was such that EPA headquarters only learnt of the Sterlings' plight through a report on the front page of *The Washington Post* in July 1979. Hugh Kaufman asked Virginia Thompson, a colleague at EPA, to investigate and she immediately contacted the regional office. The transcript of her telephone call is worth reproducing in full:

VT: We are writing damage reports on hazardous waste management. It has come to our attention that there is well water contamination in Hardeman County, Tennessee, which citizens claim is caused by wastes improperly buried by Velsicol. Are you familiar with this case?

Regional Officer: Yes (Silence)

VT: Has the Regional Office done any investigations of this claim?

RO: Yes (Silence)

VT: Can you tell me the status of your work there?

RO: No (Silence)

VT: You cannot give me any more information? Have you done water sampling or anything?

RO: No, we have not taken samples and I'm not going to tell you anything more about this. Listen this is a potential enforcement action and you people of it. I mean, I'm telling your office to *stay out* of this altogether.

An infuriated Kaufman sent an immediate memo to Steffen Plehn, imploring him to intervene and use his authority to force the local EPA to investigate the site. The memo was forwarded to John Lehman, Kaufman's immediate boss, who replied: "Based on the information in your memo, the problem is, as you say, 'perhaps serious'. However, a direct link to the Velsicol hazardous waste disposal site apparently has not yet been established."

Paltry Compensation

The case was thus closed and Velsicol's claim effectively given the official stamp of approval. Even when a public outcry forced the company to admit that there might conceivably be a connection between the dump-site and the well contamination, it still refused to admit liability and only offered local residents 160 dollars in compensation. Last November, Velsicol — no doubt disturbed by the bad press it received during the Senate hearings — finally relented and offered to buy all the houses whose wells had been poisoned.

Perhaps the last word in this tawdry story of deceit should go to its principle victim, Mrs Sterling: "I don't have words to express how I feel. I am hurt. I am bewildered. Are our daughters going to have deformed children? Is our son going to have deformed children? We have these questions and we cannot get them answered. I feel that the government officials, that the State officials should have been open and honest with us because I thought that is what the government was about."

Delays in Legislation

Earlier this year, President Carter announced plans to create a 1.6 billion dollar superfund to pay for cleaning-up abandoned waste dumps. The move has angered industry (which will be required by law to contribute to the fund) because it believes that chemical companies have been unfairly singled out to bear a disproportionate burden of the clean-up costs. Meanwhile the EPA has been sued by a coalition of environmental groups for failing to implement the Resource Conservation and Recovery Act on time. Last month, Douglas Costle, head of EPA, was forced to admit that even now the legislation was still behind schedule. A major obstacle has been the millions of pages of testimony filed by industry on virtually every clause of the proposed Bill. "These comments are a minefield", an official told Philip Shabecoff of *The New York Times*. "If we do not handle them properly, industry will be able to use them to go to court to stop or remove our regulations."

Whilst EPA and industry battle it out over the definition of 'sludge' or what constitutes a hazardous chemical, America's toxic time bomb ticks slowly away. Firms producing dangerous wastes are offloading them into their less safe sites as fast as possible before the new legislation prevents them from doing so. And all the time, the Mafia is developing its own cheap, alternative methods of disposal. As we shall see, there are many who apparently find them very attractive.

"This land is dead forever. The trees, flowers and grass will go. Nothing will remain"

THE BRITISH PROBLEM

Simple mathematics would suggest that if America has a toxic waste problem, Britain has a potential disaster on her hands. Although the United States produces nearly ten times as much toxic waste as Britain, she has thirty-six times as much land on which to dump it. By that reckoning, Britain's waste disposal dilemma should be three times as bad.

Not so, says the Department of the Environment. "In my view, we do not have the same problem as in the United States and it is invidious to make a comparison," Anthony Fagin of the Toxic Waste Division told me. "Britain has a tradition of legislative control which just doesn't hold for the US and what federal statutes there are simply aren't compatible with ours. We aren't smug about our own record, but we are satisfied with it."

Hasty Drafting

Certainly Britain has a far longer history of legislative control over the disposal of toxic wastes. The Deposit of Poisonous Waste Act (DPW), for instance, was passed in 1972 — years before the Americans even began to appreciate the extent of their waste problem. The DPW was rushed through parliament after cyanide drums were found abandoned on several sites in the West Midlands. According to Fagin, the Act was literally drawn up on the back of an envelope over a weekend, and the shortcomings of such a hasty drafting are now apparent. Under the Act, manufacturers had to notify local authorities of any toxic wastes they wished to dispose. But because the Act balked at defining 'toxic waste', it obliged industry to notify the authorities about virtually every type of waste — from plastic cups to PCBs — leaving its factories. The result was a mass of extra paper work, most of which was irrelevant.

That legislation has now been replaced by the Control of Pollution Act, the appropriate sections of which have (thankfully) escaped being axed under recent government expenditure cuts. Like the US Resource Conservation and Recovery Act, the CPA is intended to provide a 'cradle to grave' solution for toxic wastes. The Act requires local Waste Disposal Authorities to draw up an inventory of the wastes produced in their area together with a survey of sites where wastes can be dumped. To date the WDAs haven't completed their surveys (and are not expected to do so until the end of the year or the beginning of 1980) but once finished, the Department of the Environment will have a comprehensive picture of what wastes are being produced in what quantities, in which counties and where they are being disposed. Ultimately the Department intends to introduce a 'consignment system' whereby all toxic substances have to be signed for by the responsible authorities at each stage in their journey from factory to disposal site. Thus in theory it will be impossible for toxic wastes to be improperly disposed.

Burying its Head

Drawing up legislation to ensure proper disposal in the future is, of course, a wholly commendable and necessary task, but one wonders whether, in concentrating on the future alone, the DOE is not in fact burying its head in the sand. For if recent events in the US have any lesson for us, it is surely that America's toxic time bomb was not lit today but yesterday. Quite simply, if Britain has a Love Canal, it won't be defused by preventing others in the future but by searching out past sites where a potential health hazard may exist.

To date, the DOE has no inventory of past sites and no intention of compiling one. "To undertake a comprehensive survey of sites used prior to 1972 (when the DPW Act brought in a site licencing system) would be astronomically expensive and would inevitably be incomplete," Anthony Fagin told me. "What's more it would mean creating a retrospective offence — and that would go against all the traditions of British justice."

Unscrupulous

Such complacency is alarming. Even an incomplete list would be preferable to no list at all, for there is no evidence whatsoever to suggest that, in the early days, British waste hauliers were any less unscrupulous than their counterparts in the United States. Until 1972, there were no controls — other than the public health acts — over dumping sites; there was little concern over site selection; little or nothing was known about how wastes reacted with the soil, let alone with each other; and fly-tipping was rife. In fact — the industry now readily admits it — the sixties and early seventies were the heyday of the cowboy operators. "Real control over landfill only started two years ago," I was told by the Institute of Geological Sciences.

Even Pitsea, often hailed as a model site and certainly the most comprehensively monitored in the country, was not given a geological survey until it was taken over by Redlands in 1973, by which time it was already one of the largest landfills in Britain. In the event, the survey (undertaken by the company's consultant geologists) revealed no signs of faulting or kinks in the underlying strata: but if it had, who knows what the consequences might have been for the surrounding marshland or indeed the local aquifers? Incredibly, nobody thought it amiss at the time that a geological survey hadn't been taken beforehand: such simple precautions just weren't current practice. "Prior to 1972, the industry was not in the state that it should have been," says Ruth Roll, publicity officer for Redland-Purle. "Today we are much more up-market."

Bribery and Corruption

In 1964, the Government set up a working party, the Key Committee, to investigate the extent of fly-tipping. At the time, allegations of malpractice on the part of Britain's waste industry were legion. In some cases, the stories make amusing reading: one oil tanker driver tells how he emerged from a transport cafe to find that toxic waste had been pumped aboard his empty lorry whilst he was having a cup of tea. Other incidents are more sinister, however. "Drivers at the company I worked for were paid a bonus for fly-tipping, usually about three to four pounds a trip," says an informed source. "The licence for one site was revoked after a fire occurred, but drivers still continued to use it, sneaking in and tipping after dark. In some areas, local authorities were paid to turn a blind eye, and at one site we used to dump chemicals

The Latest Discovery

Bampton, in South Devon, is the latest village to discover tht it has a toxic time bomb on its door step. Waste dumped in a nearby quarry are found to have leaked into local water courses and there are fears that the River Exe might be comtaminated. A bore hole examination has revealed a massive leakage of oil through the rock strata beneath the quarry, and an analysis of water has shown that concentrations of heavy metals have increased significantly. At present they are below the level considered unsafe, but Devon's county geologist, Dr Nicholls, is adamant that the site is unsuitable for further tipping. "It leaks," he says. Haule Waste, the quarry's owner, have been refused a licence to continue tipping but it is appealing the decision. It wants permission to dispose of 7 million gallons of liquid wastes and 10,000 tons of solids each year. The company has submited a list of 45 chemicals it wishes to dump at the quarry, ranging from pharmaceuticals to 'unidentified chemicals' and 'other industrial wastes'.

Bampton is only one of thousands of sites up and down the country, few of which have been properly monitored by the Department of the Environment. Indeed the DOE doesn't even have an inventory of disused sites, many of which may have problems similar to those at Bampton. Why has the DOE not compiled such a list? And why does it turn down flat suggestions that it do so?

along with sewage, which we weren't permitted to do. When I complained, I was told to keep quiet or I might lose my job." So too, an ex-employee of a Midlands firm, who was so shocked by the activities of his company that he resigned, revealed to *Time Out* in the early seventies that chemical plants in the area were discharging wastes directly into canals in considerable quantities. "It is all concealed from the public because of the alarm it would cause if they knew," he said.

Was Everyone on the Game?

The Key Committee, which reported in 1970, documents numerous cases of pollution through the burial of cyanides, pesticides, tar sludges and other wastes. In one case, a borehole investigation of a gravel pit filled with miscellaneous sludges and oils revealed water with a Biochemical Oxygen Demand of 4000 mg/1., about ten times as great as raw sewage. In another, cattle and sheep died after drinking water contaminated by fluoroacetamide, rodenticides and pesticides dumped on a nearby field. Ditches and ponds near the site were dredged and contaminated soil excavated. Later it was mixed with cement, put into steel drums and dumped out to sea.

Nor was fly-tipping confined only to shady backstreet companies, out to make a quick profit and then disappear. Even the most reputable firms were sometimes found to be tarred with the same brush. Thus Purle Bros. — the company which for the City *meant* waste disposal — was prosecuted in 1970 for polluting Macklesfield Canal. Purle told the court that it was always looking for tipping sites and had sent a driver to investigate the possibility of using a disused mineshaft near the canal. The driver had emptied his tanker on the site instead of carrying on to an official tip at Nottingham. Elsewhere, at Kentford in West Suffolk, Purle Bros. admitted breaking planning laws when it dumped acid wastes in a quarry. After complaints from the local residents, the quarry was declared a health hazard and the liquid wastes were drained off and removed.

Fool's Paradise

Significantly the Key Committee also warned that the greater part of toxic wastes were being disposed of in tips owned by the company's that produced them. "This is satisfactory in the sense that the producer of the waste is still responsible for it after disposal and he may be expected to be reasonably cautious as to what he deposits on his tip," comments the report. "But it may be unsatisfactory because the tip site might not have been chosen with toxic wastes in mind. Moreover, a manufacturer may know little about water pollution and less about the risk of it in his own particular area. We do not know how many of them may be living in what may, or may not, prove to be a fool's paradise." That warning has proved all too prophetic.

A Few Incidents

In the ten years since the Key Committee, numerous examples of gross pollution through fly-tipping or improper disposal have been reported in the national press. A few cases, taken from the last two years, suffice to make the point:

- In 1978, blue asbestos was discovered in the gardens of a street in Barking by a pensioner digging his garden. Barking Council placed a £70,000 contract with a local nursery to remove about 1,500 tons of contaminated soil from the gardens of some twenty houses, but the contract was withdrawn when the nursery found it had nowhere to dump the soil. Mrs Ivy Steggles, whose husband discovered the asbestos, told Angela Singer of *The Guardian* that when she telephoned the Department of the Environment about the find, she was advised to tell her husband 'to bag it and dump it':

- A nature conservation area near the Humber Bridge was last year declared 'virtually destroyed' by unauthorised tipping, not of toxic wastes, but of 18,000 tons of clay from the bridge excavations. "The site has been altered irretrievably", said the local ombudsman, noting that nesting birds may have been scared away, possibly forever:

- This June, *The Guardian* revealed that the Forestry Commission had dumped drums of herbicide 2,4,5-T down a mineshaft in Wales. According to the manufacturers' instructions, used cans should be washed out in kerosine, crushed and buried beneath three feet of earth. None of the canisters found in the mine had been crushed or cleaned out. At the time they were found, local health officials claimed that the drums had been properly sterilised:

- In 1977, a 26-acre housing project in Wandsworth, London, was delayed when the soil was found to have been contaminated with industrial wastes from the old Wandsworth gas works. The

pollution had been caused by years of accidental spills of oils, tars and pitch:

- Earlier this year, the DOE halted the dumping of liquid wastes at a site in South Derbyshire. For eighteen months prior to the decision, the Seven Trent water authority voiced fears that the tip might be contaminating high-quality aquifers used to supply 350,000 people in the area:

- In Lambeth, two years ago, two tons of blue asbestos were dumped illegally on wasteland used as a children's playground:

- In 1977, fines totalling £5,200 were imposed on two West Midland companies for illegally dumping toxic wastes on a derelict building site. In another incident — for which the companies were also prosecuted — 65 drums of cyanide were deliberately abandoned on a tip near Wolverhampton after tipping permission had been refused. It was alleged in court that one of the employees had been bribed to allow the load to be dumped:

- In 1978, a fire at Nettlesfield Quarry at Beith in Scotland resulted in two substantial discharges of lethal quantities of phenolic wastes and cyanide into a nearby river. Subsequent surveys showed that 3,500 fish had been killed. Two years earlier,a number of cows had died near the site after activated carbon containing cyanide, dumped illegally in the quarry, was spread on adjacent fields:

- In 1977, it was revealed in *Municipal Engineering* that as a result of delays in the implementation of the Control of Pollution Act in Scotland, English waste hauliers were crossing the border and disposing of thousands of gallons of toxic chemicals at Scottish sites where licencing laws were less strict:

And in 1976, a tip — known locally as the 'bubbling cauldron' — at Ravensfield in South Yorkshire was hurriedly fenced off after children were burned by acid fumes. Sludges which had leached were powerful enough to have corroded drums. The site had been in use for twenty years and a variety of wastes were indiscriminately dumped. Tars in the tip were found to contain up to 32 per cent of concentrated sulphuric acid, and investigations revealed that alkaline and acid wastes had been dumped within inches of each other; if they had combined, the results could have been fatal. No-one knew what wastes had been dumped (10,000 tonnes of contaminated materials were eventually treated) and for several months it proved impossible to trace the owner of the site.

The then County Waste Disposal Officer, John Holmes told *Municipal Engineering*: "Ravensfield is not the only private tip in this condition. There must be hundreds. I expect many more will be discovered once site licencing begins to bite."

His colleague, A.Q. Khan, the County's Chief Environment Officer, concurs. Recently, in a paper delivered at a conference on waste disposal held in Eastbourne, he recommended that local Waste Disposal Authorities should prepare a full list of all old and new waste disposal sites in their area, together with a list of industrial sites where toxic chemicals may have contaminated the land He also suggested that site licences should include "a condition requiring the licence holder to obtain a suitable 'Environment Impairment Liability Insurance', which should be such that it could pay for any remedial work even after tipping is finished." It is advice that the Government would do well to heed.

How safe?

Khan argues that such an insurance scheme is essential because we can never be one hundred per cent certain that current methods of disposal are safe, however well operated they might be. "We simply haven't learnt the lessons of the thalidomide tragedy," he told me. "Scientists can be wrong. What happens if in ten years, we find that present regulations weren't adequate? Who will pay for the clean up? There must be some provisions."

Khan has good cause for concern. Reading through the literature, one can't help but be struck by the paucity of our knowledge on the long-term effects of landfill. In 1970, for instance the Key Committee admitted that it did not know what precautions should be taken to prevent water pollution through the disposal of toxic wastes. "At the moment this is largely a matter of judgement, even of 'hunch', which is hardly good enough for a scientific age", it concluded.

Five years later, after a desk study of some 3000 sites, the Institute of Geological Sciences (IGS) advised the government that 50 sites presented a "theoretically serious risk to aquifers" and that they ought to be classified as "high-risk". Like the Key Committee, the IGS concluded that too little was known about the behaviour of toxic wastes in landfill. As a result, the DOE commissioned the IGS to carry out a £1.7 million research programme into the problem.

Hazardous Wastes in Landfill

That programme has now been completed and in its final report, *The Behaviour of Hazardous Wastes in Landfill*, the IGS gives landfill a clean bill of health, claiming that "an ultra-cautious approach to landfill of hazardous and other types of waste is unjustified." But does the content of the report really support such an unequivocal conclusion? Critics point out that the report investigated no more than 19 sites — a tiny fraction of the total number in Britain — and of those 19, only fifteen were studied in depth. (Two were found to be causing water pollution). Moreover, some geologists argue that the report gives a misleading impression in asserting that the sites selected were "representative of the main geological types in the United Kingdom." They maintain that topography, rainfall patterns, soil differences and numerous other factors make each site unique, and hence generalisations impossible.

A Whitewash

One critic goes even further. "The report is a whitewash," he told me. "The evidence from other countries is that pollution from landfill is almost inevitable, but in Britain no-one has really looked for it." He points to a survey conducted in the US which came to a very different conclusion about the safety of landfill to that reached by the IGS. Out of 50 sites investigated, 43 showed migration of one or more hazardous substances; 40 showed migration of heavy metals; 30 of selenium, arsenic or cyanide; and 27 showed migration of organic chemicals. In addition, all 86 wells and springs monitored around the landfills showed one or more hazadous substances in concentrations above background. "My

understanding of the laws of science is that they apply as forcefully here as they do in the United States. I don't believe that toxic wastes behave differently just because they are American."

The same critic argues that the very nature of landfill makes pollution unavoidable and that the problems which have been encountered both in Britain and the US are not just the result of poor management. Landfill operates on a 'sponge' principle: toxic wastes are poured onto domestic refuse, which soaks them up and then breaks them down as it degrades. The success of the operation depends on how rapidly the 'sponge' becomes saturated for, once saturated, the 'sponge' can no longer soak up new wastes and they migrate rapidly to other areas outside the tip. Rainfall alone will cause some leaching at even the dryest site: indeed, I was told by a geologist from one large disposal firm that some degree of leaching is to be expected at all sites. The problem is to ensure that the leachates are collected and sprayed back onto the tip.

But what happens to those leachates that cannot be retrieved? Who knows how the wastes are reacting underneath the ground? Or how long they will remain static? And if they do emerge into an aquifer in forty years time, how can we be certain that they will no longer be harmful? As one source in the industry put it: "People throw up their hands in horror at the idea of cyanides being dumped, but at least we know how cyanide behaves in the long-term. When it comes to PCVs or any other new chemical, we really haven't a clue what they will get up to."

In themselves, such fears are a powerful argument for dealing with wastes above ground — and that inevitably means incineration. "If you don't know how two substances are going to react together, you can put them through tests before you dispose of them," one incinerator manufacturer told me. "You can't do that with landfill: you just hope for the best."

For their part, landfill operators dismiss such criticism as unfounded nonsense: whilst admitting that accidents have occurred in the past, they argue that few of today's companies would run the risk of disposing of incompatible wastes in the same tip. Indeed most inflammable wastes are automatically incinerated. They point out too that incineration is not without its own problems: some wastes simply cannot be burnt: badly run and badly maintained plants can cause significant air pollution: the process is highly energy-intensive: and, above all, the initial capital costs of installing an incinerator are extremely high.

Moreover, the latest disposal techniques — detoxifying wastes by bombarding them with microwaves, for example — are simply beyond the pocket of most firms. All in all, it is claimed, landfill is the most economic proposition.

Here one comes to the nub of the problem for, ultimately, it is the state of the economy that decides what techniques of toxic waste disposal are acceptable. The more stringent the controls, the greater the cost and, at a time of recession, the fewer the firms that can afford them. In the United States, for instance, the Dupont Corporation claims that because of new EPA regulations, it will need to spend some 220 million dollars — 4.6 per cent of its equity — simply to insure its disposal sites. "If Dupont doesn't have the money to comply with the Resource Conservation Act," David Carrol of the US Manufacturing Chemists Association asked Thomas Maugh of *Science*, "how can anyone else?"

For many small companies in the States, the problem has been solved, not by government, but by organised crime. Having wrapped up the heroin and prostitution rackets, it seems that the Mafia is now moving into the waste disposal business. The first indication came two years ago when a New Jersey policeman questioned a tanker driver who was pouring his load down a sewer. The officer first became suspicious when his shoes disintegrated after he stepped into a puddle. The tanker contained pure sulphuric acid. It later transpired that the driver and his employer both had criminal records and were well known in Mafia circles. Since that incident, the State of New Jersey — nicknamed 'cancer alley' because of the extent of illegal dumping — has set up a special department to investigate midnight haulers, and indeed to surveil the industry. The State has no illusions about who is behind the new wave of illegal tipping, pointing out that only the Mafia has the organisation to execute what are often quite elaborate operations. In one case, for instance, bulldozers moved in overnight, dug holes in a disused building site, and filled them with toxic wastes and domestic rubbish. No small time crook would have the resources to carry out such a job.

But could it happen in Britain? Few in the industry would deny that fly-tipping continues apace, and many fear that the practice will become more widespread as the present economic recession bites deeper. If that proves the case, then organised crime might well exploit the situation. The irony of the dilemma facing the Department of the Environment is clear: on the one hand it knows that, short of patrolling every highway and byeway, the only way to stop fly-tipping is to make legal disposal cheaper, and that inevitably means relaxing controls; on the other hand, it knows it must ensure proper regulation of toxic waste disposal, but that brings the risk of pushing some companies into bankruptcy and making illegal dumping more attractive.

So long as ecological considerations play second fiddle to economic ones, the DOE will always be caught in something of a cleft stick. Whichever way it turns, by trying to put industry back on its feet, it is likely to lay the rest of us in our graves. In the short term, we may avoid bankruptcies but what about the future? How safe are we from the chemicals we have dumped over the last forty years? Where will the wastes we produce tomorrow be dumped? At what stage do we decide that our land is too valuable to be used as a coffin for chemicals? And when industry can only remain solvent by contaminating our environment, isn't the game really up? Shouldn't we be working towards a saner, less vulnerable society? For ultimately, doesn't the solution lie in not generating wastes we don't know what to do with? As one incinerator operator put it to me, "Cutting back on industrial activities might put me out of business, but it would eradicate the problem, wouldn't it?"

Books

The Colour of Conservation

PLANNING HUMAN ACTIVITIES ON PROTECTED NATURAL ECOSYSTEMS: The Conservation Unit Approach to the Planning and Management of National Parks and Reserves in Kenya Based on the Nairobi National Park Ecosystem, by Walter Jami Lusigi. J. Cramer, Germany, 1978. DM50.

National Parks and Game Reserves cover 25,000 sq. km. or about four per cent of the land of Kenya, a country with a population of thirteen million and a growth rate well over three per cent. Dr. Lusigi, himself a Kenyan, and Senior Ecologist at the National Environment Secretariat of the Office of the President of Kenya, deals with the Nairobi National Park and the surrounding region — Kitengela. His book is divided into two major parts. In the first he analyses the historical behaviour patterns which have led to Kenyans presently reacting in the way they do towards wildlife. An understanding of the background is fundamental to the success of any wildlife preservation scheme. If no account is taken of the traditions of the people, and if their legitimate interests are disregarded, National Parks and wildlife preservation schemes alike are doomed to failure. To avoid such a situation Dr Lusigi proposes a new approach based on African traditions, which could overcome the present prejudices and hostilities and make the concept of wildlife conservation acceptable to the people.

In part two of the book, this new planning and management concept, based on a study of the Nairobi National Park ecosystem, is developed. The proposal is to set up a wildlife conservation unit for each relatively large area, covering one or more park ecosystems, where wildlife conservation and human activities can be co-ordinated through compatible goals and management. As the author points out the most common failure in resource conservation planning in Kenya stems from the scant regard shown to the human factor. Clearly this situation has arisen because the notion of conservation is alien to the local population, and consequently conservation policy has largely reflected Western values rather than those of the people whose livelihood it most affects. Fourteen years after independence, no proper assessment of human needs has yet been made, and conservation planning has continued on the assumption that Western values and methods are equally appropriate in Kenya.

Despite claims to the contrary, opinion surveys and the experience of the last seventy-eight years have shown that Africans do not support conservation efforts, which remain an alien idea. The transformation necessary to make such a concept emotionally and intellectually satisfying has not occurred, and is most unlikely to come about if prevailing ethnic, biological and social influences are ignored.

Kenyan wildlife heritage cannot be saved by the tourist dollar, sterling, or deutschmark. To be successful the conservation effort must take into account African cultural values and the long-standing ties between man and his natural environment.

Without historical facts and a comprehensive knowledge of the ecological situation there is a risk of making serious mistakes in both theory and practical management which would further increase existing resistance. Another problem confronting conservationists in Kenya at the present time is the rapidly expanding population which has doubled in the last fifty years and will double again in the next twenty. Since Kenya is mainly an agricultural country and all these people will be striving to derive a livelihood from the ever decreasing land resource, this means that settlements will inevitably expand into the main wildlife areas. In such a situation wildlife must therefore sooner or later disappear, and any quantitative analysis of land set aside for the conservation of wildlife, must take these factors into account. If there is any justification in the belief that Kenya already has as many wildlife sanctuaries as she can afford, which is often quoted with satisfaction, then the system must be developed to achieve realistic objectives, within the boundaries of the existing reservations.

Dr. Lusigi's book is the first serious attempt to develop a plan for the optimum management of national parks and reserves in Kenya which could be acceptable to the African under the prevailing atmosphere of socio-economic development. It is based on an appraisal and evaluation of cultural, political, ecological and socio-economic factors and tries to balance resources against local human needs in both the short and long term. Prejudices and suspicions of long-standing, created by the ivory trade, slave trade, colonisation and independence must be allayed, and the African must see for himself the advantages to be derived from conservation of the wildlife resource. The practical and even emotional significance of the use of the term "African" in this context must be appreciated since the future of wildlife in their country, now rests entirely with the Africans in Kenya and the attitude they adopt towards the conservation ethic.

Jimoh Omo-Fadaka

Trees lovely Trees

THE ILLUSTRATED ENCYCLOPEDIA OF TREES, TIMBERS AND FORESTS OF THE WORLD. Edited by Herbert Edlin and Maurice Nimmo. Salamander Books Ltd., £9.95.

The first thing to say about this book is that it is an incredibly good buy at the price. It is beautifully illustrated throughout with a mass of coloured drawings and photographs, and contains a wealth of information.

It is divided into four sections entitled respectively: *The World of Trees and Timbers, A Guide to Conifers, A Guide to the Broadleaves,* and *Tropical and Southern*

Hemisphere Trees. There are twelve authors including the editors who between them have written the whole of the second and third sections.

The first chapter by Herbert Edlin provides an overview, one that is unfortunately commercial forestry-orientated. Thus its author Herbert Edlin tells us that 'Within the foreseeable future mankind will no longer be able to afford the luxury of vast virgin forest reserves, dedicated perhaps to the preservation of only a few rare birds, beasts, bugs or flowers. Timber production from man made, man-managed forests is so much more efficient than that from unplanned natural regrowth that our successors will have to rely on it just as we already rely on cultivated crops and domestic animals for our food'. The author has obviously never learnt that natural forests have a lot of very much more important functions than providing wood for the lumber industry. However these deficiencies are made up, to a certain extent, by the authors of the next chapters Allen Paterson, Dr Pat Morris and Dr. Mary Burgis who describe what are the main features of forest ecology.

The next two sections which cover the bulk of the book are devoted to describing the main genera of broadleaved trees and conifers that are likely to be encountered in the western world including some exotics which have been imported from elsewhere.

In the introductory chapter of the section on Southern Hemisphere trees, the author describes what must be one of the greatest catastrophes ever to befall our planet; the destruction of the world's remaining tropical forests. Even areas set aside by governments as biological reserves for scientific and cultural studies and as national parks, he informs us 'are, in many countries, under constant threat of the axe and uncontrolled farming'. Only, it seems, when a country is on the verge of becoming a net importer of forest products will most governments really apply themselves to improving and caring for their forests.

The speed with which previously major exporters of tropical woods have passed into timber deficits is quite startling. 'If trees had votes' he suggests 'it might have been another story.'

This section also contains a good chapter on swamp and desert trees and an equally interesting one on palm trees. All other Southern Hemisphere trees however are lumped together into a single chapter, to which, one cannot help feeling, a little more space could have been devoted, especially if we consider that it is dealing with the bulk of the world's different tree genera. But then this book is primarily designed for readers in the Northern Hemisphere who have little time left in which to make the long journey that would enable them to appreciate many of these trees in the wild.

Edward Goldsmith

Home truths about the World's Richest Ecosystems

TROPICAL FORESTS ECOSYSTEMS, UNESCO/UNEP/FAO, (Paris 1978) US $60.
THE TROPICAL RAIN FOREST, by P.W. Richards, Cambridge University Press. Paperback £9.95.
TROPICAL RAIN FORESTS OF THE FAR EAST, by T.C. Whitmore, Oxford University Press £15.00
THE SINKING ARK, by Norman Myers, Pergamon Press £4.50
THE EQUATORIAL RAIN FORESTS A Geological History, by J. Flenley, Butterworths £25.00

That there are comparatively few books dealing with the world's tropical rain forests reflects the lack of priority generally given to tropical botany and tropical silviculture right up to the present, and the consequent dearth of reliable information of any sort. Professor Paul Richards' *The Tropical Rain Forest* has long been the classic text on the stucture of that marvellously rich and diverse plant community as it is found in different parts of the world and still remains the only global overview. It is wonderful to see it being republished yet again, this time in paperback, to delight a whole new generation of students and the increasing numbers of people eager to deepen their acquaintance with the tropical rain forest.

T.C. Whitmore decided conciously not to try to repeat or replace Richards' treatise, but the two books should be read together as Whitmore provides news of the latest research findings in the subject and it must be remembered that Richards has not revised his text substantially over the last thirty years.

While Dr Whitmore concentrates on the rain forests of South East Asia, whose study has formed his life's work, there are continual comparisons and references to the forests of Africa and South America. The style is decidedly more technical than that of Richards but the aspiring student of tropical forestry can regard this book as his 'Bible' because of the depth and breadth of coverage given.

The book provides an essential foundation for both the economic use and the conservation of tropical rain forests. It describes the characteristics of tree growth and gives a critical review of current silvicultural systems. A substantial part of the book is devoted to detailed description of the fourteen different types of rain forest and the variation in distribution of species likely to be found within the evergreen lowland rain forest (the richest of them all) throughout the region.

We are made very aware of the need, when delineating national parks or forest reserves, to pay attention to these subtle differences in what is normally thought of as a homogeneous mass of thick green jungle. Certainly, conserving *only* the Amazon rain forest is no substitute for the far richer lowland forests of Peninsular Malaysia now facing complete destruction. The role of the animal kingdom in the life of the tropical rain forest is made an integral part of this book, and in asking C.P. Burnham to write an expert chapter on tropical soils Whitmore has not only assisted in the distribution of perhaps the finest description of the latter but has succeeded in producing a book which is the most comprehensive and definitive available today. The underlying theme that forestry is closely linked with conservation should be heeded as much by foresters as by environmentalists.

The UNESCO State of Knowledge Report on Tropical Forest Ecosystems, with individual chapters frequently written in collaboration by

two acknowledged experts, should have updated Whitmore, given us a global overview for the 1980s, and an appreciation of the socio-economic circumstances which are at the root of the present seemingly mindless reign of forest destruction. Instead we have a 683 page gargantuan which will probably never be read outside the small band of scientists engaged in tropical studies and then perhaps only one or two of the twenty-one chapters or eight regional case studies will be referred to.

The report is not as grounded in the current socio-economic situation of tropical rain forest areas as might have been expected, concentrating instead on a more theoretical approach that will lead eventually to sustained yield production systems (if the forests are still there). The call for urgent work to quantify non-productive or non-monetary forest benefits so as to include them in national development plans and balance sheets is made and is very welcome.

Some contributors fight shy of making definitive statements, e.g. on the threat of pests and diseases to the survival of fast growing plantations, and others will not do so before presenting a plethora of qualifications. This is not to say that there are not occasional forceful statements, e.g. that governments should *demand* proper investigation of the productivity of natural forests before acceding to large scale plantation schemes, or: 'Preserving existing growing stock and growing timber in new forests is therefore of major environmental importance to mankind as a whole.'

The average reader is likely to be lulled by the huge size of the report into believing that we already know a vast amount — the reality is quite the opposite. Both the tropical rain forests and the contributors deserve better than this, and it is to be hoped that UNESCO will produce an abridged and better translated version, at some future date.

Norman Myers is not afraid to 'shoot from the hip' in his passionate call to mankind to safeguard the millions of other species of living things on this planet whose survival is threatened by the childish way in which we conduct ourselves as the dominant animal. The fact that one species could be lost every day at the present time and that this could very well rise to one every hour by the end of the century should jolt the unwary reader and make him realise that Homo sapiens is like a bull in a china shop: destroying everything he touches.

The Sinking Ark is broad in its scope but it is not surprising that as the tropical rain forests are the world's richest ecosystems a large part of the book should be devoted to the factors causing their destruction and to the reasons for their conservation. The book is very well researched and in its attention to current problems in the humid tropics is the ideal complement to the UNESCO Report.

Norman Myers has tried to prevent his text, which is packed with relevant and hard hitting facts, from falling into the trap of abstruseness to which the UNESCO Report succumbed, but sometimes he gets submerged in jargon and slang. The lack of illustrations, tables and diagrams is a pity. But the author knows his subject well enough to rise above both sentiment and idealism. He takes us into the tower blocks and board rooms of the big multinational timber corporations, and he sympathises with Ministers of Forestry in developing nations, always having to justify the existence of their departments in terms of on-the-spot cash income rather than being respected for the long term benefits which the forests under their control are giving to the economy as a whole.

Yet Myers does not stop there. He goes on to make an analysis of the ways in which these long term benefits are being ignored and has some harsh words for international agencies whose development programmes have in the past encouraged deforestation. Conservation has tended to tackle symptoms rather than causes of destructive processes, and it is time to realise that loss of species will have economic consequences for mankind; it is therefore time to plan a measured strategy for conservation, possibly funded by some of the proceeds from current economic use of those areas, e.g. taxes on extraction of non-renewable resources or fees for topping up the genetic make up of U.S. crops from wild plants in the tropical rain forests.

In this, Myers goes further than the UNESCO Report and is to be applauded for doing so. Clearly there is a lot of work to be done to construct a sound programme, but there must be no wagging of fingers at the leaders of tropical countries impoverished by western exploitation, who now have to sell their forests to make ends meet.

As Myers makes plain, the conservation plans for tropical rain forests must consider the refuges — areas to which tropical rain forests retreated in the Ice Ages — as having top priority in Africa and the Amazon. Just because of their long history, the evolution of the tropical rain forests since the time when all the Earth's continents were connected in one huge land mass, is to my mind as fascinating as the diversity of their plant communities or the complexities of nutrient cycling.

John Flenley has written a very interesting and original book which is well illustrated and comprehensible to non-geologists. It reviews most of the studies carried out in the humid tropics but is constrained by the fact that most of them have been in mountainous rather than lowland areas. It will probably become the standard work on the subject and serve to inspire young geologists to study tropical rain forests as much as Richards' book has entranced two generations of botanists.

Alan Grainger

ERRATA

Conservation, Coal and CHP

This booklet published by SCRAM and reviewed in *Other Books Received* last month was erroneously priced at £3.25. Readers please note the correct price is 25p. We apologise to SCRAM for this misprint.

Please note also a mistake on page 228 of part 1 of *Can we Control Pollution?* 'Several hundred nuclear power stations' should read 'nearly forty nuclear power stations functioning at one time'.

Classified

MISCELLANEOUS

WANTED TRANSLATIONS FROM FRENCH INTO ENGLISH. We have a lot of valuable texts in French that badly require to be translated into English for publication in *The Ecologist*. Would anyone interested please contact us at 73 Molesworth Street, Wadebridge, Cornwall.

LOOKING FOR APPROPRIATE ALTERNATIVES. Write for: 'Technologies too Hot to Hold' which includes an interesting bibliography with many valuable sources of information, send 70p. + SAE to: J.A. Farrar, Regenerative Technology, 22 Greywethers Avenue, Swindon SN3 1QF.

The WISCONSIN POWER PLANT CENTER has documented and stored a large data base of information related to environmental impacts of coal-fired power plants. Most of the data, which include station operating data, chemical related studies, assessment of biological effects, chemical transport mechanisms and socio-economic effects, were collected near the Columbia Generation Station near Portage, Wisconsin. We would like to make this data base known to potential scientific and technical users. Please contact for more information the Wisconsin Power Plant Data Center and Water Resources Center, University of Wisconsin-Madison, 1975 Willow Drive, Madison, Wis., 53706.

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