

The Ecologist

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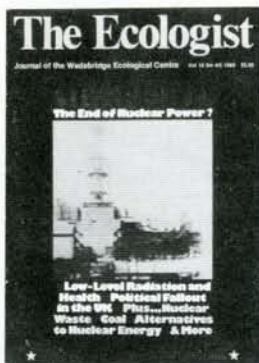
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Sea Level Rise: The Policy Implications

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- Corporate Crime and Pesticides
- Forestry & Famine
- Development—The Cause of the Population Explosion?



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The Ecologist

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Edward Goldsmith

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Science is now 'discovering' the many medicinal and pesticidal properties of substances derived from the neem tree, properties which have been known in traditional societies for many years. This traditional knowledge is now being displaced by modern chemicals vigorously promoted by multinational corporations.

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The Population Explosion: An Inevitable Concomitant of Development

An essential reason why economic development cannot help combat malnutrition and famine is that it must inevitably give rise to a population explosion. The experience has been the same everywhere. As soon as a traditional society embarks on the path of economic development, its population simply explodes. It happened in Britain where the population was under 8 million when the industrial revolution began and where it increased by more than 7 times before it eventually stabilized. It is happening today wherever economic development occurs throughout the Third World.

Our reaction to this problem is always the same. Population growth is interpreted in such a way as to make it appear amenable to a technological solution — the only solution that we as a society are organised to provide, because it is the only solution that involves the production of the sort of hardware that the corporations into which our society is organised can manufacture — the only type of solution, in fact, that is “economic” and hence politically acceptable.

The World Bank estimates that to achieve “a rapid fertility decline goal” in Sub-Saharan Africa would mean increasing the amount of money spent on ‘family planning’ by 20 times by the end of the century. Just think how the export of contraceptive pills, condoms, IUD’s and other forms of birth-control gadgetry will rocket. Is it possible to imagine a more ‘economically viable’ and ‘politically expedient’ solution? But what is the point of providing vast numbers of men and women with expensive birth control devices if, as happens to be the case, they want the children whose birth these devices are designed to prevent? The answer is clearly none at all.

Stable Populations

We tend to forget that the populations of traditional societies were stable for centuries, if not millenia. They had to be, in order to preserve their social structure and their physical environment. The reasons for that stability are clear.

To begin with, traditional society exploited a wide range of cultural strategies — such as taboos against sexual activity during lactation and during the first years of widowhood, or the prohibition against widow remarriage among certain castes in India — which are intended to minimize population growth. However, as a society’s social structure and cultural pattern are destroyed by the process of economic development, such population control strategies can no longer operate which means that the population in question simply grows out of control.

The population of traditional societies is stable for another reason, namely that each individual belongs to an extended family and lineage group (in addition to such diverse social groupings as to age grades, secret societies, etc) which, between them, provided an extraordinary degree of security. What is more, each individual has a right to the land they and their family occupy by

virtue of their status as a member of these groupings. In addition, the agricultural methods used are designed to *maximize security* even at the cost of limiting yields.

Development and Alienation

Development changes all that. In fact, it shatters every aspect of traditional life. Indeed, it is a process which, as Robertson notes, is “more likely to generate unhappiness, violence and tyranny than social harmony.” Esenstadt also considers that because “modernization entails continual changes in all major spheres of a society, (this) means, of necessity, that it involves processes of disorganization and dislocation, with the continual development of social problems, cleavages and conflicts between various groups and movements of protest and resistance to change. Disorganization and dislocation thus constitute a basic part of modernization, and every modern and modernizing society has to cope with them.”

In particular, development destroys a society’s cultural pattern and its associated social structure. The society thus disintegrates and becomes atomized, as in the industrialized world today. Such a society can no longer govern itself, nor provide its members with the security that it previously provided: instead it must now be governed by a government bureaucracy, which previously would have no *raison d’être*. Such a bureaucracy, however, can never compensate people for the inestimable social capital provided to them by the social groupings to which they previously belonged. Nor can participation in the formal economy, usually as grossly underpaid casual workers, compensate people for the loss of their land — which is inevitably taken over to accommodate more economic land uses. All this creates the most terrible misery and insecurity, and in order to survive, people are forced to seek an alternative strategy for providing them with some sort of security, however precarious. One such strategy is to have more children, who can be hired out as labourers or who can even be trained to beg and steal in the cities.

Malthusian Dogma

Interestingly enough, one of the official explanations of the population explosion is that, with development, food production increases, which means that more food is available to the local population which, in a true Malthusian manner, can be counted upon to breed up to the available food supplies. The opposite, however, seems to be true. Thus, although food production has increased in, for example, both India and Zimbabwe in the last decade, this has not meant that more food has been made available to the local population. On the contrary, the food has mainly been produced for export or for consumption in the cities and, in reality, as both Banerjee and Kothari and Jackson point out, less food is available to the rural masses. This was also so in

Ireland, when, during the eighteenth and early nineteenth centuries, the population exploded from two to eight million. During that period, much of the arable land was taken away from the peasants by the big estates, with the result that the peasants had to rely on the potato, the only crop that could feed a family from the small area of degraded land that remained at its disposal. During the course of the 19th century, an increasing proportion of food production in Ireland was exported to England: the exports were in no way reduced during the famine, which killed something like two million people and forced another two million to seek refuge beyond the seas.

The truth seems to be that, in an atomized society at least, the population explodes *not when there is more food to eat (as conventional wisdom tells us) but when, on the contrary, there is less food to eat.*

The Demographic Transition.

Of course, we are assured that development will provide people with a new form of security, one provided by membership of the growing formal economy. As people become more secure, we are told, they will then have less children, as has happened in the West. What the development industry does not tell us, however is that it is economic development that created the insecurity in the first place.

To assume that the 'demographic transition' will occur in the Third World is in any case an act of faith. We are not at all sure why the population rate has fallen in the West. Is the fall in fact due to increased security? Or are other factors implicated, such as the fear of the future which looks ever grimmer? Or even the serious pollution of human spermatazoa which has radically reduced the sperm count of young males in the western world and made a considerable proportion of them 'functionally sterile'?

Moreover, the economy of the Third World is not expanding anything like fast enough to absorb the growing hordes of unemployed in the cities and is never likely to; hence the security that participation in the formal economy could provide is available to an ever smaller proportion of the population. Indeed, the Third World can never conceivably attain the level of material prosperity we know at present in the West, which has indeed been associated (however superficially) with a reduction in fertility.

What is certain is that the much anticipated 'demographic transition' is not occurring in the Third World today. As Lester Brown notes: "The 'demographic transition' that has marked the advance of all developed countries may be reversed for the first time in modern history. African countries have now moved beyond the first stage of this transition, with the equilibrium between high birth and death rates. But virtually all remain stuck in the second stage, with high birth rates and low death rates. In this stage, population growth typically peaks at three per cent or so per year."

If the rate of population growth has fallen slightly in the dry tropics today, it is probably because of an increased death rate from famine, malnutrition and the diseases to which underfed people are particularly vulnerable. Indeed, it is only through such crude means that development can help control the very population explosion that it has itself brought about.

Impact of Consumption

Even if the demographic transition did occur, it could not conceivably solve the real problem. A growing population is not intolerable *per se* but because of the increasing impact it must

have on the natural environment. This impact is greatly magnified by the increase in material consumption made possible by economic development. To seek to reduce population by systematically encouraging economic development is thus self-defeating since it can only increase natural consumption and thus environmental destructiveness.

Edward Goldsmith

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The proceedings of the *Second Annual Camelford Symposium on Gaia and Its Implications for Evolutionary Theory* (held on 2-4th November 1988) will be available by the autumn of 1989.

Global Warming and Rising Sea Levels: the Policy Implications

by
G.P.Hekstra

Many climatologists now accept that the Greenhouse Effect is likely to cause a one metre sea level rise over the next century. This is a highly conservative estimate, taking no account, for example, of the impact of the Antarctic ice shelf melting. Nonetheless, it would still result in major environmental and social disruption. The map of the world would effectively be redrawn: many densely populated areas (with a total population of one billion people) could be flooded; coastal erosion would be severe; salt water intrusion inland would salinize many potable groundwaters; and one-third of the world's croplands could be lost to production. Remedial action is possible, but, if it is to be effective, it must involve radical change to our way of life.

Current scientific opinion is that the planet is at a climatic watershed, between a past climate dominated by natural fluctuations and a future climate dominated by uncontrolled man-made fluctuations. The changes in store may well be much larger, and much more rapid, than anything we have experienced in the past. If so, climatic considerations will have to become an integral part of future agricultural, hydrological and economic planning.

After a century or so of relative stability, global temperatures began to rise around the mid-1960s, since when the global mean temperatures have increased by about 0.3 centigrade.¹ One inevitable consequence of continued global warming is an accelerated rise in sea levels, a prospect which is of considerable concern to nations with coastal lowlands. During the last century, sea levels rose by approximately 0.12-0.15 metres; by contrast, increases of 0.6-4.0 metres are predicted for the next 100 years, and some argue that sea level rises will exceed even this 4 metre upper-bound estimate if the West Antarctic ice sheet breaks up and melts rapidly.

For practical purposes, however, a low and a high scenario for sea level rises of 0.5 metres and 1.0 metre respectively over the next century seems most useful. But, as will be clear from the discussion that follows, such global averages may mask substantial variability among different coastal regions, as well as the effects of storm surges and other intensified perturbations which, in given localities, can magnify the damage caused by rising sea levels to human settlements, croplands and the integrity of ground waters.

SEA LEVEL TRENDS: PRESENT AND FUTURE SCENARIOS

Causes and Rates of Sea Level Rise

A reconstruction of the North Sea coastline since the early Holocene (about 10,000 years before present [BP]) shows that the sea surface rose very rapidly, causing the shoreline to advance inland to its present position (Figure 1).² Between 10,000 BP and 6,500 BP, the sea level rose by as much as one metre per century. Between 6,500 BP and 5,000 BP, the rate

slowed down to 0.37 metres per century. Thereafter, until 4,500 BP, the rate diminished to 0.2 metres per century, after which it fell again over the next 1500 years to around 0.1 metre per century, a rate which remained much the same until about 1900.

The present rate of sea level rise (SLR) is attributed to both the melting of glaciers (and the Greenland ice) and to the thermal expansion of the oceans as a result of global warming. Changes in the mass balance of Antarctic ice will probably have little impact on sea level rise in the next few centuries.³ Indeed, it is possible that an increase in precipitation over Antarctica might even reduce the rate of sea level rise.⁴ The melting of Arctic Sea ice will not contribute to sea level rise.

Estimates for the global sea level rise in the past century range from 0.10-0.15 metres.⁵ The values, corrected for glacio-isostatic rebound — that is, the springing up of the land mass under its lightening load of ice — show considerable spatial variation (0.8-3mm per year), implying that other poorly defined tectonic or oreographic (mountain-forming) effects are important in determining local rates of sea level rise.⁶ These effects are illustrated in Figure 2, which shows regional average annual sea level anomalies at a number of sites around the world.⁷

Apparently the most pronounced changes are experienced along the Atlantic coast of North America and the least pronounced along the East coast of Asia. The great variability in sea level along the west coast of Central and South America can be correlated with the Southern Oscillation/El Niño phenomenon. A fairly constant rate of sea level rise is found in the Indo-Pacific Region. Barnett calculated that the rate of sea level rise almost doubled over the period 1920-1980, compared to the fifty years before. This sea level rise is likely to continue and, indeed, to accelerate further.

The time required for the temperature of the ocean's surface to reach equilibrium with a warming atmosphere is considerable. As a result of the 'thermal inertia' of the oceans, most of the expected warming attributable to the trace gases already released into the atmosphere by man has probably not yet occurred. Such inertia makes a nonsense of adopting a "wait and see" approach to controlling future emissions of carbon dioxide and other trace gases. Projections of the potential sea level rise to about 2100 range between a few decimetres to one or more metres. Hoffman⁹ et al., for example, suggest a minimum rise of 0.57 metres and a maximum rise of 3.68 metres.

Were the atmosphere to retain more of the carbon dioxide

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emitted each year, together with a very high proportion of other trace gases, and were this to coincide with an increase in solar luminosity by 0.5 per cent, a sea level rise of 4.29 metres would be possible.¹⁰ A worst-case scenario, assuming the disintegration and rapid melting of the west Antarctic Ice shelf could cause the sea level to rise about six metres. Oerlemans and Van der Veen¹¹ have argued that this extreme case is not likely to occur in the next century. The widely accepted analysis of De Q Robin¹² is 0.80 metres by 2100, with a possible range from 0.20-1.65 metres. The greatest uncertainties stem from the delays inherent in ocean warming and also the possibility of more intensive snowfall over Antarctica.^{13,14}

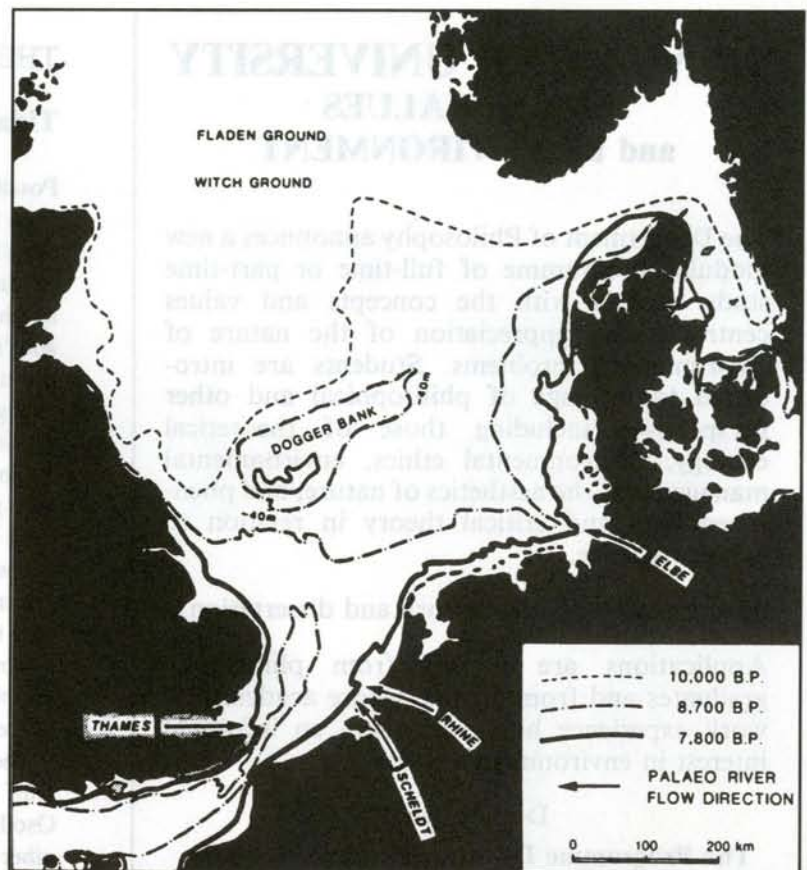
It thus appears that the future contribution from the melting of glaciers and Greenland ice will probably be the most important determinants of sea level rise over the next century,¹⁵ whereas on a local or regional scale isostatic adjustments, tectonic movements and sedimentation or subsidence through mining activities may become significant factors determining the relative change of sea level.¹⁶

For all practical purposes, it seems realistic to assume that, over the next century, sea level rises will range between a low of 0.5 metres and high of 1.0 metre. A scenario of 5 metres can be regarded as the "worst-case" for the next century, but as a real possibility for the next three to five centuries. The fact that the sea level has risen by 65 metres in the last 10,000 years (Figure 1) makes these numbers less fanciful than they would otherwise appear.

Meteorology and Sea Level Rise

Superimposed upon the above trends are changes in sea levels determined by short-term meteorological factors. A pressure fall of 1 mbar (the mean atmospheric pressure at sea level is about 1013 mbar) causes 0.1 metre sea level rise. During a series of rapid, sequential barometric lows (depressions) or a single longer-lasting depression, a sea level rise of up to 0.3 metres is not uncommon. Christiansen et al.¹⁷ found interannual variations in the sea level at locations in Denmark of 0.13 metres, monthly variations of 0.55 metres and diurnal variation to more than 0.5 metres. Along Chinese coasts too, the high sea levels have occurred during years with strong depressions and rainfall. Levels up to 0.3 metres higher than normal during very rainy seasons are usual and during typhoons surges up to 4.7 metres regularly occur. In one case, at Shanghai, the sea level rise was 5.74 metres above normal.¹⁸

Wind direction and wind speed can also greatly influence observed water levels, particularly in bays and estuaries. Under gale force winds at Wilhelmshafen, the sea level has varied by as much as 3.5 metres above normal tide levels, depending on the wind direction.¹⁹ Danish wind statistics for the periods 1876-1925 and 1931-1960 show that the frequency of north-west winds decreased in favour of winds from the west and south-west. More re-



(Above) Figure 1. Holocene shoreline changes in the North Sea region, showing approximate shoreline positions for: (a) 10,000-10,300 years before present (BP); (b) 8,700 BP; and (c) 7,800 BP. Sea levels were respectively 65 metres, 36 metres and 20 metres below the present mean sea level. SOURCE: S.Jelgersma, in Schuttenhelm and Wiggers, *The Quaternary History of the North Sea*, Uppsala University, 1979.

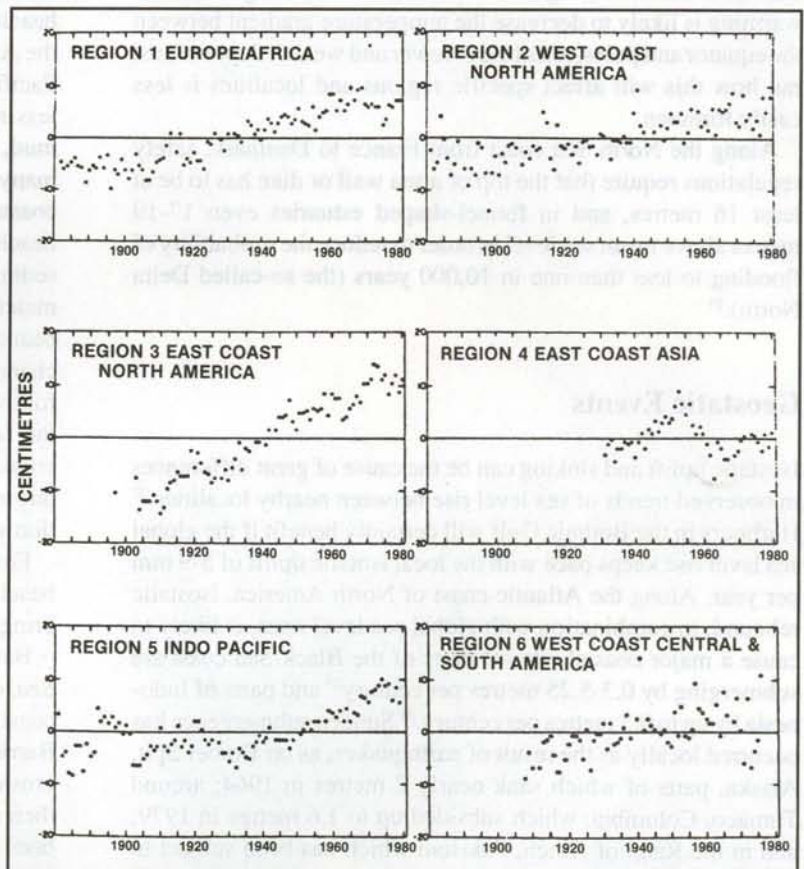


Figure 2. Regional averages for sea level rise, showing annual anomalies. SOURCE: T.P.Barnett, 'The estimation of "global" sea level change: A problem of uniqueness', *The Journal of Geophysical Research*, 89 (C5): 7980-7988.

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cently, the north-west winds have returned and the number of storms is increasing again.²⁰ At the global level, greenhouse warming is likely to decrease the temperature gradient between the equator and poles, resulting in fewer and weaker depressions, but how this will affect specific regions and localities is less easily foreseen.

Along the North Sea coast from France to Denmark, safety regulations require that the top of a sea wall or dike has to be at least 16 metres, and in funnel-shaped estuaries even 17-19 metres above mean sea level in order to reduce the probability of flooding to less than one in 10,000 years (the so-called Delta Norm).²¹

Geostatic Events

Isostatic uplift and sinking can be the cause of great differences in observed trends of sea level rise between nearby localities.²² Harbours in the Bothnic Gulf will certainly benefit if the global sea level rise keeps pace with the local isostatic uplift of 5-9 mm per year. Along the Atlantic coast of North America, isostatic rebound, in combination with global sea level rises, is likely to cause a major coastal retreat. Parts of the Black Sea coast are submerging by 0.3-5.25 metres per century²³ and parts of Indonesia by up to 0.3 metres per century.²⁴ Sudden submergence has occurred locally as the result of earthquakes, as on Homer Spit, Alaska, parts of which sank nearly 2 metres in 1964; around Tumaco, Columbia, which subsided up to 1.6 metres in 1979; and in the Rann of Kutch, Pakistan which has been subject to recurrent tectonic subsidence.²⁵ These effects are not necessarily indicative of the changes that would accompany a more gradual but sustained sea level rise.

THE MAJOR IMPACTS OF SEA LEVEL RISE

Tidal Shifts

Possible changes to tidal systems due to rising sea levels have been investigated for the North Sea.²⁶ and tide system calculations have been made for the present situation and for sea levels 2.5 and 5 metres higher and 2.5 metres lower. At higher levels, and hence greater water depths, waves will be generated faster and 'tidal amplitudes' (that is, the difference between high and low tides) will increase. Despite causing only small amplitudinal changes, a sea level rise of just one metre will nonetheless bring about important changes in the currents of the Wadden Sea behind the Barrier Islands.²⁷

In particular, the new currents will alter existing patterns of sand transport, erosion and sedimentation. If sedimentation keeps pace with rising sea levels, assuming there is available material, a shallow bottom will break the waves when they roll onto the coast. However, it is calculated that a 5 metre sea level rise over an unchanged sea bed would increase wave height along a typical sandy dune coast from 0.9 metres at present to 2.1 metres.²⁸

The impact of tidal shifts on major oceanic currents like the Gulf Stream, and the pattern and frequency of the Southern Oscillation is probably negligible, but the opposite effect — in other words, the impact of changing currents on tidal shifts and sea level rise — can be important.

Coastline Regression

Along rocky coasts, the sea is usually deep, with only narrow beaches of boulders and gravel. In such places — for example, the Atlantic coasts of the British Islands and Scandinavia or the Pacific coast of Chile — the rise in sea levels would have much less impact than along lowland coasts of more erodable sands and mud, such as are found in the southern North Sea, the Baltic Sea, many deltaic lowlands of the Mediterranean and many more coastal swamps, marshes and wetlands around the world. A beach that has attained equilibrium with coastal erosion and sedimentation processes will respond to a sea level rise by losing material from the upper part of its profile and gaining it in the nearshore area, until a new equilibrium is established.²⁹ The changes to the beach profile is usually initiated by storms, and is followed by finer adjustments at each high tide. Bird has listed the factors that favour the initiation or acceleration of beach erosion — for example, the reduction of sand supply to the shore due to constructions of breakwaters, sea walls and other protection works.³⁰

From Belgium to Denmark, the coastline has sand dunes with beach slopes of 1:60 to 1:80. A one metre sea level rise would bring about a coastline regression of 60-80 metres.

Barrier island coasts, such as those found along the Wadden Sea, or off Texas, Florida and along many stretches of the west coast of Africa, are affected differently by rising sea levels.³¹ The Barrier Islands in the Wadden Sea, for example, suffer constant erosion on their exposed coast, with sand being deposited on their more tranquil beaches, except where coastal defenses have been erected. In tropical areas, where coral reefs are often an integral part of low-lying barrier islands, and where sand supplies are insufficient to keep pace with rising sea levels, it is more likely that barrier islands will be drowned altogether. In the

Mississippi Delta — an area which is not only subsiding at an overall rate of some 2 mm per year (with some areas subsiding up to 12 mm per year), but where sand is also in short supply — the offshore barrier islands decreased in size by 44 per cent between 1955 and 1978, and have effectively 'migrated' inland.³²

Rising sea levels will cause coastal lagoons — that is, bays which are partly or wholly sealed off from the sea by deposits of sediment and which have salinity gradients from fresh river inflow through brackish water to sea water — to be trimmed back and/or to become more saline.

In river deltas and estuaries, sediment transport from inland is the main factor determining the impact of rising sea levels. If sediments are trapped in upstream reservoirs, deltas will change into estuaries and rising sea levels will help in the process of eroding away deltaic deposits. The tidal volume of the river mouth or estuary will increase, until a new equilibrium is established between the widened mouth or inlet and the rates of sedimentation and erosion. The Mississippi Delta, with its accelerating land loss of 100 km² per annum, is an example of this process.³³

Since the building of the Aswan High Dam, the Nile delta is shrinking because the sediments previously deposited there are now trapped in the dam's reservoir.³⁴ Elsewhere in the Mediterranean, similar processes have now been described for the Ebro,³⁵ the Gulf of Cadiz,³⁶ the Venetian area³⁷, the Po delta and the northern Aegean.³⁸ They will no doubt be found, on a smaller or larger scale, at the deltas of hundreds of rivers where dams have been constructed. Rising sea levels will cause such deltas to disappear more quickly, unless they are protected by coastal defense works.

The still growing deltas of such big Asian rivers as the Ganges-Brahmaputra system in Bangladesh, the Irrawaddy (Rangoon) and the Mekong (Cochin-Saigon) are likely to be affected differently again. Almost all tropical coasts are naturally protected by mangroves (salt tolerant forest swamps), but such mangroves are rapidly disappearing throughout Asia, Africa and Australia because of land reclamation, fishpond construction, mining and waste disposal (see *The Ecologist*, Vol.18, Nos 2/3, 1988). Where they survive, mangroves form a living barrier against sudden sea surges, trapping sediments and protecting the coast behind them.

In many cases, mangroves have allowed the coastline to advance, with salt marshes and fresh water communities following in succession as sedimentation builds up the substrate to appropriate levels, forming an intertidal deposition terrace.³⁹ This is particularly so in Bangladesh, where sediments washed down from the Himalayas have led to the build up of islands in the Bay of Bengal. However, the destruction of the mangroves (known locally as "sundarbans") is taking place at an appalling rate, and although mangroves regenerate quickly in areas that have been abandoned and would likely recolonize suitable habitats as the sea level rises, present land use practices will prevent this.

On the Asian coasts, the land immediately behind mangroves is commonly used intensively for fish ponds and rice fields. It is this area that would, barring human intervention, be colonized by mangroves retreating as sea levels rise and sand replenishment is diminished. In drier areas, such as in northern Australia, mangroves are backed by bare, hyper-saline plains, and in these areas a sea level rise will result in the colonization by mangroves of presently unvegetated tracts as the coastline retreats.⁴⁰

The way in which coastal nations will respond to a relatively

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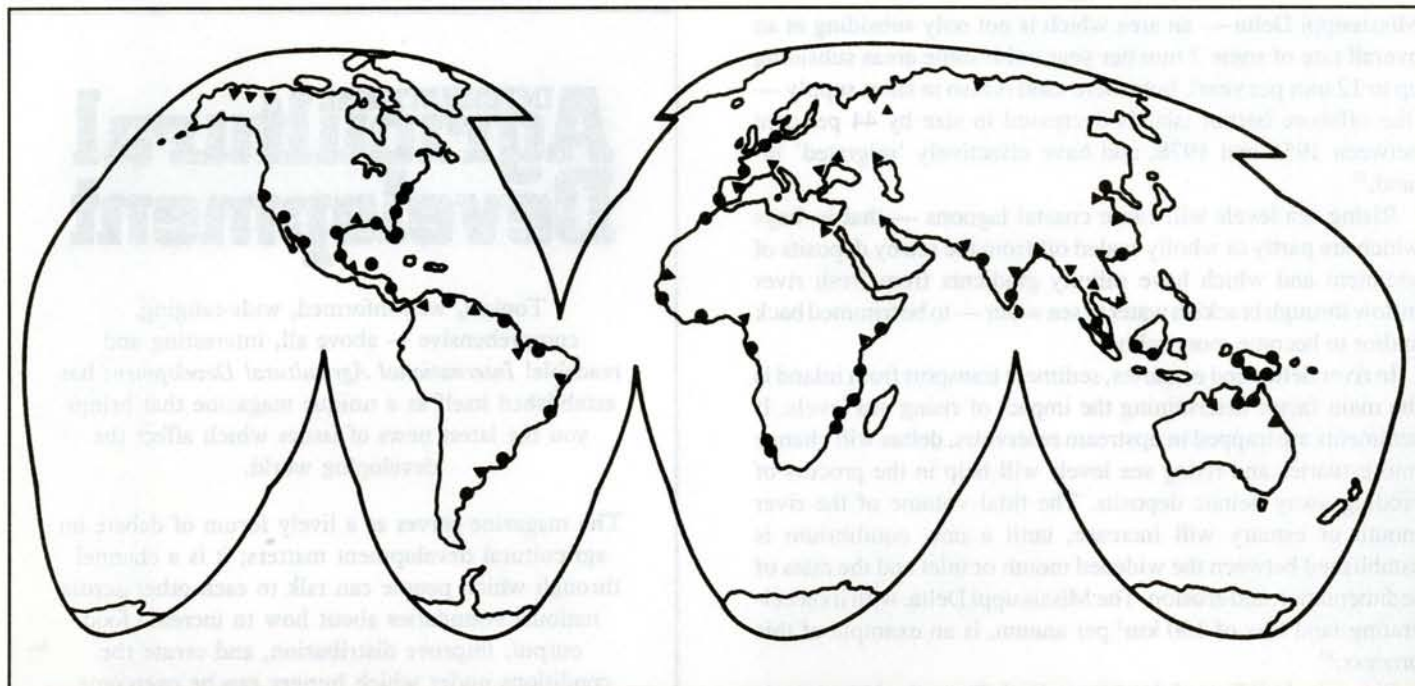


Figure 3 : Areas in the world vulnerable to rising sea levels.
(Source: S.Jelgersma, 'Geological Survey of the Netherlands', Paper presented to Workshop on the Impact of Sea Level Rise, Delft Hydraulics Laboratory, 1986.

rapid sea level rise will vary considerably according to economic and political factors, in particular population pressure. The reaction of industrialized countries, including Japan, Korea, Taiwan, Singapore, South Africa, Australia and New Zealand, is certain to differ from most of the coastal nations of Asia and Africa. Within large developing countries, such as Argentina, Brazil and India, certain areas will likely be protected and others abandoned. In highly industrialized countries, too, there will be a limit to the price which governments are prepared to pay to protect coastal stretches, some of which will undoubtedly be left to be flooded. Close to urban and industrial centres and densely populated agricultural coastal plains, massive expenditures on coastal protection schemes are more likely to be considered. The Vilan Plain in northeast Taiwan is one such area and considerable sums have already been spent to protect the region's intensive agriculture.⁴¹

In the Gulf of Thailand, specifically the Bight of Bangkok, rising sea levels could cause the coastline to recede by several hundred metres, displacing coastal villages and depriving many people of their land and resources. The protective mangrove fringe has already been largely cleared, and, inland, irrigation canals are now affected by salt water intrusion and storm surges from the seaside. Many of the existing rice fields have become brackish fish ponds, but there seems little chance that funds will be available for constructing defensive sea walls, such as those which have been built in the Netherlands.⁴²

At certain points along the Caribbean coast of South America, similar but less dramatic processes have been reported. Most alarming is the situation in the state of Rio de Janeiro, where the onslaught on the mangroves is virtually uncontrolled.⁴³

Indonesia is a country worthy of special discussion. Possessing 15 per cent of all the world's coastline, at least 40 per cent of its land surface is classified as vulnerable to rising sea levels.⁴⁴ In addition, it is one of the world's richest countries in terms of its wetland ecosystems, both in size and diversity.⁴⁵ However, the government's Transmigration Programme (see *The Ecologist*, Vol 15, Nos 2/3) is now moving millions of people

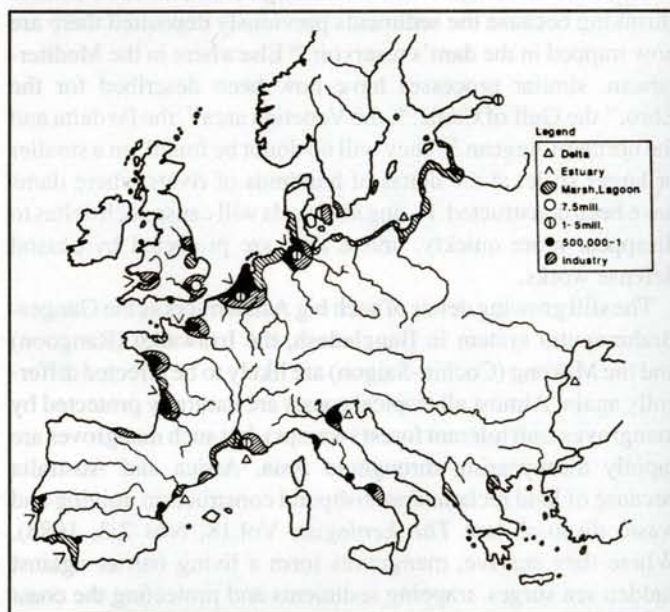


Figure 4: Areas of Europe vulnerable to rising sea levels. The circles indicate major population.

(Source: S.Jelgersma, 'Geological Survey of the Netherlands', Paper presented to Workshop on the Impact of Sea Level Rise, Delft Hydraulics Laboratory, 1986.

from the overpopulated islands of Java and Bali to the tidal swamps of Sumatra and Kalimantan (Borneo). There, the immigrants face serious problems — from rapidly declining soil fertility, to compaction, biochemical oxidation and toxification and salt water penetration — when they attempt to farm these areas. Sustaining agriculture is already now problematic⁴⁶ and will be even more so with a rising sea level.

Salt Water Intrusion

The intrusion of salt water is a well known phenomenon in all coastal lowlands, and will become an increasing problem as sea levels rise. In the Netherlands, where the impact of intrusion has been well studied,⁴⁷ salt water now penetrates at least 50 kilometres upstream of the mouth of the River Rhine, contaminating

groundwaters in locally reclaimed areas of land. As sea levels rise, sea water will enter groundwaters further inland in areas below or close to the sea level.

In tropical countries, the loss of agricultural land to sea water intrusion can be partially compensated by turning, for instance, lost paddy fields into fish or shrimp lagoons, which can be equally productive and economic and require less maintenance costs.

Loss of Coastal Ecosystems

Marine intertidal zones are of great significance as hatcheries for fish, fry, shrimp, oysters and other biota that also serve as food for geese, ducks and wader birds. This water-locked wealth is now threatened almost everywhere, but in combination with rising sea levels, the impact for humans of the degradation or disappearance of intertidal zones will become still more dramatic in future.

The likely impact of rising sea levels on coastal ecosystems can be partially gauged by studying the effects of subsidence along parts of the Black Sea coast and in the Wadden Islands (in particular Ameland) due to the mining of natural gas and oil. At Ameland, the coastline has subsided by 0.26 metres over 20 years. Coastal erosion is greatest along the North Sea shore, and in the Wadden Sea the intertidal flats are now dry for much shorter periods at low tide. Groundwaters beneath the dunes are rising closer to the surface, while salt water intrusion into the groundwater is increasing. In addition, rising sea levels will cause the area where birds can forage on the marshes and slicks to decrease progressively. The dune vegetation, in particular in the dune valleys, is also likely to shift to dryer and more salt tolerant types.

The full economic impact of these changes to intertidal zones has yet to be assessed, since the ecosystems cannot easily be valued in economic terms.

THE IMPACT OF SEA LEVEL RISE ON SOCIETY

Affected Areas

The length of coastline in the world is between 500,000 and one million kilometres. A rise in sea level of approximately one metre could potentially affect all land up to the 5 metre contour line, if maximum storm surges and the effects of salt water intrusion along river mouths are taken into account. The area potentially affected is thus in the order of five million km² — about three per cent of the land area of the globe, *but one third of the total area of cropland in the world*. Much of the threatened land is densely populated and includes many large cities: indeed, as many as one billion people may be at risk.

Figure 3 gives the general areas in the world vulnerable to a sea level rise of 1 metre, and Figure 4 gives a detailed map for Europe.⁴⁹

It need hardly be said that rising sea levels will affect not only engineering structures and land and property, but the entire socio-economic system of a country. The manner in which societies respond to the impact of rising sea levels will be determined by a mix of conditions. Many other problems compete for the attention of decision-makers. Major factors influencing policy decisions are: the vested interests that are threatened, the availability of finance, the employment opportunities, political

responsibilities and national prestige. Sadly, experience dictates that only disasters trigger counter-measures, even if there is prior warning and awareness of a problem. And even then, measures can take decades to be implemented. After the major 1953 flood in the south of the Netherlands, for example, it took until the early 1960s before the so-called 'Delta' flood protection plan was started. Coastal defenses throughout the country will only be brought up to the new delta safety requirements in the early 1990s (at a total cost of about US \$8 billion).

The ISOS Model

Delft Hydraulics Laboratory has developed a model for predicting the impact of sea level rise on society. Known as the ISOS project, the model is intended to enhance national and regional awareness of the problem and to develop strategies for responding to the impact of increased sea levels.

The model's approach is technocratic; indeed, a notorious omission from the model is any assessment of the value of the natural ecosystems at risk. The most important impacts considered relate to land losses (both in terms of area and capital value); to the costs of flood control measures; the damage incurred to water resource projects, and to shipping and port systems; and the impact of increasing salinity due to seepage on agriculture and on drinking water.

Preliminary Results for The Netherlands

Rijkswaterstaat Netherlands has already tentatively calculated the cost of a one metre sea level rise, assuming that defence is the policy option chosen rather than a planned retreat or abandonment of the threatened land. The cost of building new defences will be about twice the present cost of maintaining existing coastal defences. The construction of dikes, dunes, beaches and shorelines over the next century will cost about US \$3 billion: in addition, there will be maintenance costs, currently running at about \$30 million per year. A storm surge barrier in the Rotterdam Waterway, now being studied as an alternative for the urgent and costly strengthening of the dikes of the lower rivers, becomes all the more attractive with the prospect of a sea level rise. Inland adaptations to one metre sea level rise are estimated to cost US \$3 billion, primarily for pumps and other changes in infrastructure. Dredging costs will increase by about \$5 million per year. Adaptation of harbours, locks, bridges etc., will cost about \$500 million. In all, the total cost of adapting to a one metre sea level rise is likely to amount to \$5-6 billion, spread over about 50 to 100 years.⁵⁰ For comparison, the Delta Works cost about \$7.5 billion over 30 years.

Global Costs

It appears then as if the Netherlands could cope technically and financially with a prospective sea level rise of one metre over 50-100 years. But the Netherlands is somewhat unique in already having well-developed coastal defences: moreover, it is obvious that many developing countries lack the financial resources of the Netherlands and have much longer coastlines to protect.

Countries in North America, Europe and other regions with heavily industrialized coastlines have started preliminary and very crude cost assessments of the impact of rising sea levels.⁵¹

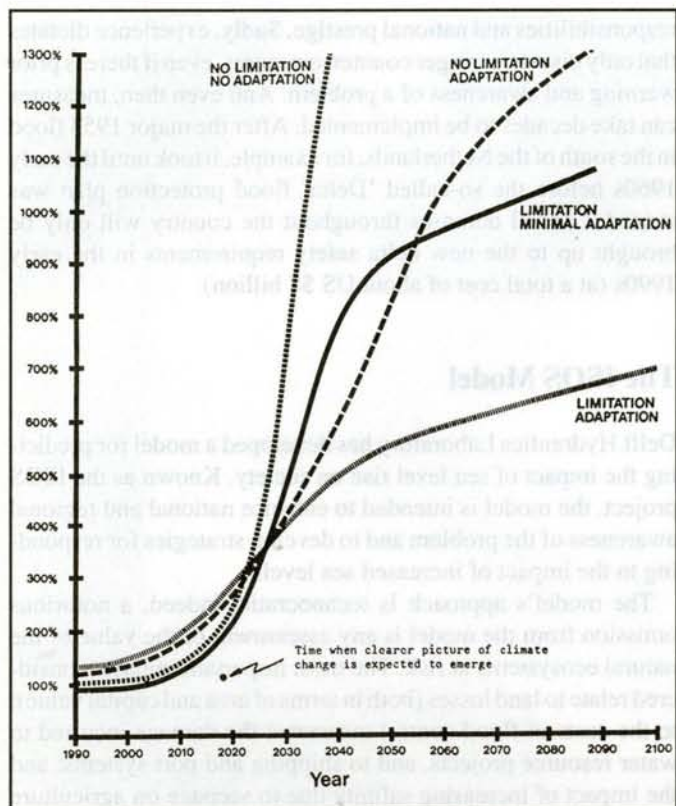


Figure 5: Approximate relative costs for management of rising sea levels (expressed as percentages). No Limitation: no action on greenhouse gas emissions. Limitation: reduce emissions by 2 per cent per year. No Adaption: retreat from coastal damage. Minimal Adaption: ad hoc measures after disasters. Adaption: selective coastal engineering measures.

Source: P. Vellinga, 'Sea level rise, consequences and policies.' Paper for the Villach workshop, 28 Sept.-2 Oct. 1987, Beyer Inst. Stockholm.

It is nonetheless still extremely difficult to come up with a figure of total global costs which are likely to be incurred.

One way to express global costs is as a percentage of the present costs of protection and maintenance. The first attempt of this kind was undertaken by Vellinga⁵² at a meeting of the UNEP-WMO-ICSU Advisory Group on Greenhouse Gases held in Villach, Austria. Figure 5 shows the results of this assessment.

Four scenarios are assumed. The lower bound estimate assumes that all the nations of the world join in a strenuous effort to limit the greenhouse effect and to implement immediately appropriate defences against rising sea levels. By contrast, the upper bound assumes that no attempts are made at limitation or adaptation, thus resulting in astronomical costs within 40-50 years. The intermediate scenarios assume either that unlimited emissions of greenhouse gases are accompanied by a positive adaptation programme or that greenhouse gases are limited to some extent and that only minimal adaptation is attempted. It seems most likely that some countries will emphasize limitation and others adaptation, and that the world at large will do a little of both, but not as much as might be necessary.

Figure 5 is based on two assumptions: (1) that the future costs of climatic change, and sea level rise in particular, are already clear enough to justify action; and (2) that the measures needed to abate or adapt to climatic change and rising sea levels must be accomplished within the next 3-4 decades if they are to be effective in time. The results imply that, regardless of the scenario chosen, the relative costs and impacts will be about the same until 2025-2030, but will diverge widely thereafter. However, the lack of divergence until 2025-2030 should not be taken as an argument for postponing decisions until then. The critical period for response will still be in the order of 3-4 decades.

Recommended Action

The Advisory Group on Greenhouse Gases has proposed that a number of actions be taken in response to the threat of climatic change. Of these, the most important are:

- **Immediate steps to limit greenhouse gases in the atmosphere.** This would involve:
 - accelerating the schedule for reducing CFC emissions;
 - revising long-term energy strategies;
 - increasing reforestation and halting deforestation;
 - controlling CH₄, N₂O and CO₂ emissions.
- **Limiting the impact of sea level rise through:**
 - identifying vulnerable areas;
 - preventing further developments in vulnerable areas.

More detailed recommendations have been made by the World Resources Institute, which suggests various strategies for controlling emissions of CO₂, CH₄, N₂O and CFCs. Several others have also presented proposals similar to those of the WRI.⁵³

Yet, even with the best technological innovations and with societal adaptations, there will be a slow build-up of greenhouse warming by 2075 of between 1°C-3°C. With only modest policies (involving the use of best available technologies only) the greenhouse warming by 2075 will be between 2°C-6.5°C. If no action is taken, the warming will be between 3°C-8.5°C.

Five Key Areas

Five major areas for action stand out as essential for controlling the rate and extent of climatic change. These are:

- Controlling those industrial chemicals that affect stratospheric ozone and the radiative balance of the atmosphere;
- Maximizing energy efficiency and the use of renewable energy sources;
- Minimising land-use changes that contribute to climate disruption, for instance through altering the albedo of the earth's surface, or through adding greenhouse gases to the atmosphere;
- Improving the resilience of the biosphere, for example by protecting vegetative cover to enhance CO₂ uptake by photosynthesis;
- Abandoning current concepts of "development", which as presently implemented can only result in environmental and social disruption.

Controlling Industrial Chemicals

Table 1 (page 12) summarises the main trace gases implicated as a cause of climate change. Of these, the halogenated hydrocarbons are only a few decades old. The world, even modern societies, have done without them for years and could dispense with them again. Not all of them are equally potent in affecting

ozone and climate, and the harmless ones could be cleared for use after proper and internationally agreed screening. Collectively the halogenated hydrocarbons are responsible for 80-90 per cent of the ozone problem and 20-30 per cent of the greenhouse problem. Even if banned today, their impact will continue to be felt at least into the middle of the next century because of their long life spans in the atmosphere (1-3 centuries).⁵⁴ Nonetheless, they are all man-made and thus (in theory) easy to control. Arrhenius⁵⁵ has listed the possibilities for reducing the use of the halogenated hydrocarbons (see Table 2). He has urged a complete ban on all halons (brominated halocarbons), on CFC-12, CFC-11, methyl chloroform, CFC-113, CFC-114 and CFC-15.

According to the 1987 Montreal Protocol, emissions in 1993 must be 20 per cent lower than in 1987, and in 1998 50 per cent lower than in 1987. By 2000, atmospheric CFCs will thus still have increased by 50 to 100 per cent. Much sharper targets therefore have to be negotiated.⁵⁶

Energy Efficiency and Renewable Energy

Few subjects cause more heated discussion than future energy demand and use. Bach⁵⁷ discusses three possible scenarios. Of these, the 'Oakridge A' scenario, as developed by Edmonds et al.,⁵⁸ and the 'Efficiency Scenario', developed by Lovins et al. (1981-1983),⁵⁹ are the most pertinent. 'Oakridge A' projects a growth in fossil fuel use from 7.83 TW in 1980 to 159 TW by 2100. This would lead to a 22-fold increase in CO₂ emissions from 1980 to 2100.

The 'Efficiency Scenario', by contrast, follows a least-cost

strategy, implying that currently available, cost-effective and efficient energy technologies will be introduced over the next fifty years. The scenario adopts a slow reduction rate initially, on the assumption that a rational energy policy will have to overcome many obstructions, and a faster reduction rate later on when the implementation of the myriad possibilities have picked up momentum. The overall reduction rate is 3.2 per cent per year. This leads to a significant reduction of fossil fuel use and the cumulative CO₂ emission is 1/33 that of the 'Oakridge A' scenario.

The potentials for maximizing energy efficiency are manifold:

- Only 32 per cent of the energy produced through centralized power generation is used: the rest (some 68 per cent) is wasted as heat. In power/heat co-generation systems, 85 per cent of the energy produced can be used and only 15 per cent wasted.
- With automobiles, the average fuel consumption is 10-12 litres/100 km, with the best available car on the market using 5 litres. Yet fuel consumption in the best available prototype is close to 2-3 litres/100 km.
- With household electrical appliances, improvements in energy efficiency of up to 50 per cent can be achieved, whilst in heating and cooling systems improvements of up to 80 per cent are possible. In construction materials and buildings, improvements between 30 and 50 per cent could be obtained.

Renewable energy sources (such as hydropower, solar energy, wind power, and geothermal power) offer a mixed bag of possibilities. Yet there is every reason to be confident that by 2000 all the renewables together could produce 2 TW, with 5 TW by 2030 and 10 TW by 2050, depending on the political will to invest in them.

If we also succeed in greater efficiency of end use, the total world energy demand by the middle of the next century could potentially be covered by renewables only.

Land Use and Greenhouse Gases

A survey of how land use changes contribute to the greenhouse effect has been recently given by Bouwman.⁶¹ Changes in vegetation (for example, deforestation) influence reflectivity (albedo), in addition to hydrological cycles (evapotranspiration and precipitation), and, via clouds, the solar radiation balance. Soils under wet conditions, as in marshes and paddy fields, emit methane, and under dry conditions carbon dioxide. Nitrous oxide is emitted from a wide range of soils by microbial transformation of nitrate or ammonia from manure and synthetic fertilizer.

From pre-agricultural time to the present, the distribution of land-cover has changed greatly.⁶² Carbon released into the atmosphere from forested lands which have been cleared for agriculture makes a major contribution to the greenhouse effect. This transfer is largest in the tropics, but as temperate and boreal forests become increasingly affected by acid rain and by the shift of bioclimatic zones, they will soon become potent contributors. Methane has been found to be rapidly increasing in the atmosphere⁶² and, per molecule, it is 30 times more potent than CO₂ as a greenhouse gas.⁶³ Table 3 shows emission rates as a result of various land uses.

Nitric oxide (NO) and nitrogen dioxide do not absorb infrared radiation, but NO plays a role in the destruction of ozone. Nitrous oxide is per molecule about 200 times as potent as CO₂ in causing

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Table 1: Summary of the main trace gases influencing climate

Characteristics	Gases						Total
	CO ₂	CH ₄	N ₂ O	CFC11	CFC12	O ₃	
Man-made sources	Fossil fuel burning, deforestation, soil destruction	Cattle biomass, rice paddies, gas leaks, mining	Fossil fuel burning, cultivation & fertil. of soils, biomass burning	Foam, aerosol, refrigeration & air cond., other uses	Refrig. & air cond., aerosol, foam, other uses	Indirect through photochemical processes	
Current emission rate (1970-1987)	16 000 - 29 000 (Mt)	135 - 395 (Mt)	16 - 28 (Mt)	330 (kt)	440 (kt)		
Sinks and removal processes	Ocean, biosphere	Reaction with OH, soil uptake, loss to strat.	No sink in troposphere, loss by photolysis in stratosphere			In trop. due to CO, NO _x , CH ₄ , HC; in strat C10 _x , HO _x , NO _x , BrO _x	
Current conc. in the atmosph. (1985/86)	346 ppm	1.7 ppm	0.31 ppm	0.20 ppb	0.32 ppb	0.02-0.1 ppm in trop, 0.1 - 10 ppm in strat.	
Atm. residence time (yrs)	ca. 500 (atm/bio/upper ocean)	7 - 10	165 - 185	ca. 65	ca. 110	hrs to days in trop., 1 hr in upper strat.	
Current conc. growth rate (1980), %/yr	ca. 0.4	1.0 - 1.2	0.2 - 0.3	ca. 5	ca. 5	increasing in trop. decreasing in upper strat.	
Future conc. growth rate (1980-2030), %/yr	0.24 - 0.98	0.23 - 1.40	0.31 - 0.81	1.16 - 4.95	1.04 - 4.99		
Future conc. in the atmosph. (2030)	381 - 551 ppm	1.9 - 3.3 ppm	0.35 - 0.45 ppm	0.5 - 2.0 ppb	0.9 - 3.5 ppb		
Contrib. to temp. °C incr. 1880 - 1980 %	0.50 - 0.61 68 - 63	0.11 - 0.20 15 - 21	0.02 - 0.04 2 - 4	0.02 - 0.03 3 - 3	0.04 - 0.05 6 - 5	0.04 5 - 4	0.73 - 0.97 (0.74 - 0.99)
Contrib. to temp. °C incr. 1980 - 2030 %	0.35 - 1.60 52 - 51	0.07 - 0.36 10 - 11	0.06 - 0.21 9 - 7	0.02 - 0.27 3 - 9	0.03 - 0.51 4 - 17	0.14 21 - 5	0.67 - 3.09 (0.70 - 3.31)
Contrib. to temp. °C incr. 1880 - 2030 %	0.85 - 2.21 61 - 55	0.18 - 0.56 13 - 14	0.08 - 0.25 5 - 6	0.04 - 0.30 3 - 7	0.07 - 0.56 5 - 14	0.18 13 - 4	1.40 - 4.06 (1.44 - 4.30)
Climatic effect of one molecule relative to CO ₂	1	ca. 20	ca. 200		ca. 10 000	ca. 2 000	

Source: W. Bach, 'The endangered climate. Report No. 15', in F. Krause and W. Bach (eds), *Energy and Climate Change: What Can Western Europe Do?*, Report for the Netherlands' Ministry of Housing, Physical Planning and the Environment, 1988.

Table 3: Methane emission rates

Source	CH ₄ emission (x10 ¹² g y ⁻¹)
waterlogged soils (paddy rice)	70-170
organic soils (peat)	25- 70
landfill sites	30- 70
oceans/lakes/other biogenic	15- 35
intestines of ruminants	70-100
termites	6-42/2-5
exploitation of natural gas	30- 40
coal mining	35
biomas	55-100
other nonbiogenic	1- 2
total	337-664/333-627

Source: A.F. Bouwman, Draft background paper for the international conference on 'Soils and the Greenhouse Effect' to be held in Wageningen, The Netherlands, August 14-18, 1989. International Soil Reference and Information Centre, Wageningen, 1988.

Table 4: emission of N₂O for major land cover types

land cover type	Emission rate (10 ⁻⁴ gN m ⁻² h ⁻¹)	global emission (10 ¹² g N)
tropical rainforest	1.0 -2.0	6.2-12.4
tropical seasonal forest	0.1 -0.4	0.6- 2.5
temperate deciduous	0.05-0.2	0.3- 1.2
temperate coniferous	0.1 -0.4	0.6- 2.4
boreal	0.1 -0.4	0.6- 2.4
woodland	0.05-0.2	0.3- 1.3
savanna	0.05-0.15	1.3- 4.0
tundra/grassland	0.05-0.15	0.3-27.6
cultivated land	0.02-2.0	0.9
marsh/swamp	0.5 *	11.1-54.7
total		

* assuming flooded conditions during half of the year

Source: as Table 3.

Table 2: CFC Reduction possibilities

	Aerosol propellant	Refrig. & air-cond.	Heat pumps	Indust. foams	Freeze preservative
Change to less persistent CFC	★	X	X	X	X
Change to non-CFC	X	—	—	—	—
Change system	X	X	X	★	X
Closed recycling	—	★	★	★	★
Avoid new CFC systems	★	★	★	★	★

Source: E. Arrhenius, *Policy questions on reducing emissions of CO₂, CH₄, N₂O and CFC's*. Paper presented at the European Workshop, Noordwijkerhout, Netherlands, 16-21 Oct. 1987. Key: X = Best option; ★ = Second best option; — = Not relevant

greenhouse warming.⁶⁴ It is a by-product in both the nitrification of ammonia and the denitrification of nitrates in soils by microbial processes, and escapes easily into the atmosphere, particularly from well aerated (ploughed) soils. Under anaerobic conditions (as in wet soils), N₂O gets reduced to N₂ which then escapes into the atmosphere. Bolle et al. estimate global emissions of N₂O from soils at 7.8-11.9 x 10¹² grams of nitrogen per year.⁶⁵ Table 4 summarizes estimated emission rates and global emissions of nitrous oxide for major land cover types.

The loss of nitrogen fertilizer as N₂O usually occurs within a few weeks after application and more rapidly for ammonia-based fertilizers than for nitrate-based ones. Based on the total production rates for mineral fertilizers, the global loss in the form of N₂O is estimated at 0.5-2 per cent.⁶⁶ With a total nitrogen fertilizer consumption of about 74 x 10¹² grams, total N₂O emissions from fertilizer amounted to 0.7-3.0 x 10¹² grams Nitrogen/year.⁶⁷ The total global emission — the oceans, fossil fuel burning and lightning included — may range between 12-15 x 10¹² g N/yr.⁶⁸

In view of its potent radiative influence, and the rapid increase



Hurricane winds batter the Florida coast. With the Greenhouse Effect, hurricanes will become more frequent, adding further to the stress that rising sea levels will place on coastal defences.

in the use of artificial nitrogen fertilizers all over the world, the growing apprehension over nitrogen emissions is thus well-founded.

Reducing Greenhouse Gases

Energy consumption must be reduced if the process of global warming is to be curbed. The ceiling of 2 centigrades by 2100 can be reached by implementing Lovins' "Energy Efficiency Scenario" for CO_2 , in combination with the "Low Trace Gas Scenario" for CH_4 , N_2O and CFCs, developed for the Montreal Protocol of 1987.

The most painful part of the decision making process is the allocation of the required emission reduction rates by source and by country.⁶⁹

Strengthening the Biosphere

Where deforestation and desertification increase albedo (reflectivity) and reduce evapotranspiration, re-greening the earth should serve to accomplish the opposite. Equally important, permanent and stable vegetative cover reduces emissions from the soil of all those gases that contribute to greenhouse warming. In addition, it will increase the uptake of CO_2 due to photosynthesis.

Dyson and Marland have calculated that to absorb the 20,000 million tons of CO_2 currently emitted every year into the atmosphere, an area of 7 million square kilometres (roughly the size of Australia) would have to be planted.⁷⁰ Assuming a net primary productivity of 600 tonnes/ km^2 for temperate evergreen forests, and 900 tonnes/ km^2 for tropical rain forests, and assuming that new forests would store 60 per cent of the carbon absorbed, some 5000 million tons of CO_2 per year could be removed from the atmosphere (one quarter of the current annual emission).

Unfortunately, instead of forests increasing in area, tropical deforestation (as well as forest dieback in northern and mid-latitudes) continues at an unprecedented rate, robbing the world of potential carbon sinks.

Changing Perceptions and Life-styles

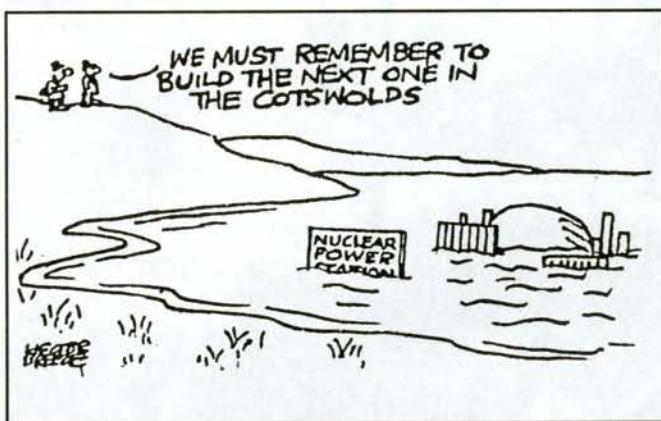
Goldsmith⁷¹ has argued that current concepts of development are self-serving, and are intended to bring Third World countries within the orbit of international trade (dominated by the West through the World Bank and International Monetary Fund). 'Development' is thus tuned to creating clients for western types of consumer goods, which are not only wasteful in terms of energy and raw materials, but whose production destroys indigenous cultural and societal coherence.

As a society's social structure and cultural pattern are uprooted and destroyed by 'development', population control strategies are no longer operative and the environment becomes over-exploited. Goldsmith thus argues that, rather than exporting western values and life-styles to the Third World, industrial societies should reconsider their own wasteful lifestyles (70 per cent of the world's fossil fuels, for example, are used by the industrialized world) and re-learn, among other things, to do more with less.

Indeed, the truth is that the world is facing an interlocking crisis, of which the Greenhouse Effect is just one aspect. And that crisis cannot be solved without radical changes to the way we live.

Among the interlocking threats facing us, the World Commission on Environment and Development (WCED)⁷² sees the following as the most pressing:

- the widening gap between the rich and poor nations;
- the desertification each year of 6 million hectares of arable land;



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Nuclear Power - A Victim of Greenhouse Warming?

The majority of Britain's nuclear reactors are at risk from sea level rises. In East Anglia, Sizewell is situated in a low-lying area suffering from isostatic subsidence. At Hinkley Point, in Somerset, adjacent drained marshlands and periodic storm surges (notably in 1910 and 1981) render the complex vulnerable to flooding.

Even at current sea levels there is a risk of storm surges in East Anglia. In 1953, sea levels rose by up to 4 metres, producing widespread flooding. Sizewell 'A' is situated just a few metres above sea level, on a coastline where sea levels are rising twice as fast as the global average, due to subsidence.¹ Sizewell 'B' will be only slightly higher at 6.5 metres above sea level.² The reactor at Bradwell, Essex is even lower than the Sizewell plants, and lies just outside the areas designated as 'Risk Level 9' flood zones by East Anglia Water Authority. Flood emergency plans do not specifically cover nuclear installations. The probability

of a recurrence of the 1953 floods is put at once every 1,000 years by the National Rivers Authority/Anglia Water Authority. However, this does not allow for the impact of global warming.

An Accident of Horrific Proportions

Existing and proposed nuclear reactor sites at Hinkley Point are respectively about 10 and 15 metres above sea level.³ Although these levels are higher than those referred to in East Anglia, the tidal regime at Hinkley is very different, so that a rise in sea level of only 30 centimetres "would effectively threaten a neap spring tide flooding of the reactor site which could cause an accident of horrific proportions."⁴ A rise in mean sea level of 25 centimetres is a strong probability over the next 40-50 years and an increase of up to 95 centimetres a possibility.⁵

Storm surges powerful enough to knock out a nuclear plant's auxiliary power systems could, in the extreme, cause several major systems failures

at once. In the case of a defuelled reactor (in the early stages of decommissioning), flooding could cause the release of radionuclides from less well protected site facilities, and seawater corrosion of concrete structures. If the reactor was being opened up for stage three decommissioning, the contamination of in-rushing floodwaters would pose an extremely grave threat. Even without flooding, raised sea levels could raise water table levels and lead to the intrusion of saline groundwaters, which could then attack the concrete base of a reactor containment building, and release radionuclides into water resources inland. Concrete is known to degrade rapidly in seawater in the presence of sulphate and chloride ions.

Although some precautions against flooding are being taken at CEBG coastal sites (for example sea defences at Hinkley), the East Anglian sites are poorly defended. At Sizewell, dunes are being reprofiled and stabilised by vegetation to a height of 10 metres above sea level² — the 1953 surges would have reached nearly half this height and given their force could probably have breached the dunes. By the time that the decommissioning of Sizewell 'B' is due to be completed in the early 22nd century, sea levels are predicted to have risen by up to two metres,⁵ without allowing for the melting of the West Antarctic ice. It is obvious that the risks to the reactor from flooding and damage from surges and saline groundwater intrusion will increase considerably.

Sea Defences

Many of the above mentioned risks could be reduced by sea defences. However, these would be expensive to con-

struct, and often have a poor record of endurance. Protection of very large areas may well be too costly to contemplate. There is no evidence that such considerations have been taken seriously in siting policy for existing and proposed nuclear facilities by either the CEBG or the relevant emergency planning authorities.

The cost of adequate sea defences and other on-site measures to protect a nuclear plant over the 130-years of its operation and decommissioning would add enormously to the unforeseen nuclear costs now discouraging private investors.

It is supremely ironic that nuclear power, often cited as a solution to the Greenhouse Effect, could yet prove to be a victim.

Paul Hatchwell

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- the destruction each year of 11 million hectares of forest;
- the spread of acid rain with industrialization;
- greenhouse warming;
- the already accelerating rise in sea levels;
- the alarming rate at which the ozone layer is being destroyed;
- the rapid rise in human and animal cancers;
- the uncontrolled disruption of food chains and mineral cycles;
- the unprecedented mass extinction of plants and animals.

The WCED rightly points out that compartmentalized or sectorial attempts to solve the above problems are doomed to failure. To

this end, the Government of the Netherlands has convened a world conference of ministers of the environment (The Hague, 5-7 November 1989) with the aim of developing a global policy for reducing greenhouse gas emissions and protecting the atmosphere. The question is whether governments have the political will to co-operate in a global response to the threat confronting them.

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Dried out river bed and eroded hillsides in Ethiopia, the consequences of upland deforestation. To pay off its international debts, Ethiopia is clearing the last of its forest remnants to plant more coffee.

Forestry and Famine: Arguments Against Growth Without Development

by
Laurence Roche

Since Independence, African nations, encouraged by Western 'development' institutions, have engaged in a desperate race for economic growth. The terrible costs of this race are now being realised in terms of famine, war and environmental degradation. A new concept of 'development' is needed, one which is responsive to the culture and needs of the African peasant, and which casts off the current fixation for huge capital-intensive projects which favour only urban elites and Western industry.

"A direct attack on rural poverty through a widespread revolution, green or red, is improbable, and would as in the past have mixed effects. A better life for disadvantaged rural people may be more feasibly sought through a different sort of change: through quiet personal revolutions in the perceptions, values and choices of professionals concerned with research technology and action for rural development."

Robert Chambers,
*Beyond the Green Revolution.*¹

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In 1974 during the time I was living in Ibadan, Nigeria, a small book by Basil Davidson was published, entitled *Can Africa Survive: Arguments Against Growth Without Development*.² It made little impact and I have never seen it on anybody else's shelf. Nevertheless, the title and thesis of this paper are in part taken from that book, for almost everything I have seen and heard during the past 15 years of work and extensive travel in many African nations confirms Davidson's assessment of that continent's troubles. His proposals for their resolution are, however, open to question; but more of that later.

Why is there so much political instability, injustice and hunger in so many Afri-

can nations at the present time? Why is there such massive destruction of natural resources, such as forests, upon which so many people depend for their very survival? Why is traditional husbandry, both of soil and water, almost everywhere neglected? Why is it that what has been done by the international community so far has had little or no effect in arresting the general impoverishment of people and the land and water resources that sustain them? Why is drought, or as it is more rightly described, 'deviations below the mean rainfall', identified as the cause of famine in African states, when foresters and others have long forecast catastrophic decline in food production as a consequence of massive deforestation? More

than forty years ago a distinguished French forester with profound experience of African conditions wrote:

"We are witnessing the death struggle of a plant world, slow stages in the drying up and degeneration of tropical Africa...it is probable that the wholesale destruction of inland forests will accelerate deterioration of vegetation and soil in Africa and bring about acute desert conditions ...The insidious thing about it is that, generally speaking, nobody seems to realize it. In much the same way that the friends of a very sick man, who has been an invalid for years, get used to seeing him in an ailing condition that they forget that once he was in perfect health. They cease to perceive the slow encroachment of the disease until one day the sick man dies."³

Why have these prophetic words by a man of such experience and distinction as Aubreville had such little effect on the African funding policies of international and national agencies like the World Bank?

Unprecedented media treatment of drought and famine, and the compassionate response of millions of individuals, has resulted in large sums of money being collected for the relief of famine. But the multitude of words and images generated has pushed aside a deeper analysis of the causes of famine in our time which might provide answers to at least some of the above questions.

Given the great complexity of the subject, I am well aware that the following analysis is offered at the risk of appearing both simplistic and dogmatic. My remarks relate primarily, though not exclusively, to the highly populated and semi-arid lands south of the Sahara.

Deforestation and Rural Impoverishment

The prosperity of traditional African husbandry in times past has been vividly described by early explorers. Travelling across Africa between 1795-1797, from Gambia through the territory of the present-day states of Senegal and Mali, the explorer Mungo Park was repeatedly struck by the agricultural prosperity and ecological richness and diversity of the region:

"We passed a large town called Kabba, situated in the midst of a beautiful and highly cultivated

"Education, training, research and development in agriculture in the tropics, are still locked in conventional attitudes and policies that have been determined by historical accident rather than the needs of rural people. Most aid programmes in agriculture reinforce these attitudes and policies."

country; bearing a greater resemblance to the centre of England than to what I should have supposed had been the middle of Africa. The people were everywhere employed in collecting the fruit of the shea butter tree from which they prepare the vegetable butter mentioned in former parts of this work. The kernel is enveloped in a sweet pulp, under a thin green rind; and the butter produced from it, besides, the advantage of keeping the whole year without salt, is whiter, firmer, and, to my palate, of a richer flavour than the best butter I have ever tasted from cows' milk. The growth and the preparation of this commodity seem to be among the first objects of African industry in this and neighbouring States, and it constitutes a main article of their inland commerce."

More than 180 years later, the states through which Park travelled are now among the most ecologically and financially impoverished nations in Africa. The shea butter tree, or what is left of it as a species, is still in its wild state, endangered, unselected, and unknown to the world's planners of green revolution technology.

This tree is a symbol of the decline and destruction of traditional husbandry over much of the tropics. Its history can be repeated many times over for other woody species throughout the region. Such species have received the attention of neither agriculturalists nor foresters, and, despite some small improvement in recent years, education, training, research and development in agriculture in the tropics, are still locked in conventional attitudes and policies that have been determined by historical accident rather than the needs of rural people. Most aid programmes in agriculture reinforce these attitudes and policies.

The Leviathan of western agricultural

science, technology and commerce has historically concentrated on an extraordinarily small number of plant species. From the beginning of colonial times this Leviathan, without change of direction or modification of any significance, has been extending its power to tropical environments where it has forged the green revolution, a high energy, essentially urban, mass-production technology not easily transferable to most small scale peasant farming systems in sub-Saharan Africa.

The shea butter tree had no significance in world markets in colonial times and was, with many other comparable food and fodder trees, ignored. All effort then and since has concentrated on commodities familiar in world trade and well-known to western science, such as wheat, rice, maize, coffee and tea. In the meantime, the ecological bases of small scale, traditional farming systems, and related, sustainable natural resources husbandry, such as that described by Mungo Park, have been — and still are — being destroyed over much of the tropics.

Ignoring Traditional Husbandry

Traditional forms of land husbandry have not been assisted or given the opportunity to evolve to higher technological levels. They are now an over-taxed, impoverished and neglected sector, albeit a sector employing the majority of African people. The resulting exodus to cities and its political consequences inaugurate the familiar pattern of increased emphasis on green revolutionary technology, often with direct involvement of the public sector (state farms etc.), and low food prices artificially maintained through government marketing boards. Over much of the tropics, the small farmer does not obtain the market price for his products due to the urban bias of these policies. A vicious circle of increased penury and increased social and political instability in the rural areas is established without any improvement in the quality of life in the urban.

Scientists, planners and politicians have simply not grasped the fact that the survival of a large number of small-scale peasant farming systems over much of sub-Saharan Africa depend on the continued existence of natural forest vegetation, woodlands and trees. For this reason, the appalling consequences of deforestation in terms of human deprivation have not been foreseen. In Tigre and Wollo, regions of endemic famine in Ethiopia, whole mountain catchment areas and huge areas

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of farmlands on the lower slopes are denuded of forest vegetation and massively eroded. Low rainfall in these has exposed both the underlying collapse of the ecological bases of peasant agriculture in countries such as Ethiopia, and the inadequacies of an urban/industrial-based Green Revolution with its limited options in crop production.

The number of plants currently used in modern agriculture is less than a fraction of one per cent of the flora of the earth. Less than 10 higher plant species of the earth's estimated 250,000 account for more than 70 per cent of the total cash receipts from crops of the member states of the Organisation for Economic Cooperation and Development (OECD).

Man has hardly begun to explore, conserve and manage for his own benefit the genetic resources of tropical and sub-tropical forests, though these forests provide habitats for the richest plant genetic resources on earth including many of the centres of origin of major food crops. Ironically, famine-stricken Ethiopia is one such centre.

Forestry, Energy and Food

Despite the adverse changes that have taken place in African ecology since Mungo Park's time, rural communities in the tropics still depend for many of their basic commodities on what is left of natural forest vegetation.

Two thousand million people, that is roughly three-quarters of the population of developing countries, depend on fuelwood and other traditional fuels for their daily domestic energy needs. Of these, 100 million are unable to satisfy their minimum energy requirements. A further 1050 million meet their needs by depleting the existing resource. By the year 2000 at least 500 million people will be unable to satisfy their minimum energy requirements.⁴

Traditional forestry practice has not been concerned with fuelwood production and since the Second World War has established mainly large-scale industrial plantations for pulp and paper. The Green Revolution in agriculture is not concerned with fuelwood production. Yet it is certain that for the foreseeable future peasant farmers in sub-Saharan Africa must grow their own fuelwood supplies.

There are at least 300 million people practising shifting cultivation in the tropics, sustained by the continued existence of primary, secondary and degraded forests. Many more millions practise some

form of sedentary agriculture but also continue to depend on the remnants of natural forest vegetation for food, fodder, fuelwood, building poles and other forest products. In India alone, it is estimated that 60 million tribal people are sustained in their traditional way of life by the continued presence of natural forest ecosystems.

Over 1500 species of wild plants, many of them woody species, are used by local people in the tropics as leafy vegetables. In Nigeria, field assessments have shown that there are 150 species of woody plants used by local people for a variety of nutritional purposes.

Trees as sources of food are often of the utmost importance in times of crop failure or scarcity. Trees, unlike annual crops, do not die when rains fail or are below average. In western Sudan in 1985 the fruits of the naturally occurring tree species, *Balanites aegyptiaca* and *Boscia senegalensis*, may have accounted for about the same calorific intake as all the food aid delivered to the area during the same period.⁵

Time and again, one reads that the forestry sector contributes one to three per cent of the gross domestic product of particular developing nations. Such statistics, which appear even in documents concerned with fuelwood supplies, invariably refer only to the quantified and monitored industrial sector, and more often than not, do not include values of other forest products including fuelwood. Yet it is certain that, for the well-being of millions of rural people, the industrial forestry sector is often the least important fraction of the overall contribution of forests, woodlands and trees. The value of trees in the provision of fuelwood, building poles, food and fodder; in the ecological underpinning of traditional agriculture and in the conservation and management of water resources, is rarely, if ever, properly quantified in national planning.

At a time when per capita agricultural production is decreasing over much of the tropics, and when chronic famine prevails in Africa from Senegal to Somalia, it is time to question the official statistics and the basic assumptions of development which lie behind them.

Growth At All Costs

Following Independence, most African nations, aided and abetted by the international development banks, have committed themselves whole-heartedly to growth, and during the past 25 years of unrelenting materialism in the West, who could blame

"Scientists, planners and politicians have simply not grasped the fact that the survival of a large number of small-scale peasant farming systems over much of sub-Saharan Africa depends on the continued existence of natural forest vegetation, woodlands and trees."

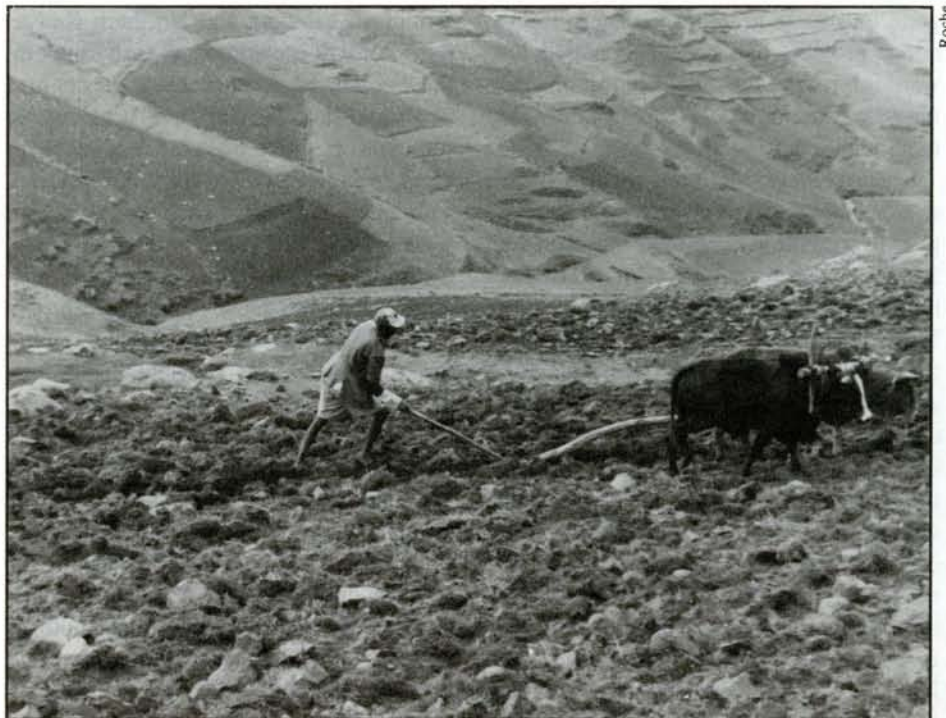
them? But growth without development is one definition of cancer. It can occur in nations as in individuals, and anyone who has visited Lagos and similar cities in the Third World will know what I mean.

"Duly encouraged by foreign advice, the essential idea of African nations about national development has been to draw up a list of desirable projects of things that modern countries were thought to need, and call this a plan. The task then was and is to tout it around the world till this necessary 'aid' was raised. Usually the totals that were raised fell a long way short of what was asked. But even what was raised then flowed into a system which belonged in all essentials to the colonial period. Such money flowed, that is, into an elitist structure concerned with its own enlargement, rather than with overall development for the mass of the population."²

In many African countries, a miscellany of growth projects, often lacking any form of logical integration with each other or with the rural economy, has taken the place of carefully thought out strategies of national development. The beneficiaries of this have been primarily the industrialized nations.

The West pointed the way, and the post-independence growth boom, fueled by cheap energy and massive imports, was launched. Cities grew grotesquely, and burgeoning urban elites achieved Rostow's fifth dimension of growth,⁶ defined as mass consumption, whilst for the vast bulk of the people the quality of life either declined or remained almost untouched within traditional societies and subsistence agriculture.

The entrepreneurial trading power of industrial nations, geared to the interests of urban governing elites in essentially agrarian countries, is in my view by far the most



The traditional farmer is the backbone of agriculture in Africa. Yet his knowledge and skills have been dismissed by the international development agencies.

important factor influencing urban growth and rural impoverishment in the Third World in general and in African countries in particular.

In comparison with the effects of this trading power, frequently given impetus by international development agencies, the bilateral aid programmes of the major powers are at best very small palliatives of human suffering, and at worst mere public relations exercises facilitating the real business of selling everything from powdered milk to gigantic, ecologically and socially destructive dams and canals, not to mention armaments of every kind.

In the philosophy of growth-at-all-costs, the small farmer and his family are deemed a hopeless case. One can not sell him anything since he has no money to buy, and he is 'ignorant', 'conservative' and 'un-teachable'. Let him disappear and let large, mechanized farms, either state or private, feed the cities and his disinherited children. If this view is not always stated, it is certainly implicit in the policies followed. Research and development in agriculture are directed not to small farming systems but to cash crops and high yielding cultivars of rice and maize, which need high inputs of water and fertilizer, and are beyond the use of the small farmer.

Disastrous Development

With western advice and money the Sudan, referred to by representatives of the

World Bank in recent years as "the Bread Basket of Africa", has ventured into one gigantic growth project after another - often in the teeth of contrary advice from Sudanese scholars in the University of Khartoum.

Mechanized farming projects, encouraged and funded by the World Bank, have repeated all the ecological errors of the Tanganyika groundnut scheme in the 1950s. Seven million acres of natural acacia forest were bulldozed and replaced by a mechanized sorghum monoculture. The net discounted revenue was finely calculated and expatriate experts gave freely of their advice. Within three years the scheme was abandoned and the World Bank is now seeking to rehabilitate the bulldozed and ravaged land with alternative agroforestry schemes.

Irrigated farming along the Nile has been progressively mechanized. Traditional manual and animal power has been replaced with pumps, but with no fuel or spare parts available, probably fifty per cent of the land is now lying idle, while in the south the 300 km, Jonglei Canal is being built at an enormous cost. The Sudan also has the distinction of building, with the encouragement and support of a well-known multinational company, the largest and most sophisticated sugar processing factory in the world, designed to produce sugar at a cost vastly inflated above world prices.

The question must surely be asked: If the millions of borrowed dollars that have

gone into these grandiose western-influenced projects had been channelled toward improving the output of established farming systems, would there be famine in the Sudan today?

Unfortunately, there are many similar examples of western inspired and funded growth projects in countries other than the Sudan. The Manantali Dam, in addition to making the Senegal river navigable from Mali to the sea, will provide the irrigation for farms, each of at least 1000 hectares, at a cost of millions of dollars. Wheat, rice and barley — all crops alien to the region — will be cultivated in place of the traditional crops of sorghum and millet. The new crops will feed the people of the cities of Dakar and Bamako now accustomed to the taste of imported cereals. Mali, with one of the most impoverished peasantries in Africa, has been provided with the loans, goods, services and encouragement to proceed with this enterprise. The traditional husbandry and culture of a vast number of small farmers in the basin of the Senegal will be destroyed as a consequence of this project.⁷

This is but one of the many examples where complex mosaics of traditional food crops and tree legumes are being replaced by monocropped systems of comparatively less efficient cash crops such as rice and wheat. A much narrower range of food and other plant products is therefore available for local use, with a corresponding reduction in the self-reliance of the rural population, particularly during periods of low rainfall. In the absence of leguminous field trees, these crops require heavy applications of costly commercial fertilizer. Fertilizer requirements are further increased because the mineral nutrients contained in the crops are lost to the ecosystem when the crops are removed. It has been estimated⁸ that in some areas the shift to mechanized, large-scale monocultures has reduced the human carrying capacity of the land from 25-40 individuals/km² to 10-20 individuals/km².

Debt and Ecological Destruction

Such projects have many adverse ramifications, one of which is the increase in demand for foreign currency to service debts and to pay for massive imports of goods of every kind including, increasingly, food. To earn such currency, Ethiopia is clearing the last of its forest remnants to plant more coffee, and Kenya is clearing another 50,000 hectares of what is left of its virgin forest to plant more tea. The

famine in Ethiopia and Northern Kenya does not halt the spread of cash crops in these countries, nor does it halt the continued imposition of grandiose projects, as remote as possible from the real needs of local communities. On the edge of Lake Turkana in northern Kenya, one can visit what is, according to the representatives of the industrialized nation that built and supplied it, the most sophisticated fish processing plant in the world. Predictably, it has proved wholly unsuitable to the needs of the locality. It is now abandoned and trees grow through its windows. It stands as a bleak monument to the folly and culpability of those representatives of western nations who have either learned nothing from past mistakes or are unaware of them, or who are aware of them, but are cynical enough to sell their technology however unrelated to the real interests of nations.

Continental Famine

The consequences of growth without development are now everywhere apparent in Africa. But it has taken famine on a large scale — famine televised into western sitting rooms — to bring home to the western world that something is radically wrong.

Africa is fast losing the ability to feed itself. In 1984, 140 million of its 531 million people were fed with grain from abroad. In 1985 the United Nations reported that some 10 million people had left their villages in search of food, with many of them crowded into relief camps.⁹

In addition to declining per capita food production and income, Africa's foreign debt is growing rapidly, not least because of rising food imports. The region's cereal import bill climbed from \$600 million in 1972 to \$5.4 billion in 1984, a ninefold increase. By 1984, food imports claimed 20 per cent of total export earnings. The cost of servicing the continent's debt consumed 21 per cent of export earnings in 1986.¹⁰ Clearly the way ahead for the industrial nations of the world, if they are serious about eliminating the causes of famine, rather than merely reacting to its effects, cannot, and ought not to be, business as usual.

A Possible Way Forward

There is some hope that lessons have at last been learned as a consequence of the worldwide publicity given to famine in Ethiopia. Even the World Bank appears to

have lost its certainty in the effectiveness of its operations. Its Vice-President has stated: "We along with other donors, I think it is fair to say, among all our achievements, have failed in Africa. We have not fully understood the problem, we have not identified the priorities, we have not always designed our projects to fit both the agroclimatic conditions of Africa and the social cultural and political framework of Africa".⁹

I have referred earlier to Basil Davidson's book, and indicated that while I subscribed to his thesis concerning the causes of Africa's troubles, I disagreed with his conclusion, namely that the continent's difficulties can only be resolved within the confines of socialist states. Surely this is as simplistic a solution as the *laissez faire* capitalist one, and Pope's dictum springs to mind:

"For forms of government let fools
contest
Whate'er is best administered is
best"

There is a way forward, long recognised and articulated,¹¹ which though requiring elements of both ideologies is not ideologically motivated. Once again we begin to hear what may be called a 'Gandhian philosophy of development' discussed in the corridors of power. The planners do not, of course, refer to it as such, for these modes of thought are being forced on them by the collapse of former policies and not because of knowledge of Gandhi's philosophy or a conversion to it.

And what is this Gandhian philosophy? I gave what I thought was a very short but reasonable version of it in a paper delivered in Ibadan, Nigeria, in 1973 at a United Nations Symposium on Soil and Shifting Cultivation in Africa. This was 15 years ago and before the first widely publicized famine in Ethiopia. Since I believe it still holds good, I will repeat it here:¹²

1. Through agriculture, however primitive, every environment has taught its inhabitants a certain way of life:
2. Attempts at improved agricultural output, to be successful sociologically and not merely in terms of output statistics, must take into account the way of life, customs and needs of the peasant farmer:
3. The technological change that must in time occur in tropical agriculture is best introduced by stages, particularly when the utilization of available labour is

low and the drift from the rural areas to the cities is high:

4. Rapid industrialization and expansion of agricultural production for market are not synonymous with improving the welfare of peasant peoples in the tropics:

5. Although the traditional structure of subsistence agriculture is unsuitable in the long run for commercial farming, designed to feed large, non-food producing urban populations, output can be considerably improved within familiar traditional patterns of production:

6. Structural change is necessary only when output can no longer be increased within the traditional forms of production. However, when this stage is reached, technological change is likely to be evolutionary and thus less disruptive of the rural welfare of peasant peoples.

Here we have a framework for the opening up of what I have called a "second front" in agricultural research and devel-

opment in African states. This second front will concentrate on small-scale farming systems and community needs, and research and development programmes will include those neglected plants traditionally valued by local communities. It will ensure the conservation of the natural forest estate and the management of rangelands, and give greater attention than ever before to the role of trees in sustaining farming systems and providing rural people with fuelwood, food and fodder, while protecting vitally important catchment areas and arresting soil erosion. Forestry in all its ramifications must become an integral part of agricultural development in African states.

Conclusion

Until local people are given a say in their own destiny; until it is recognised that growth is not the same as development; until agricultural production by the mass of the population is seen to be more important or at least as important as mass agricultural production; and until Western nations are prepared to forgo some of their selfish interests, there can be no major improvement in the present system.

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EQUADOR'S DEBT CRISIS THREATENS TROPICAL FORESTS - ABANDONED BY DEVELOPMENT BANK



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Editors

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Corporate Crime:

Can we Trust Industry-Derived Safety Studies?

by

Samuel S. Epstein

The control of pesticides in most industrialized countries relies heavily on safety data supplied by the manufacturers. Such a regulatory system can only be effective if the companies conducting and reporting the studies honestly disclose any adverse findings. The record shows, however, that all too often company executives and their scientists knowingly suppress or manipulate information which could affect the licensing and sale of their product. A case in point is the manipulation of health studies relating to the pesticides Heptachlor and Chlordane by the US chemical giant Velsicol.

It is generally assumed that the data base on toxic chemicals generated by industry provides a reliable basis for the scientific evaluation of their public health hazards and for governmental regulation. In fact, as has been documented in detail, this is generally not the case.^{1,2} A critical, but not atypical, illustration is provided by an evaluation of the track record of Velsicol Chemical Company, the sole manufacturer of the ultrahazardous, carcinogenic and highly persistent hydrocarbon pesticides chlordane/heptachlor (C/H). These were widely used for agricultural purposes in the U.S.A., until they were phased-out following cancellation and suspension hearings in 1974, when, on the basis of the prolonged hearings, the Environmental Protection Agency (EPA) determined that their continued use posed an "imminent hazard" due to their carcinogenicity.

Termite Treatment

The use of chlordane and heptachlor for treating termites in homes — a major use in the U.S.A and elsewhere — was however exempted, as the Agency accepted the industry's misleading assurances that subterranean application of the chemicals did not result in human exposure. The pesticides have thus been used extensively for termite treatment in tens of millions of homes in the U.S., with a resulting high incidence of contamination, thus posing major carcinogenic, besides other, hazards. They were finally withdrawn from commerce in the U.S. in 1988, but are still extensively used for agricultural and other

purposes in many countries, such as for the control of Argentine ants in Western Australia. The use of chlordane/heptachlor is widespread in the Third World.

Failure To Test

Velsicol has conducted its chronic toxicity, carcinogenicity and reproductive toxicity tests on chlordane/heptachlor exclusively by oral administration. This route precludes determination of the incremental effects of the high concentration in technical chlordane/heptachlor of a wide range of volatile ingredients, besides additives and contaminants. The continuing failure of Velsicol to undertake chronic inhalation tests is consistent with its failure to publish information on the composition of technical chlordane/heptachlor, and to warn and label with regard to their volatile ingredients. Even in the absence of such information, the National Academy of Sciences strongly recommended the need for:

"long-term animal inhalation studies (as) the primary route of human exposure is inhalation. Biologic endpoints to investigate in these studies included neurotoxicity, carcinogenicity, effects on blood forming tissues and teratogenic and reproductive effects."³

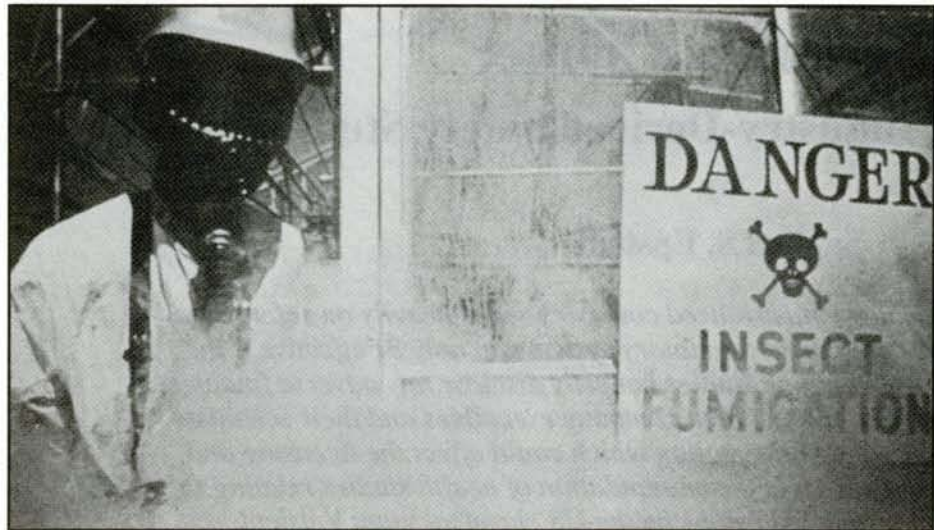
Velsicol has also failed to undertake or sponsor epidemiological studies on population groups known to have been exposed to chlordane/heptachlor in contaminated homes over long periods. As early as 1965, concerned by claims for contamination of treated homes, one of the largest pest control industries, Orkin, recognized that "slab treatment is at best a hazardous operation",⁴ although Orkin continued with such treatment until 1979.⁵ In 1974, Velsi-

col was informed by the U.S. Air Force (USAF) of contamination in some 800 homes at the Wright Patterson Base which had been treated with chlordane/heptachlor in about 1972.⁶ This information was followed by a series of USAF investigations and reports confirming such contamination in other bases and also its persistence and resistance to the most rigorous decontamination procedures.⁷ Accordingly, the National Academy of Sciences in 1979 recommended that "epidemiologic data be collected on inhabitants of the Air Force housing units from the 1970, 1974 and 1978 episodes of chlordane exposure, focusing on both acute and chronic health effects".⁸ This recommendation was subsequently endorsed by the General Accounting Office in 1980,⁹ the National Academy of Sciences in 1982,³ and belatedly, by Velsicol in 1982.¹⁰ Yet Velsicol has still failed to act on these recommendations, and, with a catch-22 strategy, matches such failure by denigrating the human relevance of chronic toxicity and carcinogenicity test data while alleging the lack of affirmative epidemiological evidence.

Failure To Publish Test Data

Over the last 40 years, Velsicol has a near consistent record of failure to publish in-house research and contracted research by commercial laboratories on the toxic effects of chlordane/heptachlor. Suppression of such information has prevented the appropriate warnings being issued to householders and pest control operators, and has also prevented an independent review of the validity of the test data, methodology and conclusions. Furthermore, the extreme difficulty in obtaining

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Tens of millions of homes in the United States have been sprayed with Chlordane/Heptachlor, exposing many millions of people to a known carcinogen.

"Even more disturbing than Velsicol's failure to warn the domestic market of the ultrahazardous properties of chlordane/heptachlor, even when applied subterraneanly by licensed applicators, is its failure to warn the export market of the much greater hazards of routine indoor spraying. Inquiries from Indonesia as to whether indoor spraying every six weeks for the past six years was safe evoked the reassuring response that chlordane/heptachlor have been 'used for many years inside homes with only rare illnesses.'"

such unpublished reports, except in response to persistent subpoenas and protective orders, has created major and inequitable restrictions on the rights of plaintiffs in chlordane/heptachlor-related law suits.

Unpublished in-house research includes reports on product composition, ingredient identity, additives and contaminants,¹¹ on household contamination following termiticidal treatment with chlordane/heptachlor by trained applicators in accordance with label directions,¹² and on the experimental reduction of such contamination by the addition of surfactants to technical chlordane/heptachlor.¹³ Velsicol's failure to publish the latter data is compounded by the company's failure to have used additives to reduce contaminant levels following application of chlordane/heptachlor.

Unpublished contract research includes a study on household contamination following chlordane/heptachlor treatment by trained applicators;¹⁴ a sub-acute inhalation test on chlordane, in which statistically significant leucopenia and thrombocytopenia was induced in monkeys;¹⁵ seven carcinogenicity tests in mice and rats completed between 1955 and 1983;¹⁶ and 11 reproductive and teratogenicity tests completed between 1959 and 1972.¹⁷

Of interest in this connection is a 1972 meeting of a Canadian Pesticide Advisory Committee in which Michael Gilbertson of Environment Canada called for a ban on chlordane/heptachlor, as "nothing was known about their reproductive potentials in various species." He was "soundly criticized...for making disparaging remarks (and) informed by a Velsicol participant of the elaborate studies available to him", in the form of petitions to the Canadian Government.¹⁸

Problems of biased interpretation apart, the validity of such unpublished data, on the basis of which false promotional and other claims of product safety were made by Velsicol, is commonly negated by incompetent and misleading test procedures. For example, in 1955 and again in 1959, a series of rat carcinogenicity tests were carried out in which ethanolic solutions of heptachlor or heptachlor epoxide were sprayed on pelleted feed rather than being incorporated within the feed as is the standard technique. The high autolysis rate and the low percentage of mice examined histopathologically in a series of 1973 tests, and the surgical removal of an unspecified number of undiagnosed subcutaneous tumors from rats during the course of a 1965 rat carcinogenicity test,¹⁹ are also

illustrative of incompetence on the part of the company. The latter procedure, "discovered (by the EPA) only as a consequence of going into one of the very intensive administrative proceedings", was characterized at a Congressional hearing as "unorthodox and misleading".²⁰ Further examples of misleading test procedures are the small sample size, restrictions to only one test dose, and the limited duration of dosing in various contracted reproductive tests.

Misrepresentation Of Test Data

The misinterpretation and misrepresentation of unpublished test data by Velsicol's contractees is commonplace. Evidence for this has been developed by independent re-analysis of such data as and when they belatedly become available, sometimes not until decades later.

From 1959 to 1972, five contract laboratories submitted reports to Velsicol on some 11 reproductive and teratogenicity tests in chickens, rats, rabbits and dogs.¹⁷ These unpublished reports, which by December 1986 had apparently not been submitted to the EPA (in violation of the Federal Insecticide, Fungicide and Rodenticide Act),⁷ only belatedly became available under a protective order in response to a 1987 Velsicol subpoena.² The various reports allege that chlordane/heptachlor and related compounds induce no adverse reproductive effects or that, where induced, any such effects induced are insignificant and can be discounted. However, contrary to these claims, subsequent independent re-analysis of the raw data demonstrates, methodological flaws apart, a wide range of compound-related and statistically significant reproductive toxicity in most tests.²² In general, fetotoxicity, miscarriages and teratogenicity were induced in rabbits, and excess post-natal mortality in rats and dogs.

From 1955 to 1973, two commercial testing laboratories submitted reports to Velsicol on five carcinogenicity tests in mice and rats.¹⁶ All these unpublished reports alleged that chlordane/heptachlor are non-carcinogenic, although a dose-related incidence of "liver nodules" were noted in some tests in mice and rats, but discounted. These conclusions remained unchallenged until November 1974 when the EPA announced its intent to cancel all agricultural and domestic uses of chlordane/heptachlor, excluding subterranean termite control; this exclusion was based on the mistaken belief that such treatment

would not result in contamination of the home, although Velsicol clearly had contrary information. In the course of the cancellation proceedings, the EPA decided to subject the industry data to independent review by a team of five consulting pathologists. Where the Velsicol contractees reported either no abnormality or non-malignant nodular liver lesions in test mice and rats, the EPA team found a high incidence of unequivocal liver cancers, which in most cases were statistically highly significant.¹⁸ These substantial discrepancies cannot be explained away by an honest difference of opinion between the industry and independent experts, as there were no diagnostic differences among untreated controls nor among positive control animals treated with a known potent carcinogen.

Velsicol was actively involved in these misrepresentations on the basis of which it insisted that chlordane/heptachlor were non-carcinogenic. A 1971 internal memorandum expressed concerns about a "warning signal (of) some suspicions of carcinogenicity", demonstrated in a 1959 rat carcinogenicity test.²³ A subsequent memorandum referred to "an unusually high incidence of liver cancers" in mouse tests.²⁴ A transcript of a telephone conversation between two senior Velsicol executives reveals the following exchange relating to the mouse carcinogenicity tests:

H. Gold: Well, not having seen the data, I really can't make any more comment. It's looking very bleak from what I've heard.

K.L. Schulz: Well, I'll give you a little rundown because they gave us the updated sheets, I've got them right here. For chlordane, the negative control after 43 weeks, no tumors. The positive control after 43 weeks, no tumors. 5 ppm chlordane, no tumors. 25 ppm, 1 tumor at week 43. Now that's of the animals that have died. You know, we don't know what's in the ones that are still alive. At 50 ppm, 12 tumors. The first one showed up at week 28 so you see it's showing earlier than in the heptachlor study. With the heptachlor on negative control after 63 weeks, no tumors. Positive control, 6. Heptachlor heptachlor epoxide mixture at 1 ppm total, 2 tumors. At 5 ppm, 2. At 10 ppm, 24. You know it's clearcut.

H. Gold: Are these CF1 mice?

K.L. Schulz: No, these are CDF1 Charles River. The natural incidence of tumors based on 1000 animals is 3 tumors just under normal circumstances, so it's a very non-susceptible animal. And Dr. Geil had the statistics on this. He's the pathologist.

H. Gold: It doesn't look good, Ken.

K.L. Schulz: No, it doesn't.

K.L. Schulz: Well, the thing that worries me so much, Harvey, if we submit this information, I think Ruckelshaus has no choice but to suspend registration of the agricultural uses for chlordane and heptachlor.

H. Gold: I agree, I agree, and I think it will happen....

K.L. Schulz: With great rapidity.

H. Gold: That's right. And you know, if it does happen....

K.L. Schulz: Heptachlor, I would say, wouldn't be a great impact because they're only projecting something like a million lbs. total for all of next year, worldwide. Chlordane's a different matter, a far different matter.

H. Gold: Well, I think that if it ever gets to a public hearing on the basis of what you've already told me, and Charlie has told me, I agree we wouldn't have a chance in hell, Ken. It would be a clearcut issue and we wouldn't have to discuss the ADI or anything else. It would mean it is carcinogenic and that's it, that's the ball game.

K.L. Schulz: Well, its tumourgenic and that's enough.

H. Gold: Yeah, right. So...

K.L. Schulz: You know with a new chemical if you came up with these results, you'd just stop right there. You wouldn't have a ghost of a chance.

In December 1972, Velsicol submitted liver sections from the mouse tests to two consultants, who subsequently warned that these clearly showed carcinogenic effects.²⁵ Velsicol was alarmed by these findings. "Drs. Rust and Newberne's reports on their evaluations of liver sections have been received. Both men generally agree in their appraisal that the findings are serious and reflect a definite carcinogenic potential."²⁶ Velsicol's failure to submit this information to the EPA resulted in its criminal indictment before the Federal Court of Chicago on April 4, 1977.²⁷ In December 1977, a grand jury handed down an 11-count felony indictment, naming six present or former company executives charging:

"From August 1972 to July 1975 the defendants...conspired to defraud the United States and conceal material facts from the United States Environmental Protection Agency by failing to submit data which tended to show that heptachlor and chlordane induced tumors in laboratory animals and thus might pose a risk of cancer to humans."

Without reaching the merits of the original issue of conspiracy raised by the indictment, the case was, however, subsequently dismissed on technical grounds.

Just as disturbing as the misrepresentation of the reproductive and carcinogenicity test data, is the misrepresentation by a Velsicol contractee of the epidemiologic data on chlordane manufacturing workers at a Velsicol plant.²⁸ It was alleged that there was no significant excess morbidity or mortality. Apart from major methodological flaws, such as the failure to provide any data on duration of exposure, analysis of the unpublished report by the National Academy of Sciences clearly demonstrated a statistically significant positive trend in standard mortality ratios for cancer deaths, with increasing duration of employment.²⁹ An updated industry epidemiological study, again claiming no significant excess mortality in chlordane manufacturing workers,³⁰ has been effectively rebutted by government scientists.³¹

Ignoring Expert Warnings

Velsicol has used an extensive battery of consultants, principally from academic backgrounds, in aggressive attempts to support its position on the safety of chlordane/heptachlor, and to defend itself in toxic tort litigation. However, contrary advice and warnings from its consultants, and also from its outside attorneys, have been ignored or discounted.

Such advice includes the explicit warnings by Velsicol's clinical consultant on the causal association between exposure to chlordane/heptachlor and blood dyscrasias;³² the warnings by two consulting pathologists that, contrary to the claims of a contract testing laboratory, heptachlor induced carcinogenic effects in mice;¹⁶ warnings by three Velsicol consultants, Drs. Golberg, Shubik and Becker transmitted through an outside Velsicol attorney, on the carcinogenicity of chlordane/heptachlor together with suggested defensive strategies;³³ and, a warning by another consultant pathologist, that "in the absence of new data, the view that both heptachlor and chlordane are carcinogenic would be upheld", accompanied by a request for more research funds to develop such new data.³⁴ The following revealing warning from an outside attorney³⁵ had no apparent impact on Velsicol's policy on the use of chlordane/heptachlor termiticides.

"On cancer risk, we are in a very poor almost no-win posture. While Stemmer and Geil will present a no-cancer evaluation of the slides, we know that Reuber, Stewart and Davis will find either malignancy or at least

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Their impact on
People, Society
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by *Graham Searle*

This study was commissioned by the International Institute for Environment and Development (IIED) to serve as a background document for a proposed meeting between the World Bank and its principal critics.

Searle looks carefully at the probable human, social and ecological consequences of three World Bank projects, the **Narmada River Development Project** in India, the **Polonoroeste Project** in Brazil and the **Indonesian Transmigration Programme**, which were to be discussed at the meeting.

The material on which the study is based was largely obtained from the World Bank itself and the study was conducted with the full co-operation of the Bank's project staff.

Unfortunately, the meeting, originally scheduled for June 1986, was postponed to October 1986 and eventually cancelled while the IIED decided against publishing the study.

The Wadebridge Ecological Centre, however, decided that this document must be published because of its value to those concerned about the role played by the World Bank in determining the present course of Third World development. This has been made possible by a generous grant from the Rowntree Social Services Trust, to whom all thanks are due.

Maps, tables and diagrams as well as references to the World Bank documents used to compile the study are included.

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tumors. Saffiotti will support the aldrin/dieldrin principle of equating tumors with carcinogenic risk. The judge can be expected to follow this group. Further, they will contend that because of wide variance in response, a threshold level cannot be established for an entire population.

"A finding of cancer risk to humans will result in cancellation of all uses in issue and may trigger an attack by EDF (Environmental Defense Fund) on even termite use.

"You must also consider the company's position after a finding of a carcinogenic risk. Those permitted uses — termites — may well expose the company to product liability claims which, though remote as to causation, could create the need for another major defensive effort. Avoiding a determination of a cancer risk to humans should be explored carefully and in depth.

"We certainly dislike a prediction of defeat, but we also cannot ignore reality. Thus, serious thought must be given to relinquishing all household and garden uses. They cannot be defended if a cancer risk finding is entered. In fact, we should realistically look at those uses for which we can argue a lack of human exposure other than to trained, professional applicators."

False And Misleading Statements

There is substantial evidence of self-serving statements by Velsicol executives which are clearly inconsistent with their own knowledge of the true facts, and which cannot be explained away by possible ambiguities or misunderstandings. Illustrative of these are statements by Velsicol on the composition of technical chlordane/heptachlor, and denials of any association between exposure to chlordane/heptachlor and blood dyscrasias, such as aplastic anaemia and leukaemia.

The official Velsicol 1971 standard for technical chlordane specifies a concentration of 43 per cent for the alpha and gamma chlordane isomers and less than 4 per cent for the volatile constituents.³⁶ Velsicol Material Safety Data Sheets specify a 60 per cent concentration for the chlordane isomers, and 40 per cent for 'related compounds'. These alleged compositions are at striking variance with testimony of Velsicol scientists and expert witnesses.

At the 1975 EPA cancellation hearings on chlordane/heptachlor, a Velsicol expert

witness admitted that:

"The real composition of technical chlordane is very different from that specified in the standard, including only 13-15 per cent of each of the two chlordane isomers and only 5-8 per cent of heptachlor. Thus, the standard method of analysis substantially overweighs the contribution of the major constituents of the mixture, and under-weights that of the minor constituents".³⁷

This admission was subsequently confirmed by another Velsicol expert witness, who stated that technical chlordane contains:

"more than 3 dozen different singular chemicals. Of these chemicals, alpha and gamma chlordane are probably the two most important ingredients. Together they comprise slightly less than 30 per cent wet weight of the product."³⁸

Most recent estimates confirm the unpublished position of Velsicol scientists, and support approximate concentrations of 25 per cent for the chlordane isomers and 17 per cent for the volatile components.³⁹ It is thus clear that, contrary to its own scientific data, Velsicol has grossly exaggerated the concentration of the chlordane isomers in technical chlordane/heptachlor at the expense of the undisclosed toxic and carcinogenic volatile components which are thus deliberately underestimated. This deception, arguably perjurious, has been further perpetrated by two leading Velsicol attorneys, although both were fully aware of the contrary scientific data.⁴⁰ Apart from major discrepancies between the real composition of technical chlordane and that misleadingly specified in the standard, as well recognized by Velsicol, there are striking batch-to-batch variations in composition.⁴¹

"It seems somewhat inconceivable, but apparently, even after some twenty years of experience, we still do not produce a consistent quality chlordane.

"Unfortunately, chlordane is not, and apparently cannot be covered with the normal chemical component-type specification. However, we do have a very specific manufacturing specifications, an original 'profile' or 'fingerprint', a biological assay, an LD₅₀ specification, and a colour specification.

"I understand the cause of 'black' chlordane is well known, and yet I am told that every summer we produce such material, and now have 581,000 lbs. of off-colour material in inventory. Of even more importance, there have been variances in the 'finger-

print', the biological assay, and the LD₅₀ specification and colour specification.

"The above problem must be given top priority, as I am sure you know that chlordane patents have expired and it is quite possible one or more competitors will enter the market. Certainly if I were a potential competitor, I think my major selling point would be the offering of a consistent quality product. And certainly I could point to many inconsistencies of quality in the chlordane produced by Velsicol."

With reference to blood dyscrasia, Velsicol was informed in 1969 by Kasik, its clinical consultant, of published information on the association between 12 cases of aplastic anaemia and exposures to chlordane/heptachlor, in four of which chlordane "was the sole agent responsible." Kasik clearly warned of the significance of this report.³² "In my opinion it would carry a great deal of weight both legally and medically". Nevertheless, just one year later, a senior Velsicol executive, referring to a recent death from aplastic anaemia following chlordane/heptachlor exposure, stated that "I intend to let (the U.S. Department of Agriculture) know that there is no evidence linking chlordane with this death"⁴² Equally striking is a 1976 letter from a Velsicol Vice-President to the Australian Government in response to an inquiry as to whether heptachlor could cause aplastic anaemia. The reply stated that, based on a thorough literature search including consultation with Kasik, "Our review has yielded no reference which would implicate heptachlor as a responsible agent in causing aplastic anaemia".⁴³

Failure To Warn

Velsicol has continually failed to warn of a wide range of information on hazards following exposure to chlordane/heptachlor. Such failure extends to homeowners (as illustrated by the gross deficiencies of the product label), to pest control applicators, industries and trade associations (as illustrated by gross deficiencies and misleading information in promotional literature, technical bulletins, manuals and Manufacturing Safety Data Sheets), and also to the EPA (as illustrated by their extensive 1986 'data call in', some four decades after chlordane/heptachlor was first introduced into commerce).

In an early publication on two cases of fatal aplastic anaemia following chlordane exposure, B. E. Conley stated, "chlordane

is one of the most hazardous hydrocarbon insecticides. Perhaps of the greatest significance is the fact that the technical preparation is still an uncharacterized mixture of chlorinated hydrocarbons whose toxic properties and metabolic fates are poorly understood".⁴⁴ This statement is as appropriate today as when it was made over thirty years ago. In spite of detailed knowledge of the product composition of technical chlordane/heptachlor, Velsicol's labels fail to disclose the presence of a variety of toxic and carcinogenic ingredients, additives and contaminants, attention to which is diverted by exaggerating the concentration of the chlordane isomers.³⁶⁻³⁸

The ultrahazardous nature of chlordane/heptachlor is in no way indicated in the uninformative and misleading label issued with the product. Chlordane has very high acute toxicity and, according to a Velsicol consultant and expert witness, the estimated human LD₅₀ is 30 mg/kg, and the toxic human dose is 3 mg/kg,⁴⁵ equivalent to about two teaspoons of diluted formulation. The label makes no mention of chronic effects on organs, such as hepatic or neurotoxic damage. The omission of reference to neurotoxicity is of particular interest, in view not only of the substantive published literature on these effects in experimental animals and humans,⁴⁶ but also of Velsicol's own admission in a technical bulletin of such effects,⁴⁷ and its admission, in response to legal inquiries, of some 35 such complaints from 1953-1983.

The label omits reference to reproductive toxicity and teratogenicity, in spite of the published literature in experimental animals and humans,⁴⁸ and Velsicol's own unpublished studies,¹⁷ some clearly showing adverse effects, although these are substantially understated.⁴⁹ Furthermore, such effects are induced at dose levels within an order of magnitude of exposures commonly encountered in contaminated homes.⁴⁹ Since 1978, Velsicol's own labels have belatedly referred to the carcinogenicity of chlordane/

heptachlor in mice, with the trivializing qualification that there is no supportive human evidence. However, the label makes no reference to the carcinogenicity data in rats, including an unpublished study contracted by Velsicol demonstrating the induction of liver tumours,^{16,50} nor does it make reference to various published epidemiological studies in which carcinogenic effects were noted and which, minimally, are supportive of the test data. These include contracted studies demonstrating a statistically significant excess of lung cancers, besides excess cancers at other sites, in pest control applicators, and in chlordane/heptachlor manufacturing workers, among whom a statistically significant excess mortality from cerebrovascular disease was also reported.⁵¹ It may be noted that these studies, which were submitted to Velsicol for review prior to publication, evoked a cautionary letter on potential conflicts of interest from the Dean of the major contractee's university.⁵² More recently, a National Cancer Institute study, published in July 1983, confirmed the statistically significant excess of lung cancers, besides excess cancers at other sites, in pest control applicators.⁵³ In recent litigation, involving neurotoxicity and cancer risk following exposure to chlordane/heptachlor in a contaminated home, Velsicol and its attorneys attempted to deceive the court as to the relevance of the NCI study by claiming that such exposure predated their knowledge of this study, when in fact they were in possession of a draft of this study during the exposure time in question, and some three months prior to its publication.⁵⁴ The significance of this deception is further emphasized by the strong endorsement by

International Restrictions on the use of Heptachlor

Banned in:

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EEC
Turkey
Sweden

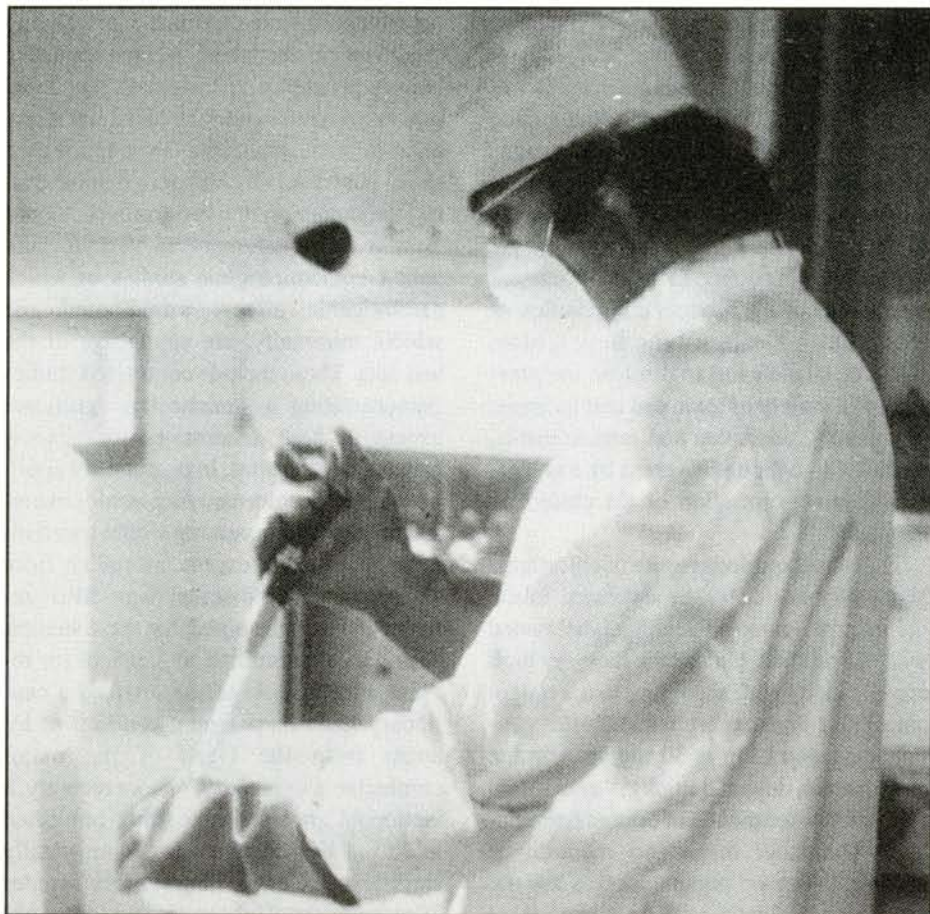
Severely restricted:

Finland
Argentina
Austria
Philippines
USSR
Canada
USA
New Zealand
W. Germany
Israel

Source: Pesticides Action Network

Status of Chlordane in UK

All amateur uses of chlordane were banned on 31 December 1988. However the control of earthworms by professional applicators is still permitted until 31 December 1990. Chlordane kept in storage can be used until 31st December 1992.



Ambio

Independent reviews of many laboratory tests submitted to support the continued sale of chlordane and heptachlor have revealed findings which are inconsistent or even downright fraudulent.

a Velsicol consultant of the conclusions of this study. "The association with carcinoma of the lung is striking and deserves attention. The methodology of this study is beyond reproach".⁵⁵ Furthermore, the label makes no reference to the association between chlordane/heptachlor exposure and fatal blood dyscrasias, including aplastic anaemia and leukaemia, in spite of some 34 case reports in the published literature and some 25 available complaints and litigations for these diseases.⁵⁶

Apart from such a panoply of acute and delayed toxic effects, the label makes no reference to the high frequency of contamination of homes following treatment by licensed applicators,¹²⁻¹⁴ let alone following misapplication; no reference to the knowledge as early as 1965 that treatment of slab homes is a hazardous procedure because of the risks of contamination and ensuing litigation;⁵⁷ no reference to the numerous complaints received annually from homeowners and pest control operators for problems including misapplication and adverse health effects;⁵⁸ no reference to the prolonged persistence of such contamination and to the extreme difficulty (if not impossibility) of decontamination;⁷ and no reference to the availability of less persistent, less hazardous and more

easily decontaminated alternative termiticides, such as Dursban.

The failure of the label to warn homeowners of the wide range of adverse health effects and contamination problems is, in general, matched by a similar failure to warn pest control applicators, in spite of their much higher levels of exposure. Velsicol training manuals, until recently, have shown applicators working in crawl spaces and cleaning up spills without respiratory protection.⁵⁹ Velsicol manuals, promotional literature and advertisements are replete with false and misleading statements such as the following:

- Chlordane has an "unmatched safety and performance record";
- Chlordane is "the safest (termiticide) to use";
- "Chlordane is not hazardous when used properly";
- "Significant air residues after a proper termiticide treatment are extremely rare";
- "The sum of toxicological and epidemiological data supports the conclusion that the uses of chlordane and heptachlor pose no identifiable health hazard";
- And, that based on occupational health studies, "there is no evidence of any long-term latent effect on

health".^{59,60}

Even more disturbing than Velsicol's failure to warn the domestic market of the ultrahazardous properties of chlordane/heptachlor even when applied subterraneanly by licensed applicators, is its failure to warn the export market of the much greater hazards of routine indoor spraying. A telex from Indonesia inquiring as to whether the indoor spraying of chlordane/heptachlor every 6 weeks for the past 6 years was safe and devoid of possible long-term toxic effects, evoked the reassuring response that it had been "used for many years inside homes with only rare illnesses".⁶¹

Apart from its failure to warn homeowners and pest control applicators, Velsicol has failed to submit critical unpublished data to the EPA. Such data includes the results of reproductive and teratogenicity tests,^{17,61} and a wide range of other information, such as data on ingredient composition and identity³⁵⁻³⁷ and applicator exposure studies.¹⁴ Velsicol has apparently also failed to submit information to the EPA on some 1200 complaints received annually from homeowners and from pest control operators,¹²⁻¹⁴ and on adverse health effects, such as blood dyscrasias, obtained from depositions by expert witnesses in recent law suits. Such omissions appear to be in violation of the Federal Insecticide, Fungicide and Rodenticide Act 6(a)(2).

White Collar Crime

Pesticide use in most nations is controlled by statutory and regulatory schemes. Ideally, the pesticide must be tested thoroughly and registered before it can be introduced into commerce. Labels, directions and methods of use or application must be approved. All active ingredients and components must be disclosed. Governments usually require that the company which desires to register the product conducts any studies or investigations deemed necessary. This continuing process of governmental monitoring and surveillance requires the company to report all adverse effects of the product of which it becomes aware. This includes studies done by others, studies done by the company and all reports the company receives regarding adverse health effects.

Such a regulatory system can only be effective if the company conducting and reporting the studies makes honest and complete disclosures, and if the underlying data base is reliable. The regulatory system is potentially only as valid as the information generated is reliable. When

the ingredients are not identified, when the proper studies are not conducted, when the results of studies are not published for review, and when the results of studies state conclusions contrary to the actual data, effective regulation becomes virtually impossible. The ineffectiveness of the regulatory system is exacerbated by the fact that private citizens and public interest groups have no right to bring a legal action to enforce the statute. When faced with misrepresentation by the manufacturers of pesticides, the judicial system (and through it the possibility of punitive damages) still provides the only effective avenue not only for redress, but also for deterrence. In addition, there is a growing Congressional and other interest in the U.S. in the development of criminal sanctions against industries, and their executives and scientists, who knowingly suppress or manipulate scientific information with resulting adverse public health and ecological consequences, offences which are now, belatedly, recognized as 'white collar crime'.

An overwhelming record confirms the premise that scientific information generated and interpreted by institutions and individuals with direct or indirect economic interests in its outcome must be regarded as suspect until proven otherwise by independent validation. This conclusion is of major importance to public health scientists and regulatory officials.

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A full version of this paper, including appendices, is available for: The Ecologist, Station Road, Sturminster Newton, Dorset., Price: £15.

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Pesticides and Drugs From The NeemTree

by

Gail Hepburn

Traditional methods of pest control and healing in the non-industrialized world are under threat. Modern chemicals are rapidly taking their place, at great social and ecological cost, and a huge body of vernacular knowledge is in danger of being lost. The neem tree is just one of the species whose beneficial properties, although widely known in traditional societies, are only now being 'discovered' by science.

In Africa and Asia, a considerable proportion of the food produced is lost to pest damage. Synthetic pesticides are widely promoted as the solution but have adverse effects on the environment, are expensive and become inactive as pests develop resistance to them. About 2000 species of plants, however, are known to have insecticidal properties. Natural plant chemicals may play an important role in the future of pest control in industrialized and developing countries.

The Neem Tree

The neem tree (*Azadirachta indica*), common in both Africa and Asia, could be a valuable source of agricultural and medicinal substances. It contains insecticidal compounds, which could be used to control many pests of important crops. Most parts of the neem tree are used in traditional medicine and, in tests on laboratory animals, extracts from the tree have been shown to be effective against a variety of diseases.

The neem is a hardy, fast-growing evergreen which attains a height of 7-20 m and a spread of 5-10 m. It thrives under sub-humid and semi-arid conditions and requires very little attention, fertilizer or irrigation. The tree is free from attack by practically all species of insects, nematodes and plant diseases, and will thrive in areas that are unsuitable for all but the most hardy species. Neem can be grown by native farmers with minimal maintenance

and its seed oil can be extracted using simple devices. Native to arid areas of India, Pakistan, Sri Lanka, Malaysia, Indonesia, Thailand, Burma and several East African countries, the neem tree has been successfully introduced to parts of Central and South America and the Caribbean, and is being planted in the Sahel in an attempt to check the advance of the Sahara. About 14 million neem trees are under cultivation or growing wild in India.

Powerful Insecticide

Biologically active constituents found in the leaves, fruit, bark and seeds of neem are reported to control at least 125 species of pest insects, mites and nematodes, including 25 species of *Coleoptera* (beetles), 10 species of *Diptera* (flies), 25 species of *Lepidoptera* (moths) and 9 species of *Orthoptera* (locusts). Many of these pests are economically important, examples being the desert and migratory locust, rice and maize borer, pulse beetle, rice weevil, the rootknot and reniform nematodes and the citrus red mite. Homemade preparations of neem seeds and leaves have been used for many years by farmers in developing countries to control pests on crops in the fields and in storage.

Neem extracts affect insects in a multitude of ways. The treatment of insects with neem seed extracts inhibits development and causes morphological aberrations, high mortality and a marked reduction in egg laying. Scientists in England, Germany, India, Israel, the Philippines and the United States have investigated the ability of neem extracts to repel insects and deter them from feeding.

Neem, unlike synthetic insecticides,

may be suitable for use in mosquito control as it appears to regulate moulting and metamorphosis in mosquitoes. Extracts or pure compounds derived from neem leaves can kill mosquito larvae. Neem is also effective against aphids, Colorado potato beetle, sawflies, boll weevils, Mexican bean beetle and gypsy moth, and against viruses and fungi. Neem seed extract is more effective than standard pesticides in reducing infestations of cabbage by larvae of the diamond back moth.

Locust swarms do not attack neem leaves; crops sprayed with a suspension of neem seed are left untouched during swarms, while untreated crops are destroyed. Experiments by the International Rice Research Institute show that when paddy is sprayed with neem oil, the number of brown planthoppers is reduced and the pests fail to transmit the grassy and ragged stunt viral diseases of rice. The transmission of rice tungro virus by green leafhoppers is also prevented. Seedlings could be protected against rice tungro virus by the incorporation of neem cake into the soil. Unlike those insecticides that kill both pests and their predators, neem oil does not kill the natural enemies of planthoppers or leafhoppers.

The semilooper, a serious castor pest, can be effectively controlled by spraying with neem seed kernels in suspension or a leaf extract. In laboratory experiments, exposure to neem oil vapour reduces the number of fertilized eggs produced by the spotted bollworm, a major tropical pest of cotton and okra. A neem seed suspension drastically reduces the number of eggs deposited by the Egyptian cotton leafworm as well as the amount of leaves consumed. Extracts of leaves and seeds of neem repel the red flour beetle, the khapra

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beetle and the lesser grain borer. Mixing neem seed powder with wheat grain provides protection from insect pests for 9-12 months. When the foliage of lima bean plants is treated with neem seed extract, 98-100 per cent of the leafminer larvae die soon after hatching. Leafminers cause severe damage to field crops in the southern states of America and to greenhouse crops in America and Canada.

A compound called margosan-O, obtained from neem seeds, is active against a number of insect pests that attack trees and flowers and has been given approval for marketing in America. Azadirachtin, the most investigated of the compounds derived from neem, causes tremendous disturbances in insect growth when used as a pure substance and as an ingredient of neem seed kernel extracts. It has a complex structure which may preclude its chemical synthesis. Extracts of neem seeds containing azadirachtin are considered to be safe and suitable for use as a pesticide.

Medicinal Uses

Neem is beneficial in the treatment of human diseases caused by bacteria and

fungi; it prevents ulcers, lowers the blood pressure and combats inflammation, diabetes, tumours and arthritis. Neem oil is 100 per cent effective in preventing pregnancy in humans when applied intravaginally before sexual intercourse. As a potent contraceptive agent, neem oil is likely to be inexpensive and without side effects.

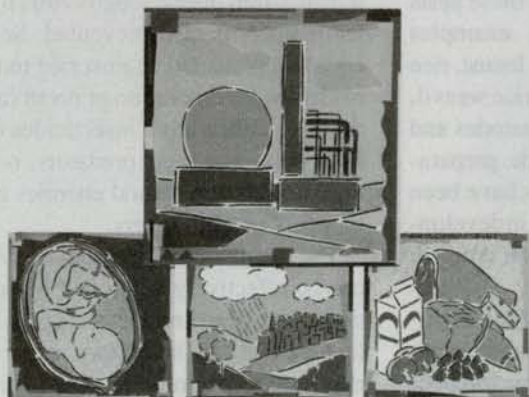
Energy from Neem

The pulp of neem fruit can be used for generating methane; in addition, neem seed contains up to 40 per cent oil and is used in developing countries as a fuel for lamps, as a lubricant for machinery, and in the preparation of soap, toothpaste, cosmetics, pharmaceuticals and disinfectants. Neem cake, the residue from oil extraction, can be fed to livestock and poultry, and has been shown to increase the growth rate of sheep. If ploughed into the soil, it acts as an excellent fertilizer and can control nematodes. The hard termite-resistant wood of the neem tree is a useful construction material and the leaves and twigs repel insects when spread among household goods and clothing.

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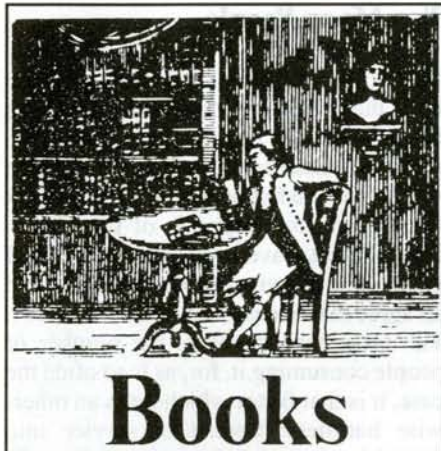
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Books

Changing Ourselves Or Changing Society?

BLUEPRINT FOR A GREEN PLANET, by John Seymour and Herbert Girardet, Dorling Kindersley, 1988, £9.95.

This book is about changing individual lifestyles, and especially about 'informed choice' in 'using the power of the purse'. What is on offer is another brand of that increasingly popular product, 'green consumerism'. Ironically, it is an approach that rather echoes the sentiments of the Radical Right, from politicians such as Mrs Thatcher and Mr Reagan to the Adam Smith Institute and other research bodies of the 'New Enlightenment'. For, different though their values and goals might be, such approaches share a common faith in individual action to solve what in fact are, to a large extent, collective problems that demand collective answers.

This should not detract from the many strengths of the strategy outlined by Seymour and Girardet (I also want to congratulate Dorling Kindersley for an excellent production whose effective graphics and clear print are particularly noteworthy). Our authors provide abundant examples of practicable alternatives which make a refreshing change from the doom-mongering to which many of us, not least your reviewer, are too prone (sad to say, we can plead mitigating circumstances!). In areas ranging from diet to household furnishings, they demonstrate that we could change our ways and be healthier, enjoy greater satisfactions, live more cheaply and do less damage to the environment as a result. One individual buying brand X rather than brand Y might not seem very significant, yet much environmental destruction is not the product of big projects but the result of the aggregate impact of so many otherwise insignificant decisions by each and everyone of us. From little acorns...

Many manufacturers have quickly re-

sponded to demands for products such as lead-free petrol (though not after long rearguard battles in which they vehemently denied their practicability). Non-converts are also not likely to be persuaded by those who, for example, denounce cruelty to animals and then go out and buy battery eggs. Nor will they be impressed by the spectacle of people jetting off to conferences in luxury hotels to discuss the state of the world. We often denounce the import of strawberries from hot countries so that the well-to-do can eat them in the middle of winter but fail to note that much produce in wholefood shops also comes from fields around which local people go without. Last, but certainly not least, greening our institutions (about which more later) will be as successful as Prohibition was against alcohol consumption if individuals have not internalised and started practising new ways of behaviour in their own lives.

Flawed Fixes

In terms of the specific changes we can make, Seymour and Girardet are, in general, reliable guides. Nonetheless, I think they overstate their case. They claim that "every problem has its answer". This is not only rather sophisticated but also fails to challenge the widespread faith in 'technofixes' as the solution for social and environmental problems. The high priests of this particular church are the wizards of technology. They only have to wave their wands and something will turn up. Society can then continue to slake its thirst for more of whatever it wants and permanently postpone the day of reckoning.

Knowledge and its applications are, however, no more free from constraints and costs than anything else in our finite world. The example with which Seymour and Girardet support their statement — car exhaust and factory chimney filters to 'fix' the acid rain problem — actually demonstrates the drawbacks to technofixes. Pollution control gadgets suffer from a diminishing rate of return; they also tend to shift the problem from one form, time or place to another, often at the expense of more energy and material inputs and therefore more resource depletion and pollution. Seymour and Girardet claim, for example, that the

catalytic converter is the "perfectly simple solution to a large part of the car pollution problem". William Ophuls, by contrast, states that they "emit sulphuric acid mist and platinum particles... the manufacture of the converters also occasions the production of pollution (as well as being an additional drain on our energy and mineral resources)". Coal pollution is discussed in terms of desulphurisation, but the greater long-term problems of carbon dioxide and thermal pollution, which are not amenable to technological control, are not given equal coverage. More generally, continued population and economic growth will quickly cancel out any successes achieved by the measures the book advocates to reduce pollution.

Net Losses

I cannot help feeling that thermodynamic and ecological bills are not being fully kept in the *Blueprint's* accounts. The casual way the Entropy laws are treated (I am thinking of Georgescu-Roegen's four part formulation, summarized in an afterword to Rifkin's book *Entropy*) is spotlighted by the nonsensical description of transport powered by renewable electricity as "genuinely non-polluting". On the same grounds, I doubt whether the net balance of recycling schemes is so much on the plus side as is implied.

Ecological costs are also underestimated by a one-sided emphasis on what we



"Environment-friendly" batteries are the latest in a line of products aimed at the 'Green Consumer'. The marketing is blatant: the batteries are being promoted as if they were as natural as apples. But whilst there is much to be said for 'greener' products, green consumerism rests on a misplaced faith in the power of the individual to solve problems that demand collective solutions.

are putting into the environment, rather than what we are taking out of it as human production systems simplify the complexity of environmental systems. This is most apparent in the section on farming. As might be expected from John Seymour in particular, the vices of industrialized agribusiness are spelled out forcefully and clearly. The organic alternative has a great many undeniable attractions. Yet all systems of cropping and ranching keep nature at an artificially simplified and unstable level, as Wes Jackson's memorable comparison of the effects of a rain storm on unmodified tall grass prairie and on a nearby Mennonite farm highlights. I've read with admiration some of John Seymour's books on farming and gardening. Organic farms doubtless provide more wildlife habitats than their chemical neighbours. Yet when compared to the deciduous woodland that once occupied British farmland, they still represent a net loss of stability and diversity.

Appropriateness

Some of the changes put forward by the authors might be alternative but they are not necessarily appropriate. Their "six principles of good housekeeping" could be beneficially reformulated and expanded to clear out what is socially and environmentally inappropriate. For example, I occasionally buy yoghurt and cheese made from a self-styled 'natural sheep dairy' up in the west Cheviots. It's small-scale, owner-farmed and meets their criterion of localism so, on their guidelines, I am being a responsible consumer. Yet sheep and goats might be non-polluting but as agents (and especially perpetrators) of upland environmental degradation, they have few equals.

In the field of welfare policy, the rhetoric about putting "care back into the community" might seem to meet the *Blueprint's* principles of localism and personal responsibility. Yet, in the absence of publically funded support systems and a fairer sexual division of domestic labour, it can only put new burdens on women, many of whom already have to go out to work and run a home.

I realise that the more detailed guidelines of green land use, product design and institutional structures become, the more disunity they inevitably create in the movement's ranks. But there is no other way of developing coherent alternatives to the monstrosities around us. Although the work of the New Alchemy Institute deserves much praise, I still think the best starting point is 'underground' architect Malcolm Wells and his "absolutely constant incontestably stable architectural value scale." It has a precision lacking in more general checklists, though one obvi-

ous improvement would be to add social criteria, for example regarding disadvantaged groups in society.

Sustaining Oppression

The problem of appropriateness becomes clearest, however, over the criteria of renewability and sustainability. I suspect Sami reindeer herders might disagree that "abundant" and "renewable" hydroelectric power is appropriate in Norway (p.152), since their land and that of other species is drowned beneath schemes such as the Alta dam (for which Sigmund Kvaløy's phrase "hydro-electrocution" seems most appropriate). Fast-growing willow plantations are cited as an example of sustainable biomass energy but, yet again, the free lunch is illusory and many writers, especially Amory Lovins, have warned about the true costs of such schemes. The book enthuses over wind power, yet it would be far from liberatory if the energy supply came from machines in the hands of the same old corporate empires. It is not made clear just how much physical space wind power programmes would require if they began to even scratch the surface of contemporary energy demand. I would refer readers to more sober estimates of the potential of such energy sources.

California Dreaming

The total environmental impact of our way of life is of course a consequence not just of the technologies we choose to meet human demands, but also their effects multiplied by per capita consumption and population size. The book indirectly has a great deal to say about the nature and size of personal consumption patterns. Yet it fails explicitly to drive home the message. "Maybe instead we should re-examine the whole idea of a standard of living", Seymour and Girardet tell us. Maybe, indeed. Moreover, if the Earth is ever going to provide adequately for the poverty-stricken millions outside the ghettos of affluence, it seems to me that the world's well-to-do are going to have to accept lower living standards measured in physical terms (though, as Seymour and Girardet do note, they might well become more contented as a result). Since advertisers and mainstream politicians are constantly promising we can all live like rich Californians, we cannot afford to pull any punches if we are to awaken people from this impossible dream (or nightmare).

Far worse, however, is the omission of the population part of the equation.

Too Many People

There is not one problem mentioned in the book that is not being worsened by rising human numbers, nor one that, conversely, would be easier to solve if they were first stabilized then humanely reduced. Recent discussions, for example, of the Greenhouse Effect, have spotlighted the role of paddy cultivation, yet I assume we would all agree that rice is an excellent foodstuff. The issue then becomes the number of people consuming it, for, as is so often the case, it is that factor which turns an otherwise harmless product or service into something harmful. Parenting fewer offspring is the most important choice responsible citizens could make and yet it is totally omitted. I recently reread the article that first put me on the road to green ideas, *4 Changes* (I came across it in *The Last Whole Earth Catalogue* - I still do not know who wrote it). One of its most striking features was the way it put the population issue squarely at the top of the agenda. People such as the Duke of Edinburgh who warn of the dangers today merely attract a load of brickbats on their heads (as happened to Norman Myers recently in the correspondence columns of the London *Guardian* from the hands of the so-called World Development Movement). At a time when the world's population has shot past 5 billion, the issue has become what Garrett Hardin aptly described as "the population skeleton in the environmental closet". For a book about how to manage your household, the failure to mention the number of people within it is truly amazing.

But parenthood apart, the book's range of topics is impressive. It would be outrageous to expect our authors to cover everything but there are three issues on which I would have particularly welcomed their opinions. Given that today's average child spends more time in front of the television than in the classroom, it could have been useful to discuss this key form of socialisation, if only via some references in the recommended follow-up reading. Writers such as Jerry Mander have made some pertinent points as to television's role in perpetuating social passivity and anti-environmental consciousness, despite the number of excellent documentaries now on the screen. Some parents' action groups have also suggested some useful proposals. There is very little on education itself although both parents and schools will surely play a vital role in inculcating values appropriate to a conserver society.

I would also have appreciated some discussion of recreation and leisure. The destructive impact of mass tourism, for example, is fast spreading its tentacles around every sunny beach and ski slope on the planet. Perhaps the green alternative would focus on rather different ideas of

relaxation and travel, emphasizing low impact on host environments and communities. 'Entertainments' such as blood-sports and circuses might also have merited a mention.

Institutional Change

My other major reservation concerns the *Blueprint's* overall strategy. Reading this book was rather like getting engrossed in a novel only to find that half the plot had been left out. Our authors omit any serious reference to structural changes to our society and its decision-making processes. The only policy principle they mention, the Polluter Pays, is inadequate and focusses, as Herman Daly has demonstrated, on the wrong end of the production/consumption process. Much pollution comes from a diversity of sources, sometimes unknown, and it is not clear how costs could be apportioned for damages which it is sometimes neither meaningful nor possible to price.

This general gap is not simply because the authors have opted to concentrate solely on individual choices. They positively dismiss hopes of governmental action and devote the grand total of one sentence to the potential role of green political parties, and even then they do not mention them by name (p 12). They do devote a chapter to "Action Beyond the Home". Yet it only mentions a few pressure groups, organisations which, despite their very real worth, are basically about remedying surface symptoms of what is a malfunctioning system. Their successes tend to be on the fringes of policy, leaving intact the engine of destruction itself. This would require institutional changes about which the *Blueprint* is silent. Writers such as Herman Daly who have made very useful proposals do not even rate a mention in the bibliography.

Changed personal behaviour must go hand in hand with collective action to change the institutional framework of society. Many hopeful initiatives, not least in the field of organic farming, have been stifled by government regulations, land ownership patterns, taxes and subsidies that discriminate against them. Compare the resources devoted to the sale of cigarettes with those deployed to discourage smoking. A business takeover can wipe out suppliers of good products and services. Britain's highly successful consumer lobby, the Campaign For Real Ale, has been constantly thwarted by the big battalions swallowing up one local brewery after another. Los Angeles once had a good public transport system — until it was bought up by car manufacturers and closed down.

However, the most fundamental case for a collective approach is the way in which

what is individually, and what is publically rational, can diverge. The short-term disadvantages of collectively appropriate changes in lifestyle often outweigh personal benefits. The floods that devastate Bangladesh and the deserts that spread across the Sahel are, for example, partly the product of countless people cutting down trees for yesterday's firewood, producing common ruin today. Or take the case of contemporary research in genetic engineering. For some individual would-be parents, it must seem perfectly reasonable for scientists to open this Pandora's box yet society's interests will be best served if it stays firmly closed.

More specifically on spending patterns, I buy tea, for example, produced on farmers' cooperatives in the Third World but it is more expensive than that on sale in the local supermarket. I am out of pocket compared to my neighbours if I spend my money responsibly. Individual acts of responsibility might make one feel good but are often otherwise futile if most other people continue to behave irresponsibly. No wonder many people conclude that it is not worth bothering. In fact, the kind of right choices Seymour and Girardet ask of their citizens are more difficult than they (and, let me add, apostles of 'willingness to pay' policy-making) fully admit.

Responsible 'shopping around' fails to escape the logic and limitations of consumerism as a whole. Given the sheer volume and rapidly changing array of products on the market, many of which have specifications comprehensible only to the expert, an individual's judgement is bound to be inadequate. Even experts do not know the potential consequences, especially their synergistic effects, of many of the complex chemical substances in many of today's manufactured goods. Even if armed with all the relevant information, the exercise of consumer choice is a time-consuming (and time-wasting) process, and, even if the right product is identified, its price may be beyond the consumer's means. It is unrealistic to expect individuals to appreciate fully the cumulative consequences of each other's decisions. Even if they did, many people are likely not to rate this factor high in their priorities simply because the price will often be paid by generations well into the future, people you or I can never know.

For all these reasons, what is necessary is not just a private but also a collective approach, in which society sets down appropriate parameters for technological choice and economic activity. Nothing better illustrates the need for such a strategy than war and the preparations for it. They must surely be the greatest single source of waste and destruction on the planet, but stopping it depends upon the political process. This too is the only way to set up the framework of a steady-state

economic system to curtail the excessive throughput of goods and services in the economy. Measures such as a Turnover tax and discouragement of mass sales promotions are necessary to curb the disease of giantism in our business enterprises, while devolution can begin to cure the same affliction in our political and welfare institutions. Developments such as the EEC's 1992 harmonisation (that is standardisation to the lowest common denominator, regardless of environmental and cultural differences) will otherwise destroy the localism which the *Blueprint* pronounces a key principle. I believe that social schemes for Basic Guaranteed Income/Social Dividend are also vital, for, without such measures, the mass of people will cling to jobs based on social and environmental destruction. Moreover, much of the 'good work' described in the *Blueprint* consists of a mass of bits and pieces which cannot form the basis of full-time permanent employment, and which will not get done without a social restructuring of how we find our livelihoods.

Withdrawal Symptoms?

Despite all the optimism that the authors and the publisher's blurb proclaim, I sense an underlying defeatism — that it is a waste of time trying to change society radically as a whole and that all that is left is to beaver away by oneself. Yet history is replete with examples of tiny minorities united by a clear vision and by effective organisation who did change society's direction. The key tool is political organisation (I am using this term in a much broader sense than that connoted by electioneering). It is about people coming together around a programme of change based on a coherent set of values, in order to contest in a concerted manner control of the levers of power wherever they exist in society. The more I read about the rise of mechanistic science and the industrial revolution, for example, the more I appreciate the role of organised groups who consciously laid the foundations of what Kvaløy aptly terms 'Industrial Growth Society'. Any satisfactory and lasting escape from it depends on similar work being done today.

Whatever the weaknesses of this book — and I think they are largely a case of 'twixt cup and lip, many a slip', rather than fundamental failings — it is still the one I will be recommending to friends if they want to find out more about the practical side of how we can sustain a good life for humans and non-humans alike. The points I have made about the need for structural change in society could in fact have been tackled simply by adding an appendix with references to the appropriate literature. There is an increasing number of books of

a similar vein to the Blueprint but I suspect that between them, Seymour, Girardet and their publishers have put together a product destined to remain the leader in the market.

Sandy Irvine

Sandy Irvine is a lecturer and co-author of *A Green Manifesto* (Optima, 1988)

A Manifest Change

A GREEN MANIFESTO, by Sandy Irvine and Alec Ponton, Optima, 1988, £6.99.

Having been chastened by my own attempt to turn the Green Party's policy tablets of stone into "a good read" for their 1987 election manifesto, I fell upon this book with considerable excitement, anxious to subject it to a scrutiny honed by a somewhat painful experience.

Liberated from the constraints of the now rather antique Green Party policy manual and the need to squash everything into a short election programme format, the authors have been able to explain clearly the Green approach to the problems facing policy makers. Not only do they illuminate how this differs from the traditional left/right approach to policy making, but they also regularly point out as they go along the interrelationships between policy areas (for example, EcoPeace) and how only the Greens have managed to come up with a holistic and thus consistent policy package. This feature of the book alone makes it a handy tool against which to measure the greening of other parties and institutions.

As a primer to Green policy-making, I think this book will be a major success. Aimed at a generally interested audience but assuming no previous knowledge of Greens and their politics, it manages to answer many questions without disintegrating into a tedious shopping-list approach to policy. The reader is led through an explanation of the problems being addressed by the Greens, passes via key (but not exhaustive or exhausting) policy areas towards a recapitulation of the main challenges for the future, and ends with a chapter which embraces the reader in its proposals for action.

The style and language are accessible; the chapters broken up by sub-titles but the flow uninterrupted. Applying Parkin's first test of readability, I can report that I did not doze off once while I read it and when I reviewed my margin notes they

revealed more quibbles over detail than substantial disagreements. My comments about the book are therefore born of my own long immersion in Green politics and might not be echoed by someone coming fresh to the subject.

While the language is easy to read, there were places where the writers skated over certain issues or buried important points in bland phrases. For example, although the writers implicitly acknowledge them from time to time, there is no specific mention of women. Nor is there mention of the important role they will probably have to play in the future. Yet women already see many of their intuitions, values and attitudes echoed in Green politics, and studies in several countries show they already make up an important part of the Green electorate and the movement's activists.

While I'm not arguing that every Green tract must also be a feminist tract, not to mention women specifically in the final chapter is surely an important omission. Especially when that chapter argues that the prospects for success depend on "clarity of vision, quality of organization and deftness of strategy", and points out that history is littered with examples of individuals or groups who have been dragged out of the wilderness by the pace of events. If the Greens wish to rally majorities around their ideas, their strategies will have to acknowledge at least the mathematical fact that women make up the majority in society! I would also argue the strategic importance of the considerable power women have to liberate not simply themselves from men, but men from themselves, and to help re-establish the confidence of all of us in the wisdom of natural instincts and patterns of life. What women lack is confidence in their powers and the sort of organization necessary to flex them. Being 'missed out' of books like this will not help.

Also missing, most noticeably in the chapters devoted to Basic Principles and Sharing and Caring, is the more spiritual side of Green politics. Irvine and Ponton quite rightly point out that we must shoulder our responsibilities, develop a new ethic and morality towards future generations, and acknowledge that in doing so we can develop the "richest part of humanity". However they keep away from direct mention of inner spirituality, which, like it or lump it, we all have. They also fail to discuss the role of traditional religious institutions in bringing us into our present predicament and how they might contribute to getting us out of it.

Squaring up to the human need for spiritual satisfaction should not be limited to noting macro signs like the growth of extremist religions — from Islam to the Christian fundamentalism of the American Moral Majority — or the attempts to replace spiritual satisfaction with rampant

consumerism or violence against the alienating environment and society of modern urban life. Mrs Thatcher is proposing "active citizenship" as her model for a caring society. Yet her sort of "active citizen" is a selfish model, one who consumes to some undefined optimum level and then disposes of their surplus charitably. It has got nothing to do with the sort of communitarian ideals that *A Green Manifesto* is proposing we adopt in order to become active citizens of the planet.

Yet the re-establishment of the sort of 'social glue' that made past societies, and keeps present 'tribal' societies, strong and self-sustaining cannot ignore the role of human spirituality. A genuinely civilized society is one where shared historical experience, culture, social customs and norms, politics, beliefs and attitudes, rituals and religions are perfectly blended, not separated and isolated as they are in modern society. Rekindling the fires of personal spiritual hope will be an essential part of working towards a Green future, and where better to start than by the personal rediscovery of our respect and awe for the beauty, power and mystery of nature.

My quibbles over the details of the policy areas covered in this book are mainly prompted by my own interests and areas of knowledge. The impression that the authors have a greater depth of knowledge than a sometimes frustratingly general statement in the text reveals, is confirmed by the amazingly comprehensive bibliography. For example, I would have liked to know more about the "unemployment industry" mentioned on page 74, and the chapter about consumerism was annoyingly vague — despite the large number of entries on the subjects in the bibliography. While it is true that more detail might put the more generally interested reader off, I feel a few more concrete examples should have been given. I particularly liked the way the complicated concepts of major areas like resources ('Sustainable Supplies'), pollution ('The Big Clean Up') and the global eco-system ('Protecting the Web') were dealt with and Irvine and Ponton must be congratulated for tackling the implications of a rapidly growing world population head-on. As Jonathon Porritt points out in his Foreword, the rigorously realistic approach of the authors to such issues should "ruffle a few feathers amongst the dozier inhabitants of the Green Party's own dovecote."

After the high concern given to the danger of a rapidly growing force (population) meeting an immovable object (the finite planet) in the early 1970s, most policy makers have steered clear of the topic. They have been helped by many 'experts' in world poverty and hunger sweeping the issue under the carpet with assertions that the problem is the 'distribution of food'

rather than absolute numbers of hungry people. Fine as long as food supplies and numbers of mouths are considered in the chaste isolation of statistics from a UN agency, but extremely dangerous when considered in the real-life context of all the other activities in which human beings indulge.

Although happier in some policy areas than in others ('Education' rather than 'Housing', for example) Irvine and Ponton have not shirked from owning up to the tough decisions that will have to be made if policy makers are serious about shifting from the "superindustrialism" of today (whether it is crafted according to the dogma of the left or the right) to the conserver society on which our very lives depend. *A Green Manifesto* not only introduces the non-initiated to the mysteries of a Green approach to today's problems, but provides a consistent framework that Green policy makers could do worse than to adopt as they set about filling in the details.

Sara Parkin

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Aid for Whom?

AFRICA IN CRISIS: The Causes, the Cures of Environmental Bankruptcy, by Lloyd Timberlake, Earthscan Publications, London 1985 (rev. ed. 1988), £5.95.

The central message of this book, now in a revised edition, is that the disasters of famine, flood and drought, which are striking Africa with ever greater frequency, are the results, not of 'Acts of God' but of "long-term political and economic policies". These policies have been "bankrupting Africa's fragile, complex environment... which makes 'development' impossible in a continent in which three-quarters of the population rely directly for their livelihoods upon the environmental resources of topsoil, plants, trees, animals and water."

Since most of the nations of sub-Saharan Africa gained their political independence in the 1960s, huge amounts of money have been poured in to the region by northern governments. Advising Africa has now become a major industry, with over half of the \$7-8 billion spent per year going on the salaries of more than 80,000 European and North American 'experts'. Yet despite (or because of) all this advice and cash, living

standards and the ability of the continent to feed itself are continually falling.

Timberlake is guardedly optimistic that African governments are beginning to lose their disastrous obsession with industrialization and urbanization and are beginning to focus more of their attention on food production and the protection of natural resources. He sees little cause for hope, however, in the attitudes of northern governments. After the publication of the first edition of *Africa in Crisis*, Timberlake addressed various gatherings of northern decision-makers and found that they all wanted to concentrate on issues over which they have no control — Africa's poor soils, difficult climate and rapidly growing population — but were not ready to focus on the problems where they have direct responsibilities — debt relief, trade barriers, or more effective aid.

"More effective aid," according to Timberlake, is aid which is given from a humanitarian motive, which goes to projects based on community participation and local direction — in other words, the type of aid which NGOs such as Oxfam are spearheading — as opposed to aid which is given in the expectation of economic kick-backs for the donor nation, and which goes on projects which tend to strengthen the position of the urban-based ruling elites — in effect the type of aid given by the multi-lateral and unilateral agencies, such as the World Bank and USAID. Numerous examples are given of the failures of large-scale, mis-conceived, mis-managed projects which have totally failed to take into account local environmental and cultural factors, and which in attempting to produce short-term gains have "encouraged the spread of deserts, the destruction of productive forests, and the over-fishing of seas and lakes."

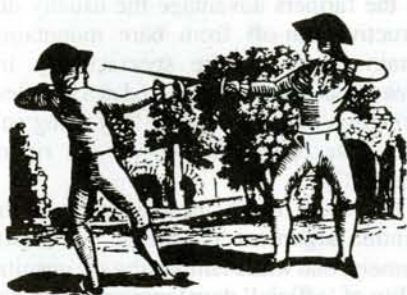
The examples of successful aid projects are generally small-scale grass-roots initiatives, but Timberlake shows that where the local people see a good idea at work (whether it be a new variety of bean or a new method of preventing soil erosion) they will be quick to adapt it and it will spread rapidly without further promotion from outside agencies. He explodes the myth of the ignorant peasant and shows that too often it is the 'expert' who is ignorant of local social, environmental and economic conditions. One of the most spectacular success-stories comes from the war-torn Ethiopian province of Tigray. A female worker from a European relief agency (which cannot be named for fear of jeopardizing its work in the rest of Ethiopia) walked into the centre of the rebel-held territory carrying \$303,850 in cash. Working closely with local officials and REST (Relief Society of Tigray), she helped to co-ordinate a programme of 'water-harvesting', building terraces and soil ridges at the base of mountains to turn

to the farmers advantage the usually destructive run-off from bare mountains. Grain harvests were spectacularly increased and posters appeared at a Peoples' Congress meeting reading "By using soil and water conservation, we get rid of drought".

But there is an inconsistency in the central argument of *Africa in Crisis*: namely, that while lambasting the unsuitability of 'official' development assistance as a cure for Africa's ills, the book calls for more of the same medicine. Timberlake canvasses for official assistance to be increased, with the proviso that official agencies must "work more through NGOs and small local organizations or work more like them — or maybe both." This ignores the essential philosophy behind the giving of official aid. It exists, not to help the poor achieve a secure food supply and a reasonable standard of living, but to increase markets for the products of the industrialized world, and to maintain the dependence of the poor on the rich. All aid has strings attached, although these may sometimes be invisible. Gift-giving, whether between individuals, groups, or nations is always based on the principal of reciprocity. Northern aid givers make sure that they get their money's worth in the form of huge contracts for arms or engineering projects, or at the least maintaining or establishing their influence in the countries from which they receive their supplies of raw materials. It is surely unrealistic to expect huge bureaucratic agencies set up with the above aims in mind — and whose main problem is not their lack of funds but rather the lack of 'absorptive capacity' in the Third World (that is, the inability of poor countries to absorb the huge amounts of money which the agencies have to spend) — to suddenly start behaving like community organizations.

While debt repayments from the less developed countries exceed the amounts they receive in aid from the more developed, while the exports of food from the poor to the rich exceed the flows in the opposite direction, and while the North continues to accelerate its use of the world's finite resources to produce frivolous, throwaway consumer goods, it is impossible to believe that Northern governments seriously want to alter the present imbalance between North and South.

Patrick McCully



Letters

Dear Sirs,
Dr. Richard Piccioni's article 'Food Irradiation: Contaminating our food' (*The Ecologist*, Vol.18, No.2/3, 1988), contains many misleading statements.

Piccioni contends that food irradiation is "an unscrupulous attempt to find a commercial use for nuclear wastes". How come then that the largest food irradiation facility — for irradiating grain in Odessa, USSR — does not have any nuclear wastes whatsoever, but a high voltage electron generator? How come that the largest food irradiation facility in the West — for irradiating meat in France — does not contain any nuclear wastes, but a high voltage electron generator?

The food industry has no interest in supporting the nuclear industry, and will use the most practical and economical means (including high voltage electron sources) for bringing the best and most wholesome food to consumers.

Piccioni lists in Table 1 a long series of articles indicating, as he says, that irradiated foods are not safe. Competent toxicologists have thoroughly perused all these articles together with other massive evidence that overwhelmingly indicate that irradiated foods are safe and wholesome. The World Health Organization has repeatedly convened committees of independent expert toxicologists to review the subject. They have concluded¹ that foods irradiated with a dose up to 10 kG/y (which covers most applications) are safe for consumption from a toxicological, nutritional and microbiological point of view.

In his one-sided article, Piccioni withholds from the reader the results of the many experiments showing that irradiated food is safe and wholesome. Let me take as an example the experiment by Bhaskaram and Sadasivan on polyploidy in kwashiorkor children (mentioned by Piccioni). In this Indian experiment, there were 5 malnour-

ished children in each group. In several much larger Chinese studies (none of which are mentioned by Piccioni), there were a total of 439 individuals.² No difference in the number of polyploid cells could be discerned between those fed irradiated and those fed unirradiated foods and little attention has been paid to the fact that in these Indian studies, the children fed irradiated wheat gained 30 per cent more weight than those fed unirradiated wheat.

The Bhaskaram and Sadasivan observation of zero polyploidy in the children fed unirradiated wheat is not representative. Erroneously, they believed that zero polyploidy was normal or standard. The skewed distribution observed in their small sample is consistent with the no effect hypothesis confirmed in much larger studies.

It is unfortunate that safety of irradiated foods, which has been repeatedly confirmed by many national and international expert committees in the past 10 years, is so much misinterpreted.

Yours faithfully,
Ari Brynjolfsson
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P.O.BOX 230,
6700 AE Wageningen,
The Netherlands.

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Food Irradiation: A Reply to the Food Industry

Dr. Richard Piccioni, whose article on the hazards of food irradiation appeared recently in *The Ecologist* (Vol. 18, Nos 2/3) answers the criticisms of Dr. Ari Brynjolfsson, Director, International Facility of Food Irradiation Technology

Richard Piccioni Replies:

Scientists concerned with food irradiation and public health should recognize that the evidence which is available in support of the safety of irradiated foods is uniformly very weak. This weakness stems from: (1) the inability to characterize thoroughly the chemical changes which take place in foods during irradiation; and, (2), the inability to expose test animals to significantly amplified doses of the *de facto* additives (for example, radiolytic products), a procedure which is strictly required in any other instance of carcinogenicity testing of food additives.¹ Because they lack a dose amplification factor, whole irradiated food feeding experiments² are generically incapable of detecting tumour risk factors which would lead to the immediate banning of any pesticide, preservative or food dye.

Because of these weaknesses in the testing of irradiated foods, the maximum excess cancer risk consistent with available toxicological data is enormous — easily several per cent for a human lifetime of exposure. Combined with the reports cited in my article (*The Ecologist*, Vol. 18, Nos. 2/3) which documents the presence of genotoxic activity and/or genotoxic substances after irradiation, that is more than ample scientific justification to ban food irradiation. Designating food irradiation a 'process' rather than an 'additive' — the approach adopted by the FAO/IAEA/WHO Joint Expert Committee³ — does not make this problem go away.

Moreover, a number of additional reports on the production of genotoxic activity in irradiated foods and food components should be added to Tables 1 and 2 of *The Ecologist* article.^{4,5} Of special interest is the identification of 6,7-dimethoxycoumarin (scoparone) in the peel of irradiated grapefruit.⁷ This compound, which

could not be detected in non-irradiated fruits, is now known to cause reproductive problems in rats.⁸ Grapefruit irradiation is being aggressively promoted by the US Department of Energy and others in the state of Florida.

Another study on the effects of irradiation on the levels of carcinogenic nitrosamines in cooked, cured bacon reported an increase in nitrosamine in irradiated bacon as compared to unirradiated controls.⁹ The authors suggested that the effect, observed in the dose range of 0.25 to 0.75 Mrad (2.5 to 7.5 kGy), was due to the radiation-induced production of malonaldehyde, a known catalyst of dimethylamine nitrosation.

A study conducted by the Shanghai Institutes of Radiation Medicine and Nuclear Research and widely cited as proof of the safety of irradiated foods¹⁰ has finally been published and made available in English translation.¹¹ Although the study was intended to refute previous results¹² showing that consumption of freshly irradiated wheat caused an increase in polyploidy in malnourished children, the Shanghai study used healthy adults, irradiated foods which had been stored for up to 180 days, and did not include irradiated wheat. In spite of these key differences from the Indian study conditions, the Shanghai study in fact reported an increase in polyploidy in the individuals eating irradiated foods. Observations on polyploidy incidence were confounded by the (unexplained) observation of an increase in polyploidy in the control group as well; however, based on a commonly-used statistical approach¹³, it emerges that the increase in polyploidy in the irradiated-diet group was significantly higher than in the control group at the 95 per cent level. Thus the Shanghai study lends support to the contention that irradiated foods, even when stored, can cause an increase in polyploidy in well-fed adults.

Dr. Brynjofsson's emphasis on the use of non-isotope radiation sources in food, irradiation is understandable, particularly in the light of the recent events in the US. Early last summer, a large (12 megacurie) cesium-137 irradiator near Atlanta, Georgia, began leaking uncontrollably, contaminating not only the source pool, but also the clothing, car seats, and homes of workers, as well as products which passed through the facility for weeks before the leak was discovered.¹⁴ The last few months have also seen the criminal conviction of one of the leading proponents of food irradiation for abuses relating to radiological safety in the handling of cobalt-60.¹⁵ Certainly,

isotope sources exist, are in use, and are giving food irradiation a bad name.

The future of food irradiation lies in the use of isotopes generated as waste or as by-products of nuclear reactors. The clearest evidence for this is the fact that three key nuclear agencies, the International Atomic Energy Agency (IAEA), Atomic Energy of Canada Ltd (AECL), and the USDOE fund and publish most of the research aimed at the promotion of food irradiation, and convene regular meetings to discuss its implementation. There may well be advantages to promoters of food irradiation to use electron-beam machines to introduce a very wary public to the habit of eating irradiated food;^{16,17} however, in the long run, IAEA, USDOE, AND AECL have little to gain from the construction of machine-source irradiators, and much to gain from the development of an industry which will require large quantities of isotopes extractable from nuclear waste.

In the meantime, the supply of isotopes continues to grow. By the year 2000, some 300,000 kg of plutonium will be separated in French and British reprocessing facilities¹⁸ making available some 3,000 megacuries of cesium-137.¹⁹ In the US, where the deterioration of military production reactors has become newsworthy, the President issued a directive to the Nuclear Regulatory Commission to prepare plans to "capture" spent fuel from commercial power reactors in case it is needed for military use via reprocessing.²⁰

Those who are sceptical about the future role of Cs-137 might consider the following statement from the USDOE:

"The goal of the Byproducts Utilization Programme is to transfer federally developed cesium-137 irradiation technology to the commercial sector as rapidly and successfully as possible."²¹

and a second statement from a prominent food irradiation industry spokesman (22):

"Notwithstanding the foregoing (increased cost of efficiently encapsulated Cs-137) the upwards of 90 million Curies of utilizable Cesium-137 at Hanford, which is expected to increase substantially, plus comparable amounts of present and future recoverable Cesium-137 at the Dept. of Energy's Savannah River, South Carolina, plant underscores the potential importance of this isotope as a gamma source for future food-processing applications. This could prove critical if radiation

processing takes off as it could in North America and worldwide, because it could outstrip the available cobalt-60 supply for a time at least, with cesium the only isotope alternative."

Yours Faithfully,
Richard Piccioni, PhD
Senior Staff Scientist
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314 West 91st Street,
New York, NY 10024.

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Nuclear Power: No Answer to the Greenhouse Effect

Dear Sirs,

Some counter is needed to your correspondent J. H. Fremlin (letters Vol. 18 Nos.2/3) which is a calculated exercise in exaggerating the dangers of burning fossil (or bio-mass) fuels in favour of more nuclear energy generation.

Yes, I agree one should be conserving fossil fuels but it is misleading to quote that much of the higher cancer rate in Glasgow is attributable to this source. Exhaust emissions, industrial effluents and smoking are the major causative agents.

Yes, I am concerned about the "Greenhouse Effect" but I am far more worried about the effects of man-made CFCs on this than the "4 million tons of carbon dioxide" quoted by your correspondent. The effects of CO₂ are dramatized by those who prefer to ignore both plant physiology and the capacity of autotrophs to rapidly assimilate this compound in photosynthesis. Leaves and green stems are extremely efficient at removing this gas from the air and the 0.03 per cent atmospheric CO₂ concentration is the main limiting factor in photosynthesis. Higher levels of CO₂ (especially where accompanied by an increase in light intensity) accelerate this process resulting in increased bio-mass yield.

According to Schroeder, global productivity of organic carbon by terrestrial plant communities is 16.6×10^9 metric tons/annum — a compelling reason (second only to loss of species diversity and exploitation/extermination of indigenous peoples) why we should be rigorously conserving the rain forest ecosystem which formerly contributed to 70 per cent of this total. However, the bulk of global carbon assimilation occurs in the oceans, due to photosynthesis of the phytoplankton of the euphotic zone. Riley has estimated organic carbon productivity to be $126 \pm 87 \times 10^9$ metric tons/annum, so that the bulk of CO₂ assimilation occurs in the marine environment — an environment which has been in-

creasingly abused by nuclear waste dumping, atomic weapon testing and running releases of plutonium-234, caesium-137, strontium-90, ruthenium-106, and other fission products from nuclear plants. These isotopes enter bio-geochemical cycles (including human food chains).

Yes, I am concerned about the "forty thousand tons of sulphur dioxide" emitted into the atmosphere, and in an ecologically responsible culture this would be removed and converted to useful by-products. The technology exists to do this and obtain clean air for a minimal increase in electricity prices. Also sulphur and nitrogen oxides are part of natural bio-geochemical cycles, unlike strontium-90 (a nasty bone seeking nuclide) and caesium-137 (which enters all soft tissues, replacing potassium in its catalytic capacity in cell chemistry) — both standard atmospheric releases of radionuclides from nuclear power plants.

Yes, I'd like to see the phasing out of nuclear energy. Those who support the so-called 'peaceful' uses of nuclear power should also be prepared to tolerate increasing military uses. To pretend we can have one without the other is naive or hypocritical or both. Expanding the 'peaceful' option by implication expands the military option and despite 'paper treaties' by politicians makes the threat of nuclear war a greater probability and increasing atomic weapon testing a definitive certainty.

When an atomic explosion occurs (which is possible in a 'peaceful' fast breeder reactor) large numbers of neutrons are released. These are captured by atmospheric nitrogen which is transformed to the unstable isotope nitrogen-15. This releases protons forming radioactive carbon-14 with a half-life of 5,350 years. This readily enters the carbon cycle, entering cells and producing both lethal mutations and long term genetic damage. Together with the seemingly insoluble problem of isolating highly active waste (with half-lives of millennia) from the biosphere, (generated courtesy of 'peaceful' nuclear fission) the build up of carbon-14 from weapon testing constitutes one of the most serious long-term threats to all life.

Yes, we must have the courage to 'let go' of nuclear energy and the greed and materialistic values implicit in the kind of unsustainable society which it supports. The tone of your correspondent's letter is that of entrenched mechanistic science, which seeks to conquer nature. We must learn to let go and live more simply within the constraints of the natural

world and show a greater reverence for life — a philosophy of the Quakers, Buddhists and those communities whose ecological values are in harmony with the integrity of creation. This means the urgent priority of limiting population growth and, in industrial societies, both conserving and reducing energy consumption as well, a goal compatible with a simpler, more wholesome lifestyle. Future energy demands (even at the present carrying capacity) could be met by wave, wind, geothermal and bio-mass generation.

Yours Faithfully,

John Sears
Ecological Consultant
Beech How
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Cumbria

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DIARY DATES AND COURSES

INTERNATIONAL WATER POWER and Dam Construction-Conference and exhibition to be held at the Hotel International, Zurich, Switzerland from 16-18 October 1989. For more details write to Conference Assistant, Water Power and Dam Construction, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS. Tel: +44 1 661 3622.

The Association of Natural Medicines are holding their 5th ANNUAL EXHIBITION OF NATURAL HEALING at Spring Lodge Community Centre, Witham, Essex on 15th and 16th of April 1989. Over the two days there will be a programme of lectures and displays on a wide range of related topics. Further details from the Secretary, 2 Harebell Drive, Witham, Essex. Tel: 0376 511069.

Medical Campaign Against Nuclear Weapons: NATIONAL CONFERENCE 'The Nuclear Mentality—Dynamics and Change', 22-23 April 1989 at the Royal College of Nursing, Cavendish Square, London W1. Peace is abroad but the nuclear arms race continues. Why? Eminent psychologists, psychoanalysts, military and media experts look at the individual, group and institutional dynamics behind the nuclear arms race and consider possibilities for change. Details and registration form from MCANW, 3 Stamford Street, London SE1 9NT. Tel: 01-261-1266.

Wageningen Agricultural University

International Congress 'Future of Butterflies in Europe: Strategies for Survival' Wageningen, The Netherlands, April 1989.

Requests for further details should be directed to the Congress Building, International Agricultural Centre, P O Box 88, 6700 AB Wageningen, The Netherlands.

The Society for Environmental Therapy presents a lecture on TRACE METALS CONTRIBUTING TO HEALTH. The speaker will be Dr Neil Ward, date 10th of May at the Adam Room, Institute for Complementary Medicine, 21 Portland Place, London W1N 3AF, time 7.30. Details from Natalie Firman, Oak House, 19 Whitegates Lane, Earley, Reading, Berks RG6 1EE. Tel: 0734 64140.

UNITING IN HEALING CONFERENCE, 27 and 28 May 1989 at Elmfield School, Love Lane, Oldswinford, Stourbridge, West Midlands. A gathering of experts and healers demonstrate their unique role in holistic health care. Lectures, demonstrations, workshops, accommodation, meals £20 per day. Send SAE to Dr Helen Ford, Holistic Health Centre, 119 Hagley Road, Stourbridge, West Midlands DY8 1RD. Tel: 0384 379740.

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THE NATURE CONSERVANCY COUNCIL is organising an international conference at the University of York, UK in September 1990. The general theme will be The Conservation and Management of Rivers. Papers on topics such as Philosophy of conservation, River classification, River management, The recovery and rehabilitation of rivers and streams etc. are requested. For information please write to: Dr P.J. Boon, Dept. FBB, Nature Conservancy Council, Northminster House, Peterborough PE1 1UA, UK.

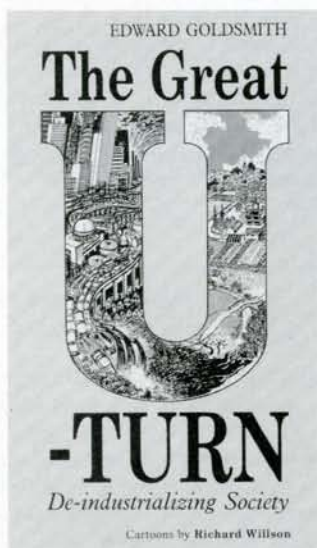
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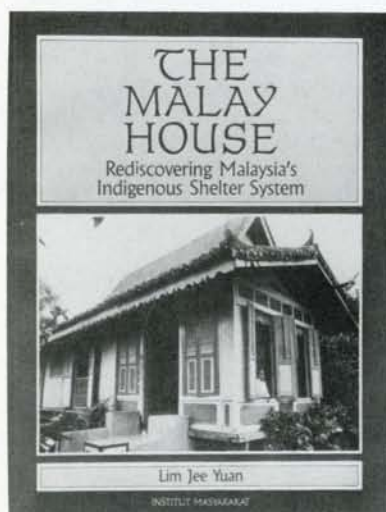
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