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Toxic Wastes: Playing in a Fools' Paradise?

The 1980s have seen a consistent barrage of reports damning waste disposal standards in Great Britain. The first salvo was fired in 1981 with the publication of the House of Lords Select Committee on Science and Technology's report on *Hazardous Waste Disposal*. The committee made no bones about the lax state of controls on waste disposal in Britain and warned, "Too many people are comforted by the belief that because nothing has gone wrong so far, nothing is likely to go wrong in the future. Constant vigilance will be needed or that comfortable belief could be rudely shattered."

That warning was quickly followed by three highly critical reports from the government's own Hazardous Waste Inspectorate (HWI). The first came to the blunt conclusion that "All is not well with hazardous waste disposal. Though there is no evidence that hazardous waste disposal is posing unacceptable risks to public health, we are not convinced that the standards and practices widely adopted by the disposal industry provide a sufficient guarantee of protection of the environment." A year later, in its second report, the HWI branded waste management in Britain as "ramshackle and antediluvian" and warned that if major problems had so far been avoided, "this is due more to luck than judgement". A third report — its last before the HWI was incorporated into the newly formed Inspectorate of Pollution — was no less critical, noting that "some operators are endeavouring to achieve short-term public acceptability of operation whilst jeopardising the long-term situation".

A Shambles

The latest volley comes from the House of Commons Select Committee on the Environment in its report *Toxic Waste*.[1] In view of the previous criticisms from the HWI and others, its opening sentence comes as no surprise: "Never, in any of our enquiries into environmental problems, have we experienced such consistent and universal criticism of existing legislation and of central and local government as we have during the course of this inquiry." Indeed, the report makes it abundantly clear that waste disposal in Britain is nothing short of a shambles. Among other things, it points out that:

- Fifteen years after the Control of Pollution Act (COPA) was introduced in order to control the disposal of "controlled wastes", the term "controlled waste" still remains unsatisfactorily defined;
- 56 out of the 79 Waste Disposal Authorities (WDA) in England and Wales have yet to submit plans for the disposal of controlled waste in their areas — some 10 years after the law required them to do so;
- The Department of Environment has "grossly understaffed" those sections responsible for monitoring and giving advice on waste disposal, with "only 6 inspectors in post to oversee more than 5000 disposal sites in England and Wales";
- The enactment of many key sections of the Control of Pollution Act has been "bedevilled by unexplained delays";
- There is "no consistency of standards between one Waste Disposal Authority and another. In many, the standards are extremely low, encouraging the operation of contractors who have no regard for the potential danger to the environment";
- Current legislation makes enforcement of site licences extremely difficult, and sometimes impossible, since prosecution requires site operators to be *caught in the act* of breaching their licence;
- Official guidelines on waste disposal lack statutory force, and are in many cases out of date in the information they provide;
- There is no legal requirement for waste disposal operators to provide for the aftercare of old landfill sites or to warn would-be buyers that the land has previously been used for waste disposal. Significantly, the consultants Clayton, Bostock, Hill and Rigby told the Committee that 16 per cent of new building developments in the West Midlands were on land now suspected of being contaminated, and that "half of all new building (in Britain) is now taking place on recycled land, most of (it) suspect in terms of contamination";
- That 1,390 landfill sites in England and Wales alone pose a risk of explosion due to the build-up of methane gas — 756 of them within 250 metres of housing. In 1986, gas from one such landfill ignited blowing a nearby bungalow to smithereens and severely injuring its inhabitants;
- And that although "the UK is fortunate to have escaped serious pollution incidents associated with old landfill sites . . allowing unscrupulous operators to dump waste, almost unchecked, because of the variations in licencing and loopholes in the Control of Pollution Act 1974, may be building up a legacy of environmental disasters for the future."

The Committee concludes that "waste disposers too often deploy the cheapest tolerable option rather than striving for the Best Practicable Environmental Option" and urges that the whole administrative system of waste disposal should be radically overhauled. "In our considered opinion, the Department of the Environment should go back to the drawing board. The present pattern of Waste Disposal Authorities based on historic administrative boundaries does not lend itself to the most effective way of organising the safe disposal, in suitable sites, of the waste generated by densely populated industrial areas."

It is a damning report and the committee's recommendations — the majority of which have been accepted by the government and will be incorporated into a new 'Green Bill' this autumn— are to be welcomed. In particular, the need to give the government's guidelines on waste disposal statutory force is long overdue, as are new provisions in the Control of Pollution Act to ensure the aftercare of old disposal sites and more effective enforcement of site licences.

Hitting the Wrong Target

Nonetheless, it would be a grave error to believe that, once in place, the promised legislation will put an end to Britain's growing waste disposal crisis. For, although they are a step in the right direction, *the Committee's recommendations rest on the*

fundamentally flawed assumption that the roots of the crisis lie in poor management and maladministration. Poor management is undoubtedly a major problem (as the Committee rightly notes "the worst sites are appalling and potential disaster areas") and no-one questions that a well-managed disposal site is preferable to a badly managed one. Equally, it is intolerable that the widely varying standards imposed by WDAs allow wastes that would be rejected for land disposal in one county to be disposed of without a murmur in the next. But, even supposing that one can actually "legislate" for better management (an assumption which is highly debatable), no amount of new laws can alter the fact that 90 per cent of the hazardous waste in Britain will still be disposed of via landfill, a method of disposal which study after study has shown to be *intrinsically* unsafe and which, for that reason, is now increasingly restricted in many other major industrialized countries.

Indeed, few (if any) of the landfills currently accepting hazardous waste in Britain would be permitted to operate in the US, where measures are now being introduced to ban the landfilling of hazardous wastes altogether, and most would not be considered acceptable in France, West Germany, Holland, Sweden, Norway or Denmark. Yet, for all its hard-hitting criticisms of current disposal practices, the Select Committee meekly accepts official reassurances that landfill is an environmentally safe method of hazardous waste disposal. More than that, the Committee comes out firmly in support of the practice of 'co-disposal', whereby hazardous wastes are mixed with household wastes. Although it acknowledges that "the UK is practically alone in its continued championship of co-disposal", the Committee concludes that the practice "is technically sound for a limited range of wastes".

That conclusion is hard to justify given the clear-cut evidence from the United States and elsewhere that, however well run, hazardous waste landfills are a major source of environmental contamination and public health hazards. Even those landfills which have been lined with "impermeable" material to prevent the contamination of groundwaters have not escaped major pollution problems. In 1980, Peter Montague, Director of the Hazardous Waste Programme at Princeton University, studied four supposedly "secure" landfills in New Jersey. All the landfills were equipped with elaborate systems to collect polluting leachate (the highly toxic liquor that accumulates in landfill sites) and were double-lined — a primary liner being placed above the leachate collection system and the secondary liner below. At one site, the primary liner (which consisted of 18 inches of clay) was found to be leaking 28-48 gallons of leachate a day within two years of operation. The other sites, which had synthetic liners, were no more secure. In one case, where the liners consisted of hypalon (a tough polymer material, reinforced with nylon), the primary liner leaked 124 gallons of leachate a day within four months of operation; a year later, the migration had slowed down but the liner was still leaking 50 gallons a day. The last two sites in the study both had PVC liners; at one, the liner leaked 2.5 to 3.5 gallons a day within a year of operation; at the other, the 30-millimetre thick primary liner leaked between 60 and 131 gallons a day within two months. Nor is that experience unique: a study by the US Environmental Protection Agency concludes unequivocally, "All liners eventually leak".

Groundwater Pollution

The threat to groundwaters is clear. Indeed, the House of Commons Environment Committee itself acknowledges that "a large number of landfill sites, mainly older ones, (are causing) local contamination of the groundwater around them"; that "once contamination of groundwater has occurred, it is rarely possible to rehabilitate the resource", and that, of the possible threats to groundwaters in Britain, "landfill sites are the most significant".

Reassurances from the Water Authorities that few public water supplies have so far been prejudiced as a result of landfill amount to little, since in all likelihood the true extent of groundwater contamination has been greatly underestimated.

- Firstly, as the National Environment Research Council (NERC) made clear in evidence to the Select Committee, the monitoring techniques employed by WDAs at landfills are frequently "inappropriate to detect groundwater deterioration", and may thus lead to "a feeling of false security and an underestimation of the true risk";
- Secondly, as the Department of the Environment reveals in its recent report *An Assessment of Groundwater Quality in England and Wales*, research into contamination by organic chemicals (which, as a class, contain a high number of carcinogens) has only "recently commenced in any serious form" — and then only for pesticides and industrial solvents. Already several cases of significant pollution have been uncovered and the DOE admits that "investigations may show the extent of contamination by organic compounds to be more widespread than is known at present". In effect, many of the water supplies which the Water Authorities reassure us are "safe for human consumption" may in fact be contaminated;
- And, finally, new EEC regulations imposing stricter limits on trace organic pollutants in groundwaters will, according to the DOE, make it "increasingly difficult for groundwater to meet water quality standards".

Ignoring Expert Advice

In light of the above, the Environment Committee's uncritical support of landfill is astounding. It is even more so given that *such support runs directly contrary to the recommendations of the NERC*, one of the few organizations in the United Kingdom researching the effects of landfill on groundwaters and soils. In its evidence to the Committee, the NERC made its opposition to the landfilling of hazardous wastes (and co-disposal in particular) quite explicit, warning that its continued use "may well lead to a gradual deterioration in regional as well as local groundwater quality".

Describing co-disposal as "an expedient response to an immediate problem which, unfortunately, takes no account of the potential long-term implications for public health and safety," the NERC told the Committee:

> "The assumptions that the toxic materials are diluted in a much larger volume of wastes and that this mixture is then non-hazardous . . . are suspect. First the degradation products and leachates arising from domestic wastes can themselves be serious water pollutants. Second many co-disposed waste substances are extremely long-lived and consequently will either remain exactly where they are buried, possibly as concentrated pockets, or be dispersed through the nearby wastes and surrounding rock formations."

The NERC concluded its evidence with one of the strongest statements against landfill yet voiced by an official body in Britain:

> "The problems of gas and leachate generation and of co-disposal, and the considerable uncertainty about the future behaviour of many landfills, suggest that a new approach to

waste disposal is required. We should no longer accept landfill as a convenient means of reclaiming derelict land if the long-term behaviour and stability of each site cannot be predicted and assured. Landfill (in the true sense of backfilling inconvenient holes in the ground) should thus be reserved for materials which are essentially inert and non-toxic, with predictable long-term stability, both physical and chemical. The implication of this suggestion is that degradable domestic wastes should not go directly to landfill, but ought to be sorted, recycled, reclaimed, used as fuel, and composted by encouraging accelerated biodegradation, to form an inert end-product which could then be used to landfill."

It is sound advice, and coming from the NERC, it should surely have been given detailed consideration by the Select Committee. Yet, it did not even receive a passing mention in the Committee's final report. Policy makers will thus remain unaware that one of Britain's most prestigious research organizations is opposed to the continuation of landfill as a means of disposing of hazardous waste. Such an omission is nothing short of shameful. It may not have been advice that the Committee wanted to hear, but it is advice that it ignores at *our* peril. It is up to the environmental movement to ensure that it is acted upon.

Nicholas Hildyard

1. House of Commons Environment Committee, *Toxic Waste*, Three Volumes, HMSO, London, 1989.

Scandalous Science

Science is the most respected scientific journal in the United States, and as such is read worldwide not only by scientists but also by industrialists, policy-makers, trade unionists and many other professionals who rely upon it as a source of objective and accurate information.

It is therefore a matter of grave concern to find unarguable evidence of increasing political bias in the journal's editorials, a bias which leans heavily in favour of industry and against environmentalists and others concerned with public health issues.

Concern over editorial bias in *Science* was first raised in 1987 by Professor Samuel Epstein of the School of Public Health, University of Illinois Medical Center, Chicago, after *Science* carried an editorial enthusiastically endorsing a lengthy article by Dr Bruce Ames, which effectively trivialized the significance of environmental contamination by synthetic and other industrial carcinogens, and concluded that such contamination did not warrant "the high costs of regulation"; Ames' current position is in complete contradiction of views he advocated only a few years ago. The article received wide publicity in the US press and has since been extensively circulated by various industry lobbying groups as part of a national strategy to oppose stricter controls at the federal and state level. Together with a group of nationally recognized authorities on environmental carcinogenesis and epidemiology, Epstein wrote a detailed rebuttal to Ames' article, but it was initially rejected. After a lengthy correspondence and repeated protests to Dr Daniel Koshland, Editor of *Science*, a severely shortened version was eventually published as a Technical Comment.

Now another editorial — 'The Product Liability Crisis' — has raised similar controversy. Only this time, *Science* has refused even to publish a letter by way of response. In the editorial, Dr Philip Abelson, the journal's deputy editor, charges that product liability suits (that is, law suits brought by individuals against companies and professionals for damages incurred as a result of faulty products or malpractice) are rendering US industry less competitive, have negatively affected medical practice, and constitute "a form of legalized extortion". A detailed article in reply to the editorial was submitted by Professor Epstein and Mr Ronald Simon, a leading labour lawyer in Washington, DC, and was subsequently endorsed by the American Association of Trial Lawyers and the United Automobile, Aerospace and Agricultural Implements Workers of America. It was rejected on the grounds of length. Following an offer to consider the reply as a short letter, Epstein and Simon reduced the original to 200 words (the stipulated length, although letters of 400 words or more are regularly published in *Science*). This letter was also rejected, this time on the alleged grounds that it "might prove actionable". In order that Abelson's views should not go unchallenged, we reproduce Epstein and Simon's abbreviated response to his editorial below:

"Abelson's editorial of 17 June 1988 excoriates the 'product liability crisis' in the United States. However, available evidence demonstrates that his assertions and opinions are uninformed and biased.

Abelson relies heavily on a 1988 Conference Board report, which characterizes product liability litigation as "pure and simple blackmail". Yet, Abelson fails to indicate that this report is based on a questionnaire survey of Chief Executive Officers of major corporations, and merely summarizes their opinions and anecdotal comments.

Contrary to Abelson, extensive studies have proven that there is *no* explosion of tort litigation. The National Center for State Courts concluded that there was "no evidence to support the often cited evidence of a national 'litigation explosion' in the state trial courts during the 1981-1984 time period".[1] The Rand Institute of Civil Justice reported that tort filings have increased by only 3 per cent above population growth since 1981 and, contrary to Abelson's fantasies about the large tort verdicts, that "the median jury award has not increased more than the rate of inflation", and also that median tort awards have been stable from 1960 to 1985.[2] In a subsequent study, Rand confirmed that "... the amount of tort litigation nationwide is growing relatively slowly."[3]

In the absence of any supportive evidence, Abelson claims that, due to product liability litigation, "the competitiveness of the US has been lessened . . . (and that) the product liability system imposes a heavy burden on the firms that make long-

lasting high quality products." Similarly, he asserts that such litigation has a "negative impact on medicine", without reference to the consequences of medical negligence and incompetence, and the failure of the medical community to remedy these problems. Another undocumented assertion is that "some of the huge punitive awards that are made seem to be motivated by a desire to injure the rich or powerful rather than to render justice." Abelson's understanding of "justice" excludes countless American workers and consumers who have been injured or killed by dangerous products.

The bulk of product liability litigation relates to a relatively few highly hazardous products, such as asbestos and the Dalkon Shield. In litigation on these products, it has been proven that their hazards were fully known and wilfully concealed by the companies that sold them. A principle reason why product and toxic tort litigation can be expensive is because corporations, their insurance carriers and lawyers, go to extraordinary lengths to block the plaintiffs and the public from discovering how much and for how long they have known about the hazards of their products, and how little, if any, they have done to correct or warn about such defects. Defendants spend lavishly in litigation, not only to make it prohibitively expensive to sue them, but also precisely because they fear punitive damages should such information become known to the courts. The high cost of litigation is thus largely created by the practiced strategy of corporate defendants who refuse to surrender product information as required by law, and who practice delay and stonewalling, necessitating extensive depositions and subpoenas, and repeated motions to the Court to enforce the law.

Abelson ignores recent anti-trust litigation, filed by the attorneys general of some twenty states, which demonstrates that the so-called "liability crisis" is no more than a blatant public relations campaign mounted by the insurance industry to justify massive rate increases to cover losses from past bad investment decisions. The insurance industry is charged with manufacturing the "liability crisis" by conspiring to deny insurance in order to raise rates and coerce the public to accept unconscionable limitations in their coverage.

Abelson's unfounded assertions on the "product liability crisis" are consistent with a series of other biased positions he has previously expressed in *Science* editorials.[4] Whether the editorial columns of *Science* are appropriate forums for the continuing advocacy of such undocumented and prejudiced opinions is a matter of critical concern to the membership of the AAAS."

With consumers' associations worldwide campaigning for stricter laws to protect individuals from defective products and from professional malpractice, products liability is an important issue. *Science*'s willingness to publish factually incorrect and biased information on the subject — and its intransigent refusal to publish a response correcting those errors — must bring into question its integrity, not only on this issue but on others relating to environmental and consumer affairs.

We would urge readers, particularly those who are members of the American Association for the Advancement of Science, the journal's parent body, to write to Dr Walter E. Massey, the President of the Board of Directors, expressing their disquiet over the handling of this and the Ames issues and to request a review of recent editorials for fairness and factual validity. Dr Massey's address is: The University of Chicago, 5801 Ellis Avenue, Chicago, Illinois 60637, USA. Dr Massey should also be asked to send copies to the AAAS Board of Directors and also to the Editorial Board of *Science*. Copies of these letters should also be sent to the editorial office of *The Ecologist*.

Nicholas Hildyard

1. National Center for State Courts 1, *A Preliminary Examination of Available Civil and Criminal Trend Data in State Trial Courts for 1978, 1981 and 1984*, April 1986.
2. J.S.Kakalik and N.M.Pace, *Cost and Compensation Paid in Tort Litigation*, Rand, 1986.
3. D.R.Hensler, M.E.Vaiana, J.S.Kakalik and M.A.Peterson, *Trends in Tort Litigation: The Story behind the Statistics*, Rand 6, 1987
4. For example, P.H.Abelson, *Science* 237, p.473, 1987.

Opening Pandora's Box:
The Risks of Releasing Genetically Engineered Organisms

by
Paul Hatchwell

The rapidly developing technology of genetic engineering will have wide-ranging and highly significant ramifications for human society and the natural world. The commercial production and release of new forms of organisms will soon be commonplace, yet there has been little open discussion on how this technology will be controlled or on the possible consequences of releases into the natural world. The methods of assessing the effects of releases or of monitoring them once they have been released are crude. Harmful effects to ecosystems will only be accurately assessed after the organisms have been released.

Biotechnology can be defined as: "The utilization of a biological process, be it microbial, plant or animal cells, or their constituents to provide goods and services".[1] Fermentation, selective plant breeding, and the domestication of animals have developed over millennia, and have provided the basis for our civilization. Genetic engineering, however, involves fundamental changes in the DNA sequence of living cells by entirely artificial means, via *in vitro* fusion of cells or components of cells: such organisms are termed 'recombinant', and are 'transgenic' where separate natural species have been crossed. The probability of such events occurring in the normal course of evolution is extremely low, since natural mutation rates are insufficient, and since behavioural, physical, or geographical barriers normally preclude natural transgenic crosses. Genetic engineering will artificially change the course and speed of evolution, to an extent previously unimaginable.

In the United States, the issues raised by the advent of biotechnology, and especially of genetic manipulation, are wide-ranging and increasingly controversial,[2] in the UK, the debate has only just begun. Crucial decisions that will eventually affect all of us are already being taken. Currently, no comprehensive statistics on either the number or type of releases to date are readily available from regulatory agencies at the UK or European Community level, let alone at the global level. To date, seven releases have occurred in the UK, in some cases involving multiple releases. In France, the number may already exceed 20.

The Economic Impact of Biotechnology

During the next few decades, biotechnology and genetic engineering are likely to become increasingly prominent in economic terms, particularly to the European, US, and Japanese economies, gradually replacing the present fossil-fuel, and inorganic mineral-based industrial structures. In several European economies, biotechnology already accounted for 20-25 per cent of the Gross Domestic Product as early as 1978;[3] by 1984, investment in genetic engineering had already exceeded $2.5 billion,[4] whilst the worldwide figure (for all biotechnologies) could reach $27-64 billion by the end of the century,[5] if some of the more bullish 'guesstimates' are to be believed. In the medium term, the economic effect will be similar to the boom in micro-electronics, but the long-term effects on society and economy will be immeasurably greater.

The fullest adoption of genetic engineering would involve fundamental changes in the way we think about our place in the natural order. Ultimately, say the technocrats, we could even be deciding upon a natural order, and engineering nature according to our priorities (or whims) at the time. Under such circumstances the question could become not so much where humanity belongs in nature, but rather whether nature has any place at all in a largely artificial world. The consequences of such an arrogant attitude to biological conservation would be disastrous, both for biological conservation and to ourselves.

Microbe Releases

Undoubtedly, there are benefits to be had from engineered microbes capable, for example, of removing heavy metals from polluted waters cheaply and efficiently. But, although the release of microbes capable of metabolizing oil[6] and concentrating heavy metals from low-grade ores is imminent, no serious effort has been made to understand the potential ecological hazards involved. The possibility of uncontrolled pollution of watercourses, by ore deposits of microbially enhanced grade over much wider areas than intended, cannot be lightly dismissed.

The risk of such organisms spreading out of control has been characterized as one of low probability, but with a large potential for damage. The probability of survival is clearly increased with frequent releases of such organisms *en masse*. The use of genetically engineered micro-organisms (GEMS), in place of agro-chemicals, is one such area of possible risk.

A US firm has recently released a genetically engineered version of the bacterium *Pseudomonas syringae*, which in nature facilitates the formation of frost, and hence causes damage to

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crops.[7] The gene responsible for ice-nucleation has been deleted, and it is intended that this mutant strain ('Frostban') should displace the 'damaging' natural one from the environment. This is an alarming prospect, particularly since it is likely that the natural strain is involved in the formation of rain by ice nuclei and there could also be serious disruption of sub-Arctic and Antarctic environments, causing ice-retreat. Finally, there is once again the possibility of genetic transfer to other bacteria, with even less predictable consequences.

Historic Parallels With Novel Releases

Ecology is still some way from fully explaining the complex functions and interrelationships of natural ecosystems, let alone the influence recombinant organisms could have upon these communities.

On the other hand, ecologists (and governments) are acutely aware of some of the adverse effects that have resulted from the intentional or accidental release of exotic organisms with no natural predators into an environment: the case of grazing damage by escaped Mink, and Coypu rodents in East Anglia; habitat damage by Brown Rats, carried by shipping, to tropical islands; loss of defenceless island fauna to feral cats in the Galapagos Islands; overgrazing by Red Deer in New Zealand; severe potato losses to Colorado Beetle (*Leptinotarsa decemlineata*); choking of freshwater habitat and canals by South American Water Hyacinth (*Eichhornia crassipes*) in tropical Africa, South-East Asia, and the United States; 'Killer' Bees in Brazil; and Dutch Elm Disease in Europe and North America, to name a few of the best-known examples.

It is fair to point out that only a minority of introductions are likely to reach such pest proportions, since most new species will not be capable of competing effectively for a niche in an unfamiliar community. On the other hand, if they *do* succeed, they could displace indigenous species, resulting in potentially disastrous changes for the rest of the food web. Sometimes the effects on other species are more subtle, for example, the replacement of Red Squirrels in lowland Britain by the North American Grey Squirrel has yet to be fully explained, but it appears that the latter species was able to take advantage of a low point in the natural population cycle of the former due to disease, and that this replacement became permanent.[8]

During the next decade, the number of releases of genetically engineered organisms will increase enormously, once legal constraints have been overcome. Although most of these organisms will remain harmless, the sheer numbers involved will all but ensure that a significant number achieve pest status and other non-pests may also have subtle effects in natural ecosystems. In 1987, Dr David Bishop, of the Institute of Virology, Oxford, predicted 10-12 notifications of releases in 1988, 50 per year after three years, and 100 after five years.[9] Whilst the actual number for the UK to date remains at only seven, these longer term predictions reveal the extent of the regulatory log-jam that is already building up.

Exotic Pests and Weeds

A study of historical introductions of exotic species by Professor Mark Williamson, a biologist at York University, suggests that 10 per cent of exotics introduced into Britain became established in the wild, and that 10 per cent of these became pests.[10]

"The fullest adoption of genetic engineering would involve fundamental changes in the way we think about our place in the natural order."

On the other hand, taken alone, this understates the scale of the problem since introduced species seem to include a much higher proportion of serious pests than indigenous ones. Introduced species represent the highest proportion of insect pest species in North America (over 60 per cent), Australia, New Zealand and South Africa, due to large-scale European settlement. Of the weeds present in Australia, 60 per cent are introduced, as are over 80 per cent in New Zealand.[11] Isolated islands appear to be rather more susceptible than continental areas, Hawaii being a notable example. The factors leading from colonization to outbreak are rarely predictable, due to the lack of historical observations of this early phase in the pest's development.

Past experience suggests that the establishment of a new pest or disease could become almost an annual event within a decade, as recombinant releases become increasingly commonplace.

Nor should the larger number of seemingly benign established alien species be ignored. In sensitive ecosystems, particularly where certain species are already threatened, large numbers of new introductions could make the difference between extinction and survival, whether or not the latter thrive. In addition, the possibility always exists that a benign alien species may become more virulent if new opportunities for colonization arise in that ecosystem in future — the case of the Grey Squirrel has already been alluded to.

Lessons From Ecology

Generally speaking, there seem to be three mechanisms by which exotics can damage a community:

- Firstly, a specialized exotic organism may displace an indigenous one occupying a parallel niche, leading to possible extinction of the latter by 'competitive replacement'. The European starling (*Sturnus vulgaris*), introduced into North America in 1891 (*figure 1*) has largely displaced the bluebird (*Sialia sialis*), and the yellow-shafted flicker (*Colaptes auratus*), from their nest-sites in tree- and man-made holes.[12]
- Secondly, a generalist occupying a very wide niche may displace several indigenous species, either directly or indirectly, by habitat destruction, the well-documented example of Brown Rat invasions of isolated oceanic islands being a case in point. This process tends to be most rapid where competition is reduced, particularly on islands.
- A third way by which a community can be affected is by the introduction of a new disease or parasite, although the effects tend to be limited to a narrow range of hosts. If the affected host species is itself a major habitat for other species, such as either of the two British species of oak or elm, the implications for the ecosystem as a whole are potentially catastrophic.

Taxon Cycles

In island ecosystems, it is believed that all species go through what is known as a 'taxon cycle'.[13] A taxon cycle begins with

an alien species arriving in a local ecosystem, often causing local extinctions through competition for resources. Once ecological disruption has reached a certain point, competition for resources by the invader becomes more severe and natural selection operates to mould the species to a new natural community, and stability is eventually restored.

In the case of the Galapagos Islands, differing conditions on each island, together with long periods of isolation, led to a remarkable development of several highly-specialized species of Finch ('Darwin's Finches') probably derived from one invading species, a process known as 'adaptive radiation'.[14]

At the end of the taxon cycle, extinction ensues. Keener competition from less specialized species, often invaders themselves, increases. Niches become too narrow (overspecialization), and numbers fall to levels at which random mutations known as 'genetic drift' and natural population cycles now jeopardize the viability of the species.[15] Meanwhile, replacement from neighbouring islands ceases, since specialization has led to a loss of the original powers of dispersal.[16] Since new species are always arriving, it follows that the established species are in various stages of the taxonomic cycle, and that the process will be slower on more remote islands. On a smaller scale, similar processes are believed to operate on isolated mainland habitats, such as fragmented woods and heathland.[17]

The 'trigger' for a taxon cycle appears to be the arrival of an exotic species in an ecosystem. Arguably, this is a situation comparable with that of pests or diseases, such as Dutch Elm Disease which first appeared at Southampton in the mid-1960s from a Canadian timber shipment. The disease spread rapidly, leaving most of England's elms dead within two decades. Presumably there is tremendous pressure to specialise operating on the offending fungus (*Ceratocystis ulmi*), as well as for the development of a resistant race of elm. The problem is that we have no idea of the length of time involved in such ecological adjustments — they could take decades, centuries, or even geological time-spans.

Colonists In Island Ecosytems

In his now classic 1961 paper,[18] Southwood found that indigenous British tree species exhibited widely varying numbers of associated insects that were not explained by palatability or present abundance alone. By analysing pollen quantities in the geological record it was found that those species which had been present for the longest periods and in the greatest abundance had accumulated the richest insect communities. These species have co-evolved with their host trees over long periods of time, the nature of the relationship probably having changed from one of host and parasite to a more benign or even symbiotic one. In this way, it is clear that the community associated with the tree, and the tree itself, which is arguably a form of ecological island, has adjusted to accommodate the new species and stability is restored. As with an oceanic island, the community theoretically tends towards progressively greater complexity with each addition, until a 'climax' community is established, where extinctions and colonizations are in a state of dynamic equilibrium, at least until a major environmental change occurs. It is clear that genetically engineered species that become pests could produce excessive disruption, not permitting accommodation to occur. Equally, introduced crops can represent new habitats for colonization by native species, leading to pest damage, on a human timescale at least.[19]

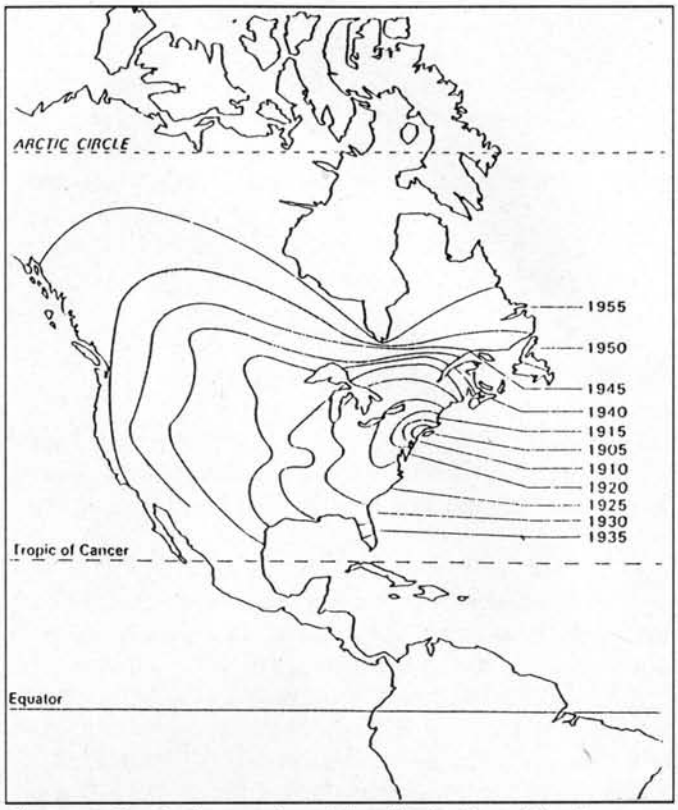


Figure 1. Gradual extension of the distribution of the European Starling in North America from 1905 to 1955. (Reproduced with permission from: C.B. Cox and Peter D. Moore, Biogeography; An Ecological and Evolutionary Perspective, Blackwell, 1980.)

A further complication arises because we are constantly disrupting and simplifying ecosystems, leaving them stressed and therefore vulnerable to invasion by alien species. The recent threat to Australian forests by the fungus *Phytopthora cinnamoni*, spread by logging traffic on forest roads, is a case in point.

It is likely that on rare occasions, genetic transfer to other species occurs in nature, with highly disruptive effects on ecosystems. Such an event could be caused by the arrival of a new virus, or retro-virus, acting as a vector. This process may be one cause of the phenomenon of 'evolutionary bursts', evident from the fossil record. If so, there are alarming parallels with GEMs, and the use of viral vectors in recombinant technology.

Although we cannot be sure how long ecological adjustment to a new species can take in nature, it is clear that biotechnology could be unleashing a Pandora's Box of hazardous organisms at a rate far higher than they could be absorbed by natural communities. In effect, environmental health would not have time to recover from a previous onslaught, and would be progressively degraded and destabilized.

The Threat From Recombinant Organism Releases

To be a serious threat to ecosystems, recombinant organisms would need to persist, to spread out of control, or to transfer undesirable traits to wild or domestic species.

The persistence and mobility of natural micro-organisms adapted to survive or degrade particular pollutants in soil and water has been shown. For example, bacteria found on riverbed stones can very rapidly develop the capacity to degrade organic pollutants, yet, if removed to cleaner waters, the bacteria lose

this ability, but survive.[20] Similarly, a GEM could be mobile enough to colonize new territory, with the possible re-appearance of the engineered trait under favourable conditions.

Genetic transfer to other species from GEMs has frequently been shown to occur in the laboratory, although field evidence is still being assessed. Given that new natural strains of nitrogen-fixing *Rhizobium* species associated with legume roots developed within a few years of initial introductions into Australia,[21] and that genetic transfer to related species of *Rhizobium* and even human gut bacteria has been shown in the laboratory,[22] it is obvious that the possibility of uncontrollable proliferation exists.

A key issue is the rate of genetic transfer in the natural environment, knowledge of which helps put hazards from engineered releases into context. It is now known that such events are far more common between simpler lifeforms, such as viruses, than between higher plants, and animals. For example, bacteria are well known to transfer resistance to antibiotics. In one recent experiment, resistance to the widely used antibiotic tetracycline was transferred not only between the gut flora of separate chickens ingesting the drug, in one case some 50 feet apart, but between these and the gut flora of a human being taking none.[23] Significantly, in most cases genetic manipulation involves microbes, precisely because the insertion of foreign material is more likely to be expressed in GEMs.

Genetic Transfer Between Multicellular Organisms

Multicellular organisms, such as plants and mammals, possess very much larger genomes, much of which remain a mystery. In plants, only some five per cent of the genome appears to be expressed as identifiable traits,[24] with the rest including a high proportion of 'cryptic DNA sequences' that do not appear to code for anything. Consequently, genetic engineers have claimed that the probability of an accidentally transferred gene being expressed is so low as to be negligible.

However, this is a dangerous assumption. Many of the more complex and ecologically significant traits in higher organisms are controlled by highly complex interactions between several genes. Moreover, we have very little knowledge of the environmental factors that could 'switch on' such apparently benign sequences in the future, under altered circumstances. In other words, such assurances owe more to the notion that 'ignorance is bliss', than to proven fact.

Even plants can experience substantial genetic transfer within closely related populations. A study by Ellstrand revealed a gene flow via pollen of between 4.5 per cent and two per cent in wild radish populations separated by up to a kilometre. Given such fluxes, the possible selective advantages arising from them, and the intimate association between crops and weedy relatives in agro-ecosystems, Ellstrand not surprisingly concludes that "Without substantial mitigation...ecological damage seems likely, or even certain".[25] Other evidence for transfer between crops and wild relatives abounds. In Mexico, where wild maize ('teosinte') and its domesticated relative grow alongside each other, both the crop and wild populations are altered, though almost indistinguishably, as a result.[26] In Africa, sorghum cereal crops have hybridized with weedy relatives, producing a serious pest known as 'shattercane' which can mimic the crop.[27] Such studies show not only that genetic transfer between plants occurs, but also that the resultant crosses often pass unnoticed.

As recombinant material accumulates in the environment, we could be creating a genetic and ecological 'time bomb' that could blight future generations.

Survival Chances of Releases

Proponents of releases often claim that the chances of survival and therefore of genetic transfer are low, since most genetic alterations tend to reduce the fitness of the organism. This may be true of the overwhelming majority of natural mutants, but with genetic manipulation a number of altered organisms could equally well hold their ground or even thrive in the wild — if they were unable to persist, they would scarcely be worth the investment.

Furthermore, human intervention could shift environmental conditions in the favour of artificial organisms. For example, if herbicide resistance was to be transferred to wild relatives of an engineered crop, further applications of agro-chemicals would tend to select for these mutant strains, and to displace the original weeds. Since most crops are intimately associated with weedy wild relatives, the potential for genetic transfer is large. Similarly, antibiotic resistance, if transferred to human pathogenic bacteria by genetic transfer, could well become even more prevalent, given the selective pressure from widespread antibiotic use.

Genetic engineers refer to a 'numbers game', in which the risks mentioned are reduced by minimising the numbers involved in each release; without sufficient numbers, it is argued, natural selection is less likely to generate new strains. Unfortunately, the cumulative effect of increasing numbers of persistent releases

from different sources, reduces the value of such assurances from individual companies involved.

Monitoring Engineered Organisms

Current monitoring methods include a range of traditional and more advanced techniques. Each method has both advantages and weaknesses, which have been assessed in a detailed study by Colwell, a leading authority on the subject, at the University of Maryland.[28]

The presence of GEMs can readily be detected if a 'marker' gene is inserted. Several of the current releases of engineered organisms are field monitoring trials of this sort, the only change being a marker, or 'junk' gene. These trials have been criticized as resistance to certain antibiotics has been used for identification in field samples. The possible hazards involved in widespread transfer of this trait to pathogenic microbes are clearly serious for the health of humans and livestock. The use of alternative markers, for example involving differential take-up of specific dyes in samples, is now increasingly encouraged.

In November 1987, the first controversial field trials were carried out on the bacterium *Pseudomonas fluorescens* near Blackville, South Carolina, by researchers from Clemson University.[29] Bacteria which had been genetically altered to turn blue in the presence of a chemical known as 'X-Gal' and were also resistant to the antibiotic rifampcin rendering them easily detectable in soil samples, were sprayed onto winter wheat seeds during planting. In time, the multinational corporation Monsanto, expects valuable information to be provided on the movement of microbes in the environment. More importantly from the point of view of the industry, it is hoped that these trials will show that the insertion of such 'marker' genes into organisms is an effective method of facilitating monitoring of other planned releases, thereby convincing regulatory authorities of their responsible attitude. Certainly, confidence will need to be restored after recent illegal releases.[30]

Surprisingly, there will be no legal requirement at all to 'label' recombinant organisms in the forthcoming revised UK guidelines.

A combination of monitoring methods, depending on the type of organism, release site, and knowledge of its natural ancestors, can increasingly provide the means to monitor releases in the shorter term. However, the value of rapid advances in monitoring techniques is severely undermined by the lack of baseline studies of natural microbial populations in soil and water. The unglamorous task of classification of these communities has been neglected, and underfunded. Only medically significant bacteria are well-documented. The UK Department of the Environment estimates that only five per cent of soil micro-organisms are detectable in samples.[31] Until these vast gaps in our understanding of ecosystems are filled, there is little hope of accurate long-term monitoring of GEMs.

The Risks of Risk Assessment

Scientific opinion remains divided over the adequacy of pre-release trials, particularly of GEMS. Initial releases of GEMS are often carried out in contained miniaturized ecosystems, known as 'microcosm studies'. These are claimed to satisfactorily reflect behaviour in the wider environment, without the risks of release, and are increasingly popular with both companies and regulatory agencies.

In the 1950s, the Californian ecologist, Huffaker, experimented with predatory and plant-eating mites in orange boxes as confined ecosystems. He found that population cycles of predator and prey were grossly distorted and that the ecosystem was unstable. However, with a more varied habitat and more shelter from predation (in this case, more oranges), the long-term survival chances and stability of the ecosystem were greatly increased, though still well below natural conditions.

Current microcosm studies by the US Environmental Protection Agency are habitually discontinued after a few weeks, since after this period, it is claimed that the results become erratic and 'unreliable'. This is surely a clear indictment of the longer-term predictive value of microcosms, no matter how complex they have become.

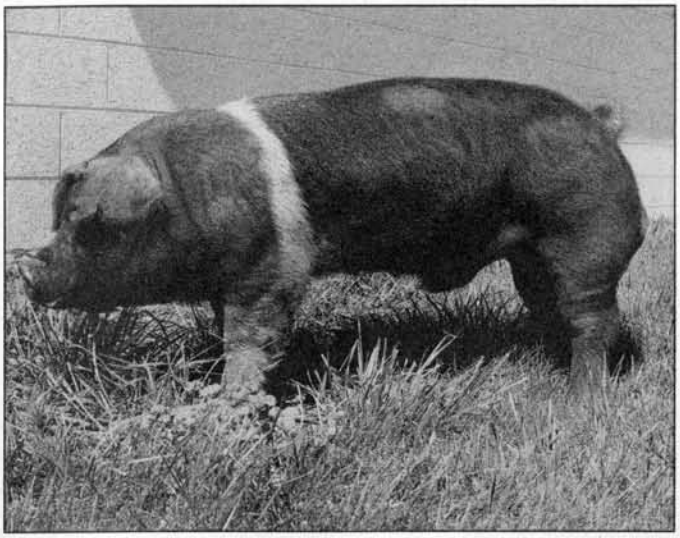
Whilst such tests may reveal some of the more gross ecological distortions that could occur, they are necessarily too simplified, and too short-term, to reveal longer-term hazards of persistence, genetic transfer, and ecological disruption. In any case, ecological conditions will vary at each release site.

Restricted 'monitored release' field trials in the wider environment are the only other way of testing the behaviour of recombinant organisms under less artificial conditions. For example, the contained release of the weakened baculo-virus *Autographica californica*, intended to control small mottled willow moths was accomplished in 1987 by the Institute of Virology, Oxford, without incident,[32] the protective viral coat having been removed, and a gene deleted to provide a genetic marker. This success has been used to show that such trials can be environmentally benign. However, the majority of experimental releases proposed or in progress involve unweakened GEMs, well able to survive for extended periods in the environment. Clearly, the risks from such research are real, especially in the absence of comprehensive monitoring ability and risk assessment models.

Reducing the Hazards From Novel Organisms

The most obvious barrier to uncontrolled spread is that of physical containment. Good laboratory practice is clearly most important in the earlier stages of product research. The containment policy for serious pathogens has undergone a number of changes in both the USA and the UK. Early concern in both the public and scientific communities led to a voluntary moratorium on certain lines of research considered to be of high risk, and more stringent codes of practice for general containment of bio-hazards. However, the non-appearance of predicted problems and increasing commercial and scientific curiosity, later overcame many of these taboos, and the rules were relaxed. The halting of the controversial European Community Human Genome Project, involving the mapping of human DNA sequences, pending the introduction of more stringent regulations, suggests that public concern may have begun to turn the tide.

Unfortunately, abuses in developing countries are more easily overlooked or ignored. Increasing public concern in the advanced economies is already tending to push hazardous lines of research further afield. In Argentina, during 1986, the Pan-American Health Organization and the US-based Wistar Institute carried out trials of a recombinant rabies vaccine on humans and livestock — in direct contravention of a law forbidding importation of exotic micro-organisms and without proper medi-



A transgenic pig from Beltsville, Maryland, which is crippled by a genetic disorder. This animal, which received a human growth gene, is claimed as a success by genetic engineers as it has only about a fifth the normal amount of fat. (Photo: Technology Review)

cal and regulatory controls. Two workers were infected by the recombinant virus, and both the cattle and their (unpasteurized) milk were consumed.[33]

Even the Developed World has not escaped research abuses. The current secretive sale of milk from UK dairy herds treated to raise yields with Bovine Somatotropin hormone does not augur well for the future.

Accidents or inadequate precautions have already led to several reported cases of viral infection in HIV and other research laboratories. In one case, Paul Berg of Stanford University, USA, admitted that most of his research team had routinely developed antibodies to monkey Simian Virus within a year, in a supposedly highly secure laboratory.[34] Even where the strictest rules are applied, biological contamination of laboratory equipment and waste is not necessarily removed by high temperature sterilization (autoclaving), before disposal or re-use.

Controlling Deliberate Releases

The most controversial aspect of genetic engineering is, of course, that of deliberate recombinant releases into the wider environment. The dangers of genetic transfer and of uncontrolled proliferation are the key areas of concern. Several methods of control are proposed, depending on the nature of the organism involved.

Large, domesticated animals are obviously the least problematic, being kept isolated from contact with non-transgenic stock by containment in pens. However, in the Third World context, as shown by the Argentinian cattle example, even these rules are not necessarily enforceable.

The problem of controlling released microbes (GEMs) is vastly more difficult, even if they do prove adequately detectable. Once released, they cannot simply be recalled to the laboratory. One common method by which synthesized microbes could be controlled is by the insertion of genes that would cause them to self-destruct after an appropriate period of time. The problem is not necessarily solved by this means, however, since the offending part of the genome of GEMs could 'jump' to a wild relative or even to another species before the organism destructs. The species barrier is far more plastic than formerly realized, especially in the evolution of new bacterial strains.

To make matters worse, there is a conflict of interest between safety considerations, demanding a short-lived and weakened GEM, and the commercial desire for a persistent product, that would be more marketable.

Regulating the Genetic Engineers

As a result of past experience with pests, many nations have imposed restrictions on the international movement of certain agricultural products and livestock across borders. However, there is now increasing commercial pressures for similarly strict controls on recombinant releases to be relaxed. Jeremy Rifkin and others claim this is due to the backlog of products awaiting consideration, and consequent political pressures. In the case of the 'Ice-Minus' bacterium, release was prevented by a protracted legal battle in the Californian courts. Rifkin maintained that the planned release should be the object of an Environmental Impact Statement, under the 1969 National Environmental Policy Act. Although Rifkin won the case, the firm concerned went ahead with an illegal rooftop release, and were fined. In other cases, firms have simply gone to less restrictive countries.

In the UK, a voluntary scheme for deliberate release projects has been in operation since April, 1986. Under the Health and Safety at Work Act, 1974, potentially hazardous activities are notified to the Health and Safety Executive, with other interested parties involved including the Department of the Environment, and the Ministry of Agriculture, Fisheries & Food. The Advisory Committee on Genetic Manipulation (ACGM), composed of representatives of industry, employees, local authorities and scientists, acts as the principle scientific adviser to the relevant government departments. The Royal Commission on Environmental Pollution will publish the results of its study into the release of genetically engineered organisms in July, 1989, and the Government has indicated that it may introduce additional legislation on the matter in an Environment Bill expected to be introduced to Parliament later in 1989.[35]

Currently, proposed releases are judged on a case by case basis, with only generalized guidelines from the UK Advisory Committee on Genetic Manipulation. Given the unique nature of individual organisms, many genetic engineers argue this is the best that can be expected. However, new statutory regulations will now require prior notification of the Advisory Committee on Genetic Manipulation, stating the nature of the organism, release site, monitoring and emergency arrangements, and other details, although these regulations still fall far short of equivalent West German and Danish restrictions. The UK maintains that an unnecessarily restrictive regime would damage the fledgling biotechnological industry in Europe, or drive it elsewhere, as has been the experience in the United States.

The Need For Public Debate

It is increasingly clear that the development of an effective regulatory framework will have to await more accurate means to monitor novel organisms, and an accompanying predictive ecology for risk-assessment. There is also a need for much greater involvement of the public in the evolution of the genetic engineering industry; given the controversial issues involved, public accountability is crucial.

Currently, the European Commission is reviewing the inadequate regulatory framework that has developed to cover genetic engineering. New measures are now likely to be legally based on Article 130 of the Treaty of Rome, dealing with environmental safeguards, rather than on Article 100 A, which was concerned largely with eliminating trade barriers.[36] Two directives are under intense debate, dealing with both deliberate releases and contained use.

Two pressure groups, the Gene-Ethic Network and the European Environmental Bureau (EEB), are lobbying for much stricter regulations than at present, with the former pointing out the need for a moratorium on releases "at least until a scientifically sound predictive ecology has been developed and procedures for full public participation" have been introduced. The EEB have gone further, demanding that releases should not only be demonstrated to be "environmentally benign" but also "...ethically, socially and economically desirable".[37]

Genetic Pollution

Society has long benefited from biotechnology through fermentation techniques and plant and animal breeding programmes. Now, however, with genetic engineering, we are poised to take a much greater step towards dominating our environment, one which will inevitably alter both domestic and wild ecosystems.

We clearly do not have the ability to adequately control the Pandora's Box of transgenic organisms about to be unleashed. The concept of 'genetic pollution' is not yet even recognized by society, yet in the Brave New World of genetic engineering it could be a more serious, though more insidious, threat to survival than current chemical and radiological pollution. Genetic engineering will not allow us the luxury of learning by our mistakes, as we have invariably done in the past.

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Emissions from petrol engines are a major source of environmental carcinogens and a precursor of tropospheric ozone. (Photo: Environment)

The Real Cost of Petrol

by
Samuel S. Epstein

Industrial society's reliance upon petroleum-fuelled vehicles has helped the oil industry to cover up the real costs of this fuel in terms of human health and environmental damage. Alternatives are available in the forms of oxygenated fuels such as ethanol and methanol and new developments such as electric cars, but the growth of these alternatives is stunted by opposition from the powerful oil industry.

Environmentalists and the American Lung Association recently observed (May 1-5) a 'Clean Air Week' in Washington, DC to support initiatives for improving air quality. With the *Exxon Valdez* oil disaster and drought affecting much of the nation, environmental awareness in America is now at a level unmatched since Earth Day, 19 years ago.

May also marked the opening of the summer 'ozone season', during which the air quality of over 90 U.S. cities will dramatically deteriorate because of increased ozone levels.

In the stratosphere, around 15-50 kilometres above the earth's surface, ozone shields the planet from harmful solar radiation. Nearer ground level, however, ozone is a toxic product of the action of heat and sunlight on volatile hydrocarbons and nitrogen oxides. Emissions and evaporation from vehicle exhausts, from the idling and refuelling of petrol and diesel vehicles, from filling stations and from oil terminals and refineries, contribute 75 per cent of the volatile hydrocarbon precursors of ozone.

The young, pregnant, old and ill are especially vulnerable to ozone. Persons with lung and heart disease are warned to remain indoors during ozone 'episodes'; even athletes are cautioned. Despite oil industry claims that further regulation of ozone is not cost-effective, it has been estimated in the US that the health of 28 million children is at risk from ozone, that childhood asthma has increased 25 per cent from 1982 to 1986, that over 750,000 children were hospitalized with respiratory disease in 1987, and that deaths from chronic lung disease have increased 36 per cent since 1970. And that is not all. Ozone causes costly damage to forests and agriculture.

The Hidden Costs

So who is responsible? Over the last 20 years, the automobile industry has invested billions of dollars with the aim of reducing emissions of hydrocarbons and nitrogen oxides, as well as carbon monoxide and particulates. But there are limits to which existing engines can be further modified. As one automobile executive recently stated, "there's no squeal left in that pig".

Meanwhile, the petroleum industry has made petrol more dangerous than ever. With the Environmental Protection Agency's decision to phase-out lead additives over the last decade, the volatile aromatic hydrocarbon content of petrol — benzene, toluene and xylene — has doubled to over 40 per cent and is particularly high in high octane grades.

The relatively low price of petrol hides its real societal costs. Apart from the strategic and security costs of dependence on foreign oil, the other costs of this fuel are prohibitive. These include:

- The contribution of petroleum to global warming:
- The costs of oil spills: The clean-up costs of the Valdez disaster, an "act of God" according to Exxon attor-

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neys, are estimated to add four dollars per barrel to the cost of Alaskan crude oil and eventually exceed one trillion dollars. Exxon Senior Vice-President McMillen denies that the recent retail petrol price increase in the US — the largest in history — is due to the disaster, insisting that the clean-up is just "another cost of doing business":

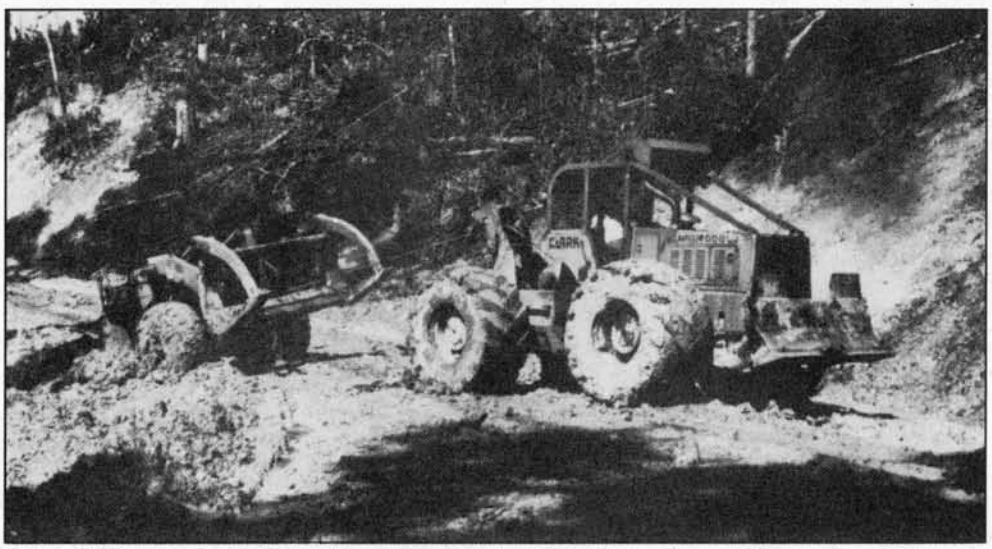
- The ecological effects of other marine accidents and offshore and tundra drilling:
- The contamination of surface and groundwaters by oil drilling muds, hazardous refinery wastes and effluents, and leaking storage tanks:
- The excess leukaemia and brain and other cancers in refinery workers due to benzene and other carcinogenic petroleum components:
- The atmospheric emissions from refineries responsible for excess cancers in surrounding communities:
- The exposure of consumers to one part per million (ppm) levels of benzene during full-service vehicle refuelling, and three ppm at self-service filling stations (workers must be warned and protected above an one ppm standard). The Senate Environment and Public Works Committee recently estimated that benzene-laced ozone smog is responsible for over 220 excess cancers annually in the Los Angeles basin alone. The Committee also noted that mobile sources accounted for about 85 per cent of the benzene emission inventory:
- Consumers are also exposed to potent isoalkane carcinogens in petrol, which the industry has attempted to trivialize. These may be responsible for the 140 per cent increase in kidney cancers in US males since 1950. Recent studies in Southern California have shown that drivers, particularly in older cars, while idling or held up in traffic, are exposed inside their cars to high levels of benzene and other toxic pollutants.

A Post-Petroleum Economy

So what is the solution? EPA-approved oxygenated fuels, ethanol, methanol and their other derivatives, are readily available and economic alternatives. They can replace aromatic hydrocarbons and improve octane in today's cars, and eventually completely replace petrol with little adverse health or environmental effects. Increased levels of aldehydes in emissions from cars running on oxygenates can be eliminated or sharply reduced by the use of catalytic converters or related technologies. Ethanol has been used for years in Brazil, alone or in petrol blends, and in the U.S. as 'gasohol' (10 per cent agriculturally-derived ethanol and 90 per cent petrol). Methanol and natural gas are also alternative fuels, especially for urban mass transit and fleet applications. Despite industry's claims that ethanol, methanol and natural gas are too expensive, these fuels are bargains compared to the externalized costs of petrol. Other safe fuel technologies, including electric, photovoltaic-powered and hydrogen-fuelled engines, are particularly promising in the dawning post-petroleum era.

EPA Administrator William Reilly announced in April 1989 that the administration intends to propose strengthening amendments to the Clean Air Act to "ease the burden of air toxics — and reduce the smog that so bedevilled our cities last summer." EPA recognizes that petrols containing 3 per cent oxygen are among the most cost-effective means of improving air quality.

Petrol in all phases of production, use and disposal is a major source of environmental degradation and disease (especially cancer). The time is overdue to replace this obsolete and ultrahazardous fossil fuel by safer alternatives and modern technologies.



A log skidder stuck up to its axles on the soft shoulder of a logging road in northern Palawan.

Logging Versus Fisheries in the Philippines

by
Gregor Hodgson and John A. Dixon

The pollution of rivers, lakes, and sea by sedimentation is increasing on a worldwide scale. Sedimentation pollution of coastal marine areas is an especially serious problem in Southeast Asia, where fish harvested from coastal waters serve both as a major source of protein for human consumption and a significant source of foreign exchange through exports. One major cause of sedimentation is logging, and in particular the building of the roads and other infrastructure needed to get the logs onto the international market.

In 1985, a logging operation was begun in the watershed bordering Bacuit Bay near the village of El Nido, Palawan, Philippines, an important area for two other foreign exchange earning industries — tourism and marine fisheries. The effects of logging-induced sedimentation on the bay's previously pristine marine environment was the subject of a one year study. By the end of the study, only eleven per cent of the available commercial forest had been logged, but high rates of accelerated erosion due to logging had already resulted in dramatic increases of sediment transport and discharge into the bay. Sedimentation damage to coral reefs and associated fisheries was rapid and severe.

The detrimental side-effects of logging on watersheds have been well documented throughout the world[1] and include damage to young trees through unplanned felling, soil degradation and soil loss. Although tree-cutting exposes underlying soil to the direct effects of wind and rain by removing protective layers of leaf canopy,[2] the major cause of erosion due to logging operations has been shown to be the construction of the extensive road and skid-trail network,[3] which is necessary to allow for log removal. This erosion in turn is the primary cause of high levels of suspended sediment load in streams and rivers which leads to reduced fish and invertebrate biomass and diversity.[4] In addition, silt deposited in dams and reservoirs results in reduced economic returns.[5]

Although the connections linking watershed erosion, silt-laden rivers, and siltation of the coastal marine environment appear obvious, they have received relatively little attention despite the high economic value of coastal marine life. Terrestrial ecologists have often failed to look beyond the freshwater systems affected by erosion. In the few cases where marine scientists have studied siltation damage to tropical coastal marine species, the origin of the silt has rarely been documented.

Siltation of coastal marine areas occurs throughout the world and may result from logging, agriculture, dredging, construction, and other development activities that expose previously protected soils to the erosive action of wind and rain.[6] Coastal marine pollution is especially serious in developing countries such as the Philippines where the rapidly expanding population depends heavily on marine fisheries to meet protein requirements.

Observed reductions of marine fish stocks in Southeast Asia are partially due to overfishing,[7] although marine pollution such as siltation probably accounts for a significant percentage of the reported reduction in fish catches in many areas. The negative effects of siltation on fish stocks are often indirect, for example, increased

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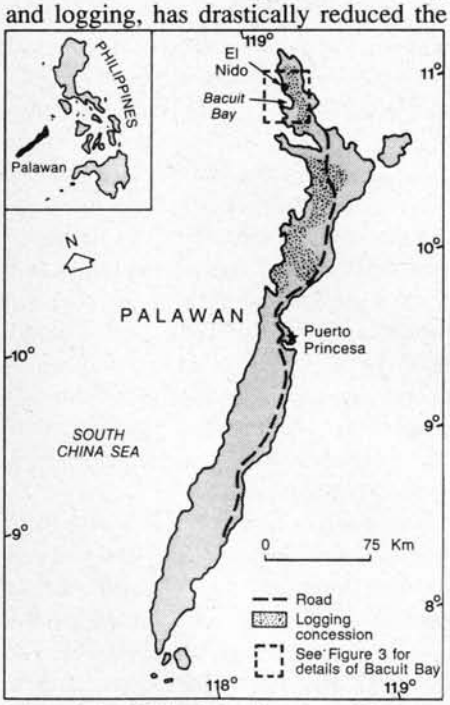
silt load could act indirectly on a tuna fishery by killing planktonic larvae of coral reef fish upon which tuna feed.[8] In this case, the resulting decrease in tuna catch would not be reported until long after the sedimentation event, when the affected year-class of tuna matured and fishermen noticed a reduced catch. Unfortunately, the intricate nature of marine food webs make it difficult to demonstrate conclusively a specific cause-and-effect relationship.[9]

Bacuit Bay

Bacuit Bay is located on the west coast near the northern tip of Palawan Island in the southwest Philippines (*map 1*). Palawan is a thin, 425 kilometre-long island bisected by a central mountain range, leaving only a narrow coastal margin of cultivable land that accounts for about 20 per cent of the total land area.[10] The weather pattern in Palawan is monsoonal with northern Palawan receiving from 2,000 to 4,000 millimetres of rain each year.[11] It is not however located on a high frequency typhoon track[12] and El Nido has not been hit by a typhoon during the past 30 years.

Ten years ago, Palawan was considered one of the last unspoiled regions in the Philippines, with virgin timber stands and plentiful marine resources, numerous endemic species of plants and animals, and a relatively low population density. More recently, rapid population growth, combined with industrial expansion in mining and logging, has drastically reduced the size of Palawan's remaining wilderness areas. Part of the reason for this expansion is that by the late 1960s, natural resources in the southern Luzon and Visayas regions had been depleted by a rapidly growing population, so that government and private interests turned to Palawan to supply their needs. In addition, migration to Palawan has accelerated due to increases in civil strife in rural areas of other provinces. Half of the nearly five per cent annual population increase in Palawan is estimated to result from immigration.[13]



Map 1. The Philippines (inset) and Palawan Island.

In 1968, almost 92 per cent of Palawan's land area was forested. By 1980, poorly controlled logging and slash-and-burn agriculture had resulted in a decrease in forest area to 70 per cent,[14] and by 1987 perhaps only 50 per cent of Palawan remained forested. Present forest consumption is estimated to be 200 square kilometres per year, just more than three per cent of the 1987 forested area.

Fish are an important resource for Palawan. A high percentage of the total Philippine fish catch is estimated to be taken from the waters surrounding Palawan.[15] The total Philippine catch of many demersal (bottom-dwelling) fish species, however, has been declining in recent years.[16] Previously pristine, the coastal marine environment of Palawan has begun to follow the trend seen in most other areas of the Philippines and is now being subjected to intense fishing pressure, illegal fishing (with dynamite, poison, small mesh nets, and weighted-scareline or *muro ami* fishing), siltation, and heavy metal pollution from mine tailings. Because of its remote location and the lack of roads, port facilities, or other infrastructure, northern Palawan has been one of the last areas to hold-out against this onslaught of intense fishing pressure.

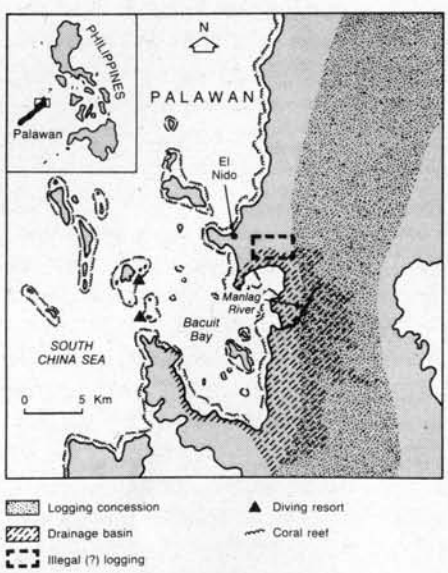
Logging

The Bacuit Bay drainage basin (*map 2*) covers 78.3 square kilometres and extends inland to the central Palawan dividing range. Prior to the initiation of logging in 1985, 53 per cent of the basin was composed of primary forest. Most of this forest is now included within a large logging concession, encompassing most of northern Palawan. Logging operations in the area bordering Bacuit Bay commenced in January 1985, and in January 1986 were temporarily suspended by the logging company for one year.

Philippine law requires that three trees be planted for each tree harvested. This level of planting, combined with diametre limits and selective logging practices that remove approximately half the number of harvestable classes of trees, will theoretically allow a sustainable yield operation with two harvesting cycles during the 85-year timber rotation. Unfortunately, lack of tree planting, overcutting in low-volume timber stands, and excessive felling damage have already been cited as threats to the sustainability of the northern Palawan concession, held by Pagdanan Timber Products Inc. (PTPI).[17]

Transport Infrastructure

Three construction projects connected with the Bacuit Bay logging operations contributed to the serious erosion. First, an earthen pier (known as a 'logpond' in the industry) was constructed. The pier is used to offload heavy equipment such as trucks and skidders shipped in by barge, as a log storage area, and for loading logs onto a barge for transport to the sawmill. The Philippine mahogany (*Dipterocarpus spp.*, locally called *apitong*) logs from this region do not float due to a high resin content and must be transported to a sawmill by barge. In order to construct the pier, approximately 100,000 cubic metres of soil was pushed down into the bay from an adjacent hillside. With only a bare minimum of protective log pilings, the pier eroded rapidly due to wave action and runoff. The second construction project involved clearing 200 square metres for the logging camp, which is used for housing, equip-



Map 2. The study area showing Bacuit Bay, El Nido village and the overlap of the drainage basin with the logging concession area. The Manlag River drains about 70 per cent of the basin.

Area type	Area (km^2)	Erosion (tonnes/km^2)	Total (1000 tonnes)
Roads	0.41x(3)[a]	14,130	17.4
Cut forest	4.80	260	1.2
Uncut forest	37.00	60	2.1
Total	42.21	14,450	20.7

[a] measured area multiplied by three to account for cut-and fill slopes.

Table 1. Sheet erosion in logging concession area within Bacuit Bay drainage basin, 1986

ment storage and repair. The camp, located about 3 kilometres inland, was cleared almost entirely of vegetation and left bare. The third and largest construction project was road-building.

The Bacuit Bay drainage basin terrain is steep (30 per cent mean slope), and the land is classified in the "severe erosion hazard" category.[18] Road construction within the hilly drainage basin is generally achieved by cutting into the hillsides, leaving an exposed vertical face on the uphill side. On the downslope side, the extra clay soil is pushed over the edge of the road, spilling down in a wide swathe called a sidecast fill slope. Both the uphill and downhill slopes are destabilized by this type of road construction, increasing the potential for accelerated erosion. During the 1985 and 1986 rainy seasons, the logging roads were frequently blocked by landslides from cuts above them.

Primary access roads are used daily (for example to transport logs to the log pier) and are usually gravel surfaced. Secondary roads are built to service specific logging zones within the concession and are used only while those areas are productive. Tertiary roads connect secondary roads to the skid trails. Skid trails are the paths cut into hillslopes by bulldozers (Caterpillar tractors) to allow skidders access to specific tree stands. Following tree felling by chainsaw, the skidder transports each log to the log truck onto which it is loaded. Skid trails are normally used for only a few days and then abandoned. In this concession they were designed and built perpendicular to the land contours, thus allowing the greatest possible erosion by maximizing the slope angle for the full length of each skid trail.

Erosion

The results of erosion plot studies show that sheet erosion per kilometre of logged area (roads and cut forest) was about 240 times greater than from uncut forest plots. The sheet erosion for the logging area lying within the Bacuit Bay drainage basin was calculated by extrapolating the erosion plot results (*table 1*). These total sheet erosion values do not include other forms of erosion such as gully or rill erosion and mass wasting.

The estimate of logging road area, 0.42 square kilometres, is 8.5 per cent of the cut forest area and is within the range measured in concessions in Malaysia and other tropical regions.[19] When considering erosion from roads, however, the entire area of soil disturbance, not just the width and length of the road surface must be taken into account. Erosion from sidecasts along logging roads in Malaysia was found to contribute up to 1.5 times the road surface erosion.[20] Field measurements and aerial photograph analysis revealed that cut-and-fill increases effective road width by a factor of three. Using this factor, the total effective road area is 1.23 square kilometres. Roads thus make up three per cent of the drainage basin area but account for 84 per cent of the surface erosion due to logging (*figure 1*). This finding is in agreement with most previous work on the contribution of road-building to total erosion in logging areas.[21]

No attempt was made to measure rill and gully erosion or mass wasting within logged over or undisturbed forest. Therefore, the quantitative contribution of these erosion processes to a total erosion budget for the Bacuit Bay drainage basin is unknown. Sediment from these sources in the cut forest is probably reflected in the high suspended sediment load measured in the major river draining the area. Along logging roads and near the earthen log pier, landslides of various scales were commonly observed. Rill development on most exposed, sloping surfaces, and metre-deep gullies on steep roads made it clear that these processes would contribute a significant amount of soil to a total erosion budget. Colonization and growth of grasses and weeds on level and low-slope road surfaces occurred within one year, especially if only a thin strip of land was cleared of vegetation on either side of the road. Steeply sloped roads bordered by 10 metre wide cleared areas showed no plant recolonization two years after abandonment and may continue to erode for decades to come.

Sediment Delivery From the Manlag River

Although accelerated surface erosion was documented within the logging concession, it is important to estimate the 'sediment delivery ratio' — the proportion of eroded soil carried out of the drainage basin by rivers and streams and into Bacuit Bay. From *table 1*, the sheet erosion from the Bacuit Bay drainage basin during 1986 was estimated to be 20,700 tonnes. This figure can be compared with the total 1986 sediment discharge of 35,000 tonnes from the Manlag River, which drains approximately two-thirds of the Bacuit Bay drainage basin. This figure does not include bed load (the heavier material which is washed along the river bottom).

In order to estimate sediment discharge from accelerated erosion due to logging for the entire Bacuit Bay drainage basin, the measured discharge from the Manlag River needs to be adjusted to account for the concession area not draining into the Manlag River and also for the surface erosion component contributed by natural erosion from the uncut forest. These adjustments yield an estimate of about 41,000 tonnes, which is more than twice the sheet erosion due to logging. With a logged area (plus roads) of 5.2 square kilometres, this equals nearly 8,000 tonnes per square kilometre in annual sediment yield. In comparison, annual sediment yields reported from various logging operations in the United States range from about 300 to 20,000 tonnes per square kilometre.[22]

Total Sediment Deposition

Vast amounts of soil eroded due to logging operations in the drainage basin are thus transported to the river and carried to Bacuit Bay. The sum of sediment deposition in the entire bay during the May to December 1986 rainy season was about 128,000 tonnes. An estimate of pristine sedimentation conditions can be made by multiplying the control station sedimentation rate (82.5 tonnes/square kilometre/month) times the entire bay area (120 square kilometres). The result is

9,900 tonnes per month or about 79,000 tonnes for the 1986 rainy season. Subtracting this figure for 'pristine' conditions from the measured total leaves 49,000 tonnes of sediment deposition that could be associated with the logging operations.

Effects On Coral

As a result of this high sedimentation rate, a significant reduction in coral cover and diversity was measured on Bacuit Bay reefs. The control reef with a low (pristine) sedimentation rate showed no significant change in these ecological parameters. The greatest change occurred on the reef closest to the river mouth, which lost nearly 50 per cent of its living coral cover. Most of this loss occurred following a storm that resulted in high sediment discharge from the Manlag River for several days.[23]

Although the increase in sediment deposition attributable to logging is only about 60 per cent of the 'pristine' rate, any increase in sediment deposition is additive and may stress a living organism, such as a coral, beyond its tolerance limits. Since corals are sessile animals (attached to the bottom), they are unable to escape from temporarily high concentrations of suspended sediment. Instead, they must rely on cleaning mechanisms such as polyp movement, ciliary action, and mucus production to remove the deposited sediment from their surfaces.[24] This cleaning process requires energy, and each species has a limit to the rate, intensity, and duration of sediment deposition it can counteract.[25] If the sediment deposition rate exceeds the species-specific sediment cleaning limits (its biological threshold for this stress), the corals will die. Experiments have also demonstrated that corals held in aquaria and exposed to sediment deposition are more susceptible to lethal bacterial infections than corals held in control aquaria.[26] The corals may also be killed by oxygen or nutrient starvation, or poisoning by coral waste products or bacterial toxins.

Effects of Sediment on Fish

In contrast to corals, fish can swim away from localized high turbidity areas. Some estuarine fish species may even prefer slightly turbid water over clear water during the early stages of their life cycle.[27] It is likely that very high suspended sediment concentrations would be required to kill coral reef fish directly. Laboratory experiments have shown that the white perch (*Morone americana*), a North American estuarine species, is killed by exposure to a suspended sediment concentration of 19,000 milligrams per litre. Mortality is due to gill clogging[28] and oxygen starvation. This extreme level of suspended sediment concentration is probably rarely found in nature. The highest turbidity recorded from the Manlag River was 3,000 milligrams per litre and from Bacuit Bay, 1,000 milligrams per litre. Therefore changes in abundance and diversity of coral reef fish and pelagic (open sea) fish dependant on the bay's food chain are not expected to be caused by fish mortality due to the direct effects of sedimentation. However, little attention has so far been given to the effect of high turbidity on coral reef fish behaviour. For example, intricate mating and territorial behaviour patterns, which are reported to be highly dependent on visual cues,[29] might be disrupted by turbid water conditions. This could result in a reduced reproductive rate that would eventually reduce biomass.

Numerous studies have documented direct and indirect dependence of coral reef fish on the coral reef community.[30] When the coral reef community is damaged, large decreases in fish diversity and abundance result. In one case, the complete destruction of a coral reef at Iriomote Island, Japan, resulted in the loss of 90 per cent of fish abundance within two years.[31] Hourigan et al.[32] cite siltation due to dredging as the cause of local extinction of 12 species of butterflyfish at Johnston Atoll in the Central Pacific. In this case, local extinction was correlated with widespread coral mortality resulting in a severe food limitation for those species that feed directly on corals. In general, major shifts in fish diversity and abundance are expected to result from changes in coral reef community structure, which reef fish depend on for food, shelter, reproduction, and juvenile fish recruitment.[33]

Although some coral reef fish feed on coral directly,[34] most depend for their food supply on prey organisms (for example, crustaceans, other fish, or algae living in association with coral reefs). In addition, reef fish use the reef structure for shelter.

Analysis of changes measured in Bacuit Bay coral and fish populations during 1986 produced the following relationships:

- Annual decrease in coral cover of one per cent for every additional 400 tonnes per square kilometre of annual sediment deposition in Bacuit Bay
- Annual decrease of one coral species (extinction) per increase of 100 tonnes per square kilometre annual sediment deposition in Bacuit Bay
- For each one per cent annual decrease in coral cover, fish biomass is decreased by 2.4 per cent
- For each annual decrease of one coral species associated with coral cover loss, fish biomass is decreased by 0.8 per cent.

Long-Term Effects of Logging

If a forest is logged and then left undisturbed, it has been generally accepted that surface erosion will eventually decrease with time as plant cover and soil stability increase.[35] The rate of this decrease of total erosion following logging will depend on local conditions such as the variation in annual rainfall.

Tree roots provide soil stability, especially on steep slopes. Following logging, the dead roots of cut trees decay and eventually lose their stabilizing capability, frequently leading to slope failures. Large-scale landslides could cause an in-

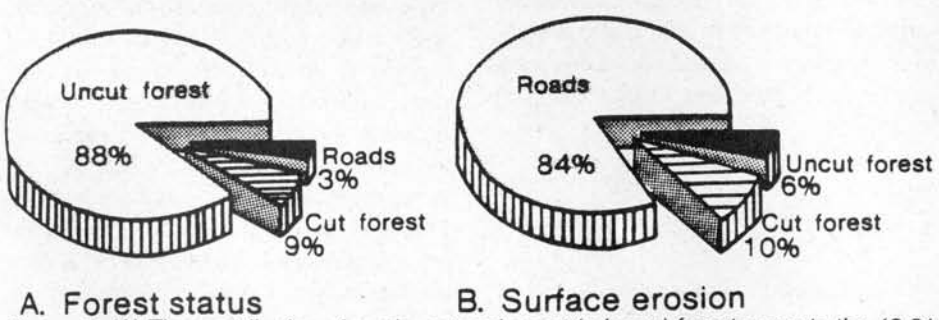


Figure 1. (A) The contribution of roads, cut and uncut (primary) forest areas to the 42.21 square kilometre logging concession area lying within the Bacuit Bay drainage basin in 1986. (B) The contribution of each of these areas to surface erosion (about 21,000 tonnes) estimated from erosion plot measurements in 1986.

crease in total soil erosion and sediment discharge several years after logging has stopped. A study in California found that sediment loads were still significantly higher in streams draining logged-over forest than in control streams six to ten years after initial logging.[36]

In tropical forests, ground cover may colonize and grow more quickly than in mid-latitude forests, thus protecting soil exposed by tree cutting, but the typically shallow layer of tropical forest topsoil may be washed away before recolonization by dipterocarpus tree species can begin. The soil surface of logging roads will generally consist of low nutrient level subsoil and often gravel. When this surface is highly compacted, it will provide a poor environment that only a few specialized plant species will be able to colonize.[37] In addition, gully erosion on steep road surfaces will tend to prevent a rapid decrease in the rate of erosion and sediment discharge from logged-over tropical forest. Observations of forest areas south of El Nido that had been logged several years before, indicated that erosion, especially of the gully and rill type, was still severe on road surfaces.

Resource Use Conflicts

The results of the ecological and economic analysis of the development alternatives for the Bacuit Bay area in the Philippines have implications for coastal development in many other countries. Specifically, the results indicate that sedimentation pollution can seriously degrade coastal marine fisheries in the tropics. Many countries are now at risk from sedimentation pollution due to logging that may already be creating significant resource use conflicts.

The conclusion that much of the erosion is from road-building is of considerable significance. 'Sustainable logging' as proposed by the International Timber Trade Organization and the international development institutions will have to take account of this factor, and ensure that logging which may be 'sustainable' in terms of timber yield, does not destroy local fisheries and therefore the major source of human protein in many tropical countries.

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Toxic Trade-Off:

The Price Ireland Pays for Industrial Development

by
Kieran Keohane

The tightening of environmental regulations in the richer countries has forced heavily polluting industries to transfer manufacturing capacity to less developed countries which have weak or non-existent regulatory frameworks. The Republic of Ireland, much less developed than most Western nations, has ineffective anti-pollution legislation and a government keen to provide employment at almost any cost. Multinational pharmaceuticals industries have taken full advantage of this situation, relocating the most polluting parts of their businesses to the South of Ireland.

Economically underdeveloped countries are often targeted as export markets for toxic and dangerous products, such as pesticides, herbicides and pharmaceuticals, which have been banned or restricted in Western countries. Often entire toxic industries, or at least their hazardous and most polluting stages of production, are transferred from wealthy nations to poorer ones where environmental regulations are weak, and cheap and uninformed labour abundant.

A seminal report into this process by Barry Castleman[1] documented the response of major US corporations to legislative and regulatory changes implemented by the Environmental Protection Agency. Castleman's findings were supported in a US Congressional Submission which recommended that:

"Measures must be taken to prevent the mere displacement of killer industries to export platforms in non-regulating countries. Poverty and ignorance make communities in many parts of the world vulnerable to the exploitation implicit in hazard export."

One of the industrial sectors most affected by the regulatory and legislative changes which Castleman examined was the pharmaceuticals industry. A quarter of the waste produced by this sector is classified as hazardous, and three-quarters of this hazardous waste is produced in manufacturing the basic active ingredients. The waste from this stage of production is the most hazardous, and consequently the most expensive to treat and dispose of. It is therefore not surprising that during the past 15 years the active ingredients plants of America's pharmaceuticals corporations, and those of other developed nations, have been relocated from their domestic bases. Puerto Rico and Mexico now supply the US market, while the Republic of Ireland services the European Community.

Industrial Development in the Irish Republic

The Irish Republic is unique among the Western nations. Due mainly to its colonial history, it is comparatively underdeveloped and shares some of the structural problems found in Third World countries. Like many underdeveloped countries, successive Irish governments have attempted to accelerate industrial development by actively courting direct investment by foreign corporations. Also, the existing administrative infrastructure, legislation, statutory regulatory bodies, scientific and technical knowledge and expertise, and the body of appropriate public knowledge held by the society has not kept pace with the international rate of industrial and economic change.

Ireland has rapidly become a base for toxic waste producing pharmaceuticals plants. In the early 197Os, Ireland exported practically no pharmaceuticals products, but is presently one of the top ten producers in the world. For many years pharmaceuticals plants operating in Ireland were controlled only by non-specific pollution legislation implemented at local authority level. Local authorities lacked the experience, the expertise and the resources to use effectively the legislation, and penalties for transgressions were negligible.

Effective water pollution legislation was not introduced until 1977, but it continues to be underused due to a lack of resources at local authority level. Air pollution legislation was not introduced until ten years later, and it is widely regarded to be seriously flawed. Employees who are exposed to toxins in the workplace have scant legal protection, and both the environment and the public are endangered by the storage and movement of large amounts of hazardous chemicals over which there is very little control.

Industry-State Collusion

In an internal industry report on the suitability of Ireland for locating toxic industries, the favourable social and political climate of the country was given careful consideration:

"The prospect of employment tends to outweigh suspicion, especially in areas of high unemployment such as Cork. It is said that there has been victimization by the local population of people who have attempted to oppose the building of a pharmaceuticals plant which would provide employment in the area. An environmentalist who blocked the construction of a plant by Schering Plough was forced to move out of the area."[2]

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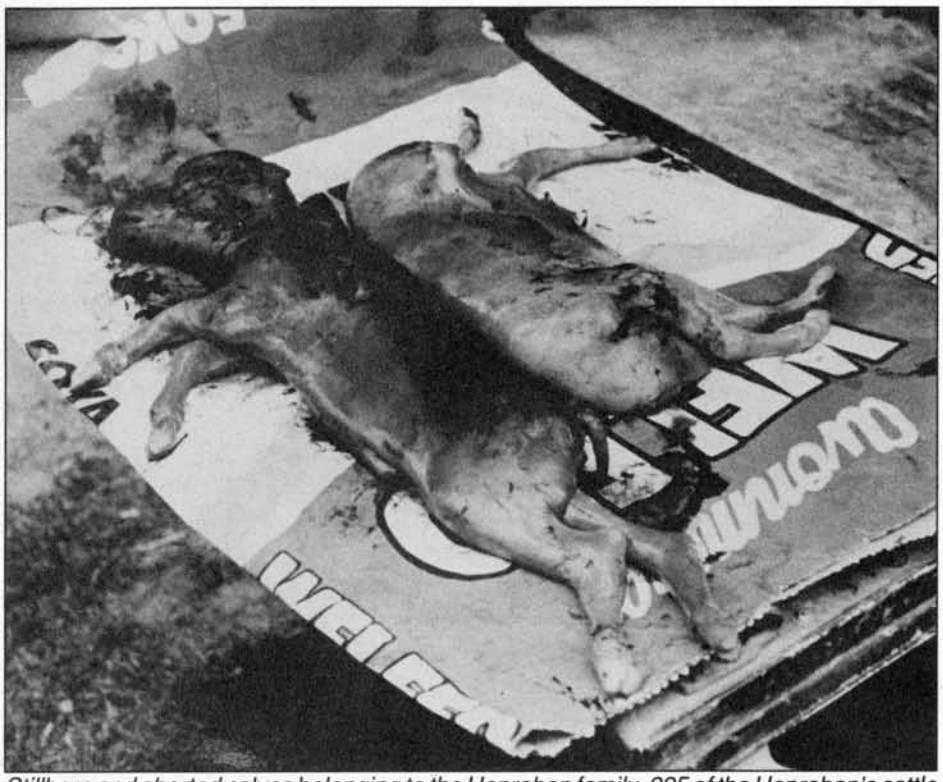


Stillborn and aborted calves belonging to the Hanrahan family. 225 of the Hanrahan's cattle died due to emissions of hydrogen chloride and hydrochloric acid from the nearby Merck, Sharpe and Dhome pharmaceuticals factory. (Photo: Press 22)

Even more disturbingly, this report reveals that the Irish State actively colludes with toxic industries in keeping people uninformed and suppressing disquiet. This can be seen at many levels. The State Institutes for Industrial Research and Standards and An Foras Forbatha (the State Planning Institute) which conduct Environmental Impact Surveys on new industrial projects have been deliberately unscientific in their assessment of environmental risks. Local authorities have repeatedly failed to prosecute pharmaceuticals companies for regular persistent breaches of effluent and emission levels. Public objections to proposed developments are stonewalled, or as has been the case more recently, have simply been rejected out of hand. The State is deliberately slow to implement European Community legislation on environmental and employee protection and on corporate privacy, and when forced to adopt this legislation ensures that it remains ineffective.

Some of the toxic waste generated in Ireland used to be dealt with by English companies, but following a series of accidents in 1982, most notably a fire at the Chemstar solvent recovery plant in Manchester and the wrecking of the *Craigantlet* (a ship with a cargo of toxic waste from Ireland), on the Scottish coast, the British government restricted the importation for disposal of toxic waste from Ireland. Presently toxic waste is either stored, dumped on public refuse tips, or more usually is incinerated on site. Department of the Environment figures show that Ireland produces 58,000 tonnes of hazardous waste each year, and that from 1986-1988 between 4000 and 5000 tonnes 'disappeared'. Poor record keeping may account for some of it but the bulk is likely to have found its way into drains or to have been illegally dumped. The maximum penalty for the illegal disposal of toxic wastes in Ireland is a mere £1,000.[3]

On site incineration in the absence of effective controls on air pollution has resulted in serious pollution by toxic solvent vapours and various other noxious and toxic substances. Syntex's County Clare plant and Smith Kline French's plant in Cork have been causing serious pollution since their operations commenced ten years ago. The worst case by far however — one that has become a watershed in Irish environmental history — is that of Merck, Sharpe and Dhome's plant in County Tipperary.

Merck, Sharpe and Dhome: A Case Study

In 1972 the Institute for Industrial Research and Standards (IIRSs) commissioned an environmental impact survey for a proposed plant by Merck, Sharpe & Dhome. Although it was the first time the IIRSs expert who conducted the survey had dealt with a chemicals plant, he felt confident to report that "Merck would operate a clean plant without detriment to the local environment." The factory began production in 1976.

Two years later, John Hanrahan, a farmer living about a mile from the factory, lodged a complaint with Tipperary County Council. He claimed that he had difficulty breathing and that his cows had streaming eyes, which he blamed on emissions from Merck. Others living in the vicinity also complained of problems with their livestock. In 1980, the County Council reluctantly commissioned a report to monitor the atmosphere in the vicinity of the factory. In the meantime, 70 of Hanrahan's cattle had died of mystery illnesses and there was a continuing high incidence of stillbirths and deformities among his calves.

Carcasses of the dead animals were sent to a veterinary laboratory for examination but nothing was found — not surprisingly as the laboratory had no facilities for examining for toxic chemical substances. Meanwhile, the report commissioned by the County Council, conducted by An Foras Forbatha, vindicated Merck and found no serious air pollution. Animals continued to die on local farms. As a result of continued monitoring, it was revealed that during May and June 1980, acidic emissions from the factory were four times the permitted level. Tipperary County Council took no action against Merck. During this period several government ministers and TDs (Members of Parliament) had publicly castigated and ridiculed environmentalists. The state Industrial Development Authority had launched a public propaganda campaign in favour of the pharmaceuticals industry and Hanrahan in particular was the butt of widespread slanderous rumour and innuendo which blamed the events on his farm on his personal incompetence.

Chronic Pollution

A second report, conducted by An Foras Forbatha during 1981 and 1982, noted that although emissions were within the permitted levels, (levels set in 1972) acid concentrations were higher than might be expected for a rural area. However, a further, more comprehensive study, conducted by the Botany Department of Trinity College, Dublin, concluded that

certain areas near the factory were subject to high pollution levels and that there was evidence of chronic pollution which, it predicted, would destroy sensitive plant growth in the region within a few years.

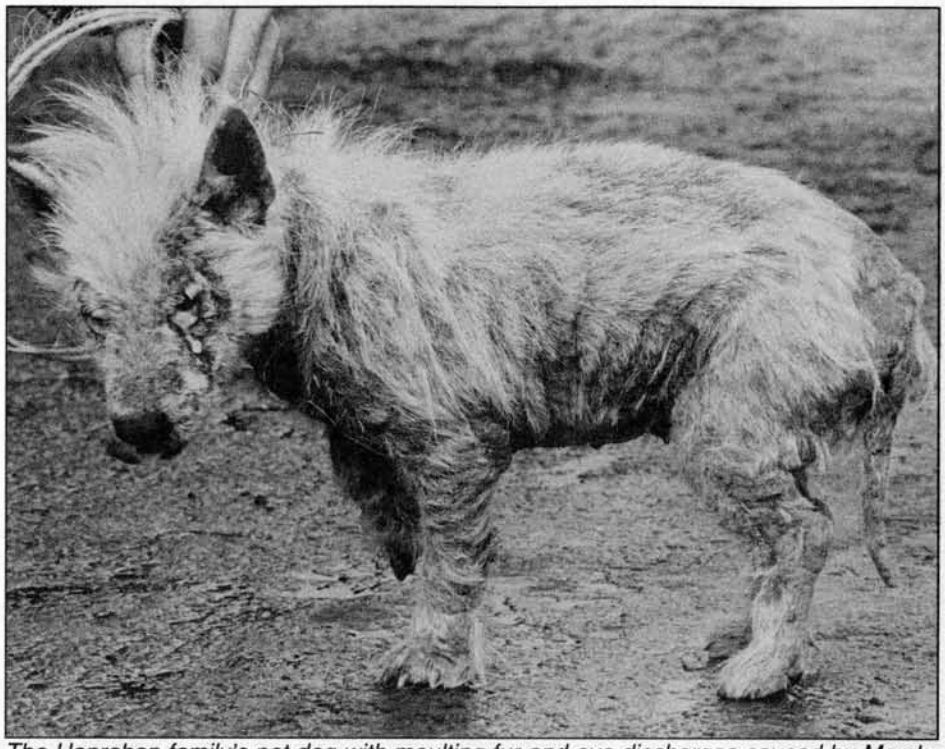
Legal Proceedings

Hanrahan initiated legal proceedings against Merck at this stage. None of the reports, nor other information from local government or health board sources were made available to him, even though it was supplied to Merck management by Council officials. By 1985, when the case came before the High Court, 225 of Hanrahan's cattle had died.

The High Court ruled against Hanrahan on the grounds that it could not be proved that the factory was directly responsible for the human and animal health problems on the Hanrahan farm. Hanrahan appealed to the Supreme Court and the case was heard in June and July 1988. In a unanimous verdict the three Supreme Court judges overturned the High Court ruling and found in Hanrahan's favour. The Court found that atmospheric pollution, mainly in the form of hydrogen chloride and hydrochloric acid mists, was present in the region and that it was an unquestionable fact that the Merck factory was the source of that pollution. There was unimpeachable independent evidence linking that pollution to human and animal health problems on the Hanrahan farm. A consultant in respiratory diseases who had treated Hanrahan during 1981 and 1982 had submitted that on the balance of probabilities the plaintiff's lung disease was caused by toxic emissions from the factory.

Merck's Evidence

Merck's defence was that it could not be proven that the emissions from their plant directly caused the health problems and they offered a whole range of alternative explanations for the events on the farm. The Court however accepted the most probable explanation of events — that toxic emissions from Merck, especially from an incinerator which frequently operated at a temperature not adequate to destroy dangerous and contaminated solvents, were the source of the problem — and ruled that Merck's theoretical and inductive evidence could not displace the proven facts of the case.



The Hanrahan family's pet dog with moulting fur and eye discharges caused by Merck, Sharpe and Dhome's toxic emissions. (Photo: Press 22)

The case has been referred back to the High Court to assess damages and compensation to be awarded to the Hanrahan family.

Watershed

The case is widely acknowledged to be a watershed in Irish environmental history. Previously, the difficulty facing people had been to prove a direct link between the ill effects of pollution and the putative cause. The Supreme Court decision has considerably lightened the burden on the plaintiff to show that a particular factory is the source of the problem.

Despite the Court's findings, certain State agencies and trade and industry organizations have voiced concern over the implications of the case for the future of the pharmaceuticals industry in the Republic of Ireland. While paying lip service to the importance of protecting the environment, in the aftermath of the case most State Departments set about minimising the damage to the industrial development programme.

Governmental double standards on toxic industry are by no means unique to Ireland. Indeed, it is the norm for governments to profess concern for the protection of the environment and the health of its citizens while not only doing nothing to actualize that concern, but on the contrary, promoting the sort of industrial development which directly destroys the environment and threatens the physical well-being of the population. Indeed, the toxic industry problem cannot purely be explained in terms of local or national politics. It is a global structural problem which can only be understood within an analysis of the international market system.

Governments in underdeveloped societies are faced with enormous global structural imbalances of economic and political power. In order to achieve some measure of national development — employment creation for example — they are forced to pander to transnational corporations and to try to balance a trade-off between toxic hazard and socio-economic destitution.

Until this structural imbalance is rectified by supra-national legal regulation, or by the co-ordinated efforts of underdeveloped nations, toxic corporations will continue to lay waste the environment and menace the world's population; and while this threat is truly global, underdeveloped societies are clearly in the front line.

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Gaia and Evolution

by
Edward Goldsmith

The 'survival of the fittest' maxim of Darwinism is widely used to justify the disastrous process of unrestrained technological progress and economic development. However, if the world is seen as a single self-regulating system, then progress through competition becomes fundamentally anti-evolutionary. Co-operation is the true evolutionary strategy.

Neither Darwinism, nor the neo-Darwinism of Bateson and Weissman, nor its latest version, the Synthetic Theory, provides an evolutionary theory that is reconcilable with our knowledge of the structure and function of the world of living things. This is particularly so if the biosphere is seen as a single living system, whose constituent parts co-operate in achieving a specific strategy — the maintenance of its basic features or organization in the face of internal or external challenges, that is to say its stability or homeostasis.

Little attempt has been made to provide any serious evidence for the Darwinist theory. This has been noted by a number of critics, for example Karl Popper, who considered that "neither Darwin nor any Darwinian has so far given an actual causal explanation of the adaptive evolution of any single organism or any single organ. All that has been shown — and this is very much a hypothesis — is that such explanations might exist, (that is to say, they are not logically impossible)." Popper does not, for that reason, consider Darwinism a scientific theory — though he does not necessarily reject it.

Michael Polanyi accepts that though "neo-Darwinism is firmly accredited and highly regarded by Science...there is little direct evidence for it." Ludwig von Bertalanffy makes the same point. In the debate on evolution, he writes, there has been no more concern with proof "than in the operation of a Tibetan prayer wheel."

These criticisms apply equally to the role that random variations or random mutations, or indeed randomness itself, are supposed to play in the evolutionary process, and to the role which is supposed to be played in that process by natural selection.

Randomness

The notion that the biosphere is the production of random variations could not be stated more unequivocally — and indeed more dogmatically — than by Jacques Monod:

> "Chance alone was the source of every innovation, of all creation in the biosphere. Pure chance, absolutely free but blind is at the very root of the stupendous edifices of evolution. This central concept of modern biology is no longer one among other conceivable hypotheses. It is the only conceivable hypothesis, the only one that squares with observed and tested fact. And nothing warrants the supposition — or the hope — that on this score our position is likely ever to be revised."

In the same way non-human animals are seen as learning by random trial and error, and humans by 'induction', which involves making naive correlations between random observations. Human history is seen as composed of random events, and historians such as H.A.L. Fisher pour scorn upon historicists such as Arnold Toynbee and Spengler, who sought to introduce a pattern into our historical experience.

To tell us, as Monod does, that the thesis of randomness is the only conceivable thesis "that squares with observed and tested fact" is untenable. There is no possible way of determining empirically whether an event is random. All that we can say of an event that appears to be random is that we do not know the circumstances that brought it about.

Lamarck noted this: "*Le mot hazard n'exprime que notre ignorance des causes.*" Poincaré said the same thing in slightly different words: "*Le Hazard n'est que la mesure de notre ignorance.*" Waddington also intimated that gene mutations may only appear to be random because of our present lack of knowledge. "A gene mutation which consists of some alteration in the sequence of nucleotides in the DNA is from a chemical point of view presumably not wholly at random. There may well be quite considerable regularities in the processes by which the alterations come about: however, we know very little about them as yet."

The important role attributed to random mutations appeared more credible in the days when the genome was seen as a random assortment of genes. It makes far less sense, however, now that the genome is known to be a highly sophisticated and elaborately regulated organization, capable, among other things, as Lerner has shown, of maintaining its own homeostasis.

In response to such criticisms, neo-Darwinists have modified their position, cosmetically at least. Mutations may well be caused by factors that we ignore, they tell us, but as Julian Huxley wrote: "in all cases they are random in relation to evolution. Their effects are not related to the needs of the organism or to the condition in which it is placed. They occur without reference to their biological uses." Dobzhansky and Waddington stated the same principle in slightly different words.

But this concession changes very little. Randomness necessarily means randomness vis-à-vis a specific process. An event cannot be random to all processes, as this would mean that it had occurred spontaneously, which would violate the principle of causality that is critical to the paradigm of reductionist science. Indeed, if an event is seen as the product of a "cause", it cannot be random to the causal process of which it is the effect. The official position is thus still very close to Jacques Monod's and it is an untenable one — one that is in complete conflict with our knowledge of life processes in the world we live in.

"Behaviour exhibits so little 'randomness' that it is questionable whether living things are in fact capable of behaving in a random way, even if they make a determined attempt to do so."

Randomness: Fact or Fiction?

Indeed, even ordinary cultural phenomena with which we are all acquainted, and which, in terms of the paradigm of reductionist science, are interpreted as random, are not, in reality, random at all. For instance, art styles do not develop at random, but closely reflect the cultures in which they developed. The clothes people wear are indicative of the image of themselves they wish to communicate to others. The way people walk, eat, light cigarettes, blow their noses, do up their shoelaces, all convey some information as to the personality of the individuals concerned.

In fact, behaviour exhibits so little 'randomness' that it is questionable whether living things are in fact capable of behaving in a random way, even if they make a determined attempt to do so. This appears to be confirmed by various experiments such as those described by W.R. Ramsay and Anne Broadhurst, who experimented with a panel of 72 people by asking them to repeat in time to a metronome a series of numbers between 1 and 9, in as random a manner as possible. They found that "...in accordance with other studies on randomness and response in human subjects, the result of this experiment shows that even when subjects try to be random, there is a high degree of stereotype."

In the world of living things, randomness is so rare that to achieve a state which even approximates it, it has to be 'manufactured' artificially. Stafford Beer points out the absurdity of such a situation.:

> "It really is ludicrous that we should have gone so far with Epicurius as to manufacture chaos where none exists, in order to provide ourselves with the properly certificated raw materials for system building. Take my own case. There are a random number of tables on my bookshelf; there are computer tapes for producing pseudo-random numbers next door; there is a large electronic machine for generating noise upstairs; down the road there is a room full of equipment designed to hurl thousands of little metal balls about in a random way; and I use ten-sided dice as paper-weights. The upkeep of this armoury is considerable. Think of all the time we spend trying to ensure that these artefacts produce results which are 'genuinely random' — whatever that may mean. This tremendous practical problem of guaranteeing disorderliness ought to be enough to satisfy any systems man that nothing is more unnatural than chaos."

Indeed, living things actively seek to eliminate randomness. We know, for instance, that mutant genes tend to be eliminated. Lerner has shown us how a genome tends to maintain its structure, thereby countering random changes. We know that random bodies within a biological organism are eliminated with the aid of the immune system; and that in all known vernacular societies, people whose behaviour is socially random, in that it diverts from the traditional norm, are ostracized or eliminated. We know too that the ability of natural systems to eliminate randomness increases as they develop or evolve, and that climax ecosystems are very much better at doing this than pioneer ecosystems. Natural systems are, in fact, committed to the elimination of randomness by virtue of the fact that they function cybernetically to maintain the basic features of their order — and hence their stability or homeostasis. Life, in fact, develops and indeed evolves at the expense of randomness.

Natural Selection: The Motor of Evolution?

Randomness is essential to the Darwinian notion of natural selection. Yet, it is hard enough to demonstrate that natural selection from random variations is even *one* of the mechanisms of evolution, as Darwin maintained, since the term 'natural selection' is a very vague one, indeed Darwin actually admitted that he used it metaphorically. To demonstrate that natural selection is the *only* mechanism of evolution, as is maintained by the neo-Darwinists, is still more difficult.

How do neo-Darwinists know that no other factors are involved? In particular, how do they know that no 'internal factors' are operative, that living things, in fact, do not evolve as a result of their own behavioural efforts and ontogenetic adaptations?

There is no epistemological justification for maintaining such a thesis. Neo-Darwinists simply assume that living things do not evolve in that way.

That natural selection is operated by the 'environment' is a further unjustified assumption. Why should the environment behave in that way? What motivates it to do so? How is it capable of displaying such highly discriminatory and indeed highly teleological behaviour? These questions have never been answered, nor can they be since the term 'environment' is never defined, it is simply taken to be that which is 'out there' — some strange mystical entity to which all the dynamic, creative, intelligent features of life have somehow been delegated.

Selection As God

If natural selection from random mutations is indeed the only mechanism of evolution, then the most sophisticated achievements must be attributed to it — and indeed they are. Thus, according to Ruse, natural selection can act not only to cause evolutionary change "in the sense that it can cause change in gene ratios", it can also act "as a conservative force preventing change, that is keeping gene ratios stable."

Merrell tells us that natural selection "will tend to operate in such a way as to minimize interspecific competition." It is also capable of deciding, if we are to believe MacArthur and Wilson, whether to favour "increased reproductive rates" (K selection) or "greater efficiency of conversion of food and other resources into offspring" (R selection).

Selection can also decide, if we are to believe Lerner, whether it should be "intensive" or "less intensive". It has the ability to eliminate deviants and thereby favour stability, hence Waddington's "stabilizing selection". According to Dobzhansky, it is responsible "for directedness of the general as well as for the grouping of particular evolution."

Alistair Hardy notes too that "moral and aesthetic qualities in man are not infrequently said to be explained by the operation of natural selection." This is true of the sociobiologists who even see natural selection as giving rise to altruism (kinship selec-

tion). Similarly, Waddington, when it was suggested to him by Piaget that it might be difficult for such a crude mechanistic device to create complexity, answered that Piaget greatly underestimated the capacity of natural selection.

Selection is thus invoked to explain everything, (which indeed it must be, if we are to accept the neo-Darwinist thesis). Julian Huxley explicitly states:

> "The hoary objection of the improbability of an eye or a hand or a brain being evolved by 'blind chance' has lost its force because natural selection, operating over stretches of geological time, *explains everything*."

Lewontin claims to have established this principle experimentally. "There appears to be no character — morphogenetic, behavioural, physiological or cytological," he writes, "that cannot be selected in *Drosophila*."

Selection, like God, is thus omnipotent. Neo-Darwinists may laugh at Lamarck's idea that if an animal needs some organ, that need will somehow call the organ into existence. Dawkins regards this notion as "so obviously mystical to the modern mind that it is fairer to Lamarck for us to concentrate on those parts of his theory that at least seem to have some chance of explaining evolution." But the neo-Darwinists entertain an almost identical notion, the only difference being that it is the environment's "need" that "will call the organ into existence", which seems just as mystical.

The question that needs to be asked is how does 'natural selection' — supposedly a purely mechanical process, like a sorting machine in a post office, that does no more than sort the 'fit' from the 'unfit', — achieve this omnipotence? How can this mechanical sorting machine create complex living things?

One can understand that by selecting the most viable living things, and allowing them to reproduce themselves, their characteristics will be transmitted to the next generation, which will become correspondingly more viable, but this is only possible if living things can transmit such characteristics to the next generation. Billiard balls cannot, and it is difficult to see how they might be made to evolve by natural selection however much variability they might exhibit.

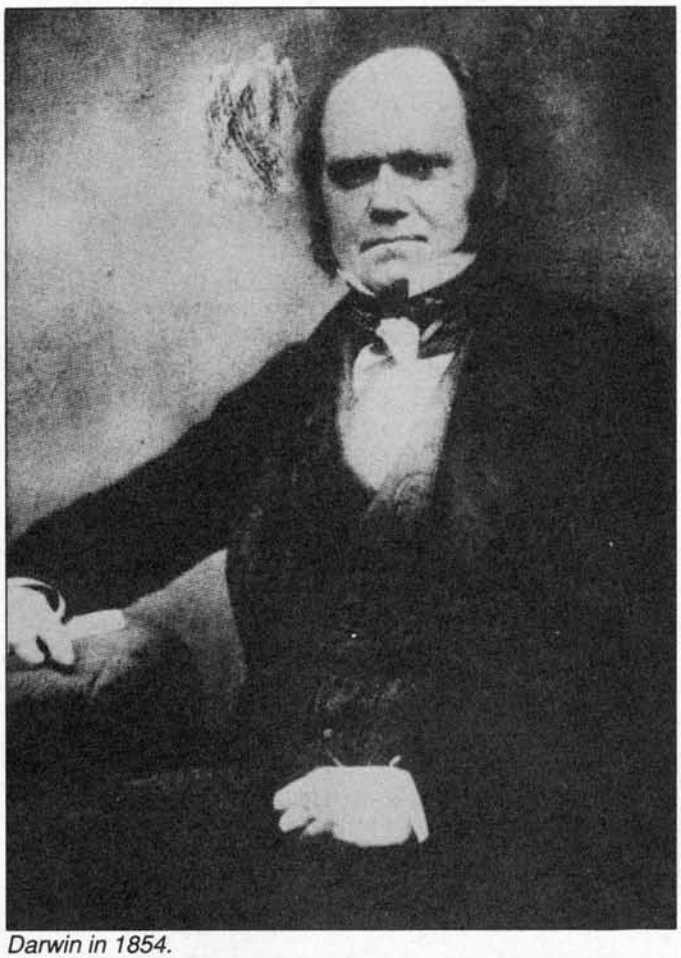
Whitehead noted this: "A thorough going evolutionary philosophy is inconsistent with materialism. The aboriginal stuff, or material, from which a materialistic philosophy starts, *is incapable of evolution.*"

Woodger made the same point. The Darwinian doctrine, he noted, "is committed to ascribe to 'bits of matter' properties which they do not exhibit today, instead of searching for an adequate conception of organism."

Popper also pointed out that "only an organism which exhibits in its behaviour a strong tendency or disposition or propensity to struggle for its survival will in fact be likely to survive." But to compete *is to exhibit goal-directedness*. Indeed, as Popper notes, goal-directedness is one of the conditions for evolution. But there are many other such conditions. Indeed, one can draw up a whole catalogue of conditions which must obtain before a sorting machine could conceivably be used to bring about constructive changes in the structure and function of living things, however great the diversity of random or non-random variations which it may have the privilege to select from.

Von Bertalanffy notes this:

> "Selection *presupposes* self-maintenance, adaptability, reproduction, etc. of the living system. These therefore cannot be the effect of selection. This is the oft- discussed circularity of the selectionist argument. Proto-organisms would arise, and organisms further evolve by



Darwin in 1854.

chance mutations and subsequent selection. But, in order to do so, *they must already have had the essential attributes of life.*"

For Woodger, the neo-Darwinist thesis is unacceptable on this count alone:

> "An explanation of this kind can only make out a case for itself by begging the fundamental question at issue — the essential characteristics of an organism *have to be surreptitiously introduced in vague general language.*"

They are so introduced largely by attributing to natural selection — the mechanical sorting machine — qualities which no machine can possibly display, and that are, in effect, little more than the very 'internal factors' whose role in determining the evolutionary process, neo-Darwinists are at such pains to deny.

The following passage makes clear how Darwin "surreptitiously introduced" the highly sophisticated features of life processes into what he made out to be a purely mechanical process. In it, Darwin tries to explain how so phenomenally complex an organ as the eye could have been produced by natural selection:

> "We must suppose that there is a power, represented by natural selection or the survival of the fittest, always intently *watching* each slight alteration in the transparent layers; and carefully *preserving* each which, under varied circumstances, in any way or in any degree, tends to produce a distincter image. We must suppose each new state of the instrument to be multiplied by the million; each to be preserved until a better one is produced, and then the old ones to be all destroyed. In living bodies, variation will cause the slight alterations, generation will multiply them almost infinitely, and natural selection will pick out with unerring skill each improvement. Let this process go on for millions of years; and during each year on millions of individuals of many kinds; and may we not believe that a living optical instrument might thus be formed as superior to one of glass, as the works of the creator are to those of man?"

"We must suppose that there is a power, represented by natural selection or the survival of the fittest, always intently watching each slight alteration in the transparent layers; and carefully preserving each which, under varied circumstances, in any way or in any degree, tends to produce a distincter image."
Charles Darwin

Note that selection is referred to as a "power", that it is "intently watching" each slight alteration, that it picks out each improvement "with unerring skill". Is Darwin really talking about a mechanical sorting machine? Indeed, it is difficult to avoid the feeling that there is some living being endowed with such non-mechanistic qualities as purpose, reason, knowledge and intelligence lurking in the background and secretly manipulating the sorting machine.

This is not altogether surprising, since a machine needs a living designer and operator. That is in itself sufficient reason why a mechanistic theory of evolution can only superficially replace a theistic, a vitalistic or an ecological theory.

Equating Selection With Adaptation

The subterfuge of disguising complex life processes as crude mechanistic processes by the use of the appropriate words and imagery is probably most discernible in the attempt by neo-Darwinists to prove, how, in specific instances, natural selection has actually occurred.

The subterfuge consists in noting that adaptation has occurred and then *quite brazenly taking such adaptation as constituting evidence of natural selection at work.* Instead of demonstrating that natural selection leads to adaptive change, *it is simply assumed to do so by the expedient of equating natural selection with adaptation.* It thereby suffices to show that adaptation has occurred in order to prove, in the eyes of neo-Darwinists at least, that the corresponding adaptive characteristics have been selected.

Thus on the subject of the finches of the Galapagos that so impressed Darwin, Ruse writes, "we find that all the different species show the effects of selection." What are these effects, we might ask?

> "Peculiar characteristic after peculiar characteristic *has some special adaptive function.* Some finches have evolved in such a way that they are ideally suited to the consumption of plant food; some mainly for the consumption of animal food; some solely for animal food. Then there are beaks for cactus eating, beaks for insect eating on the wing, beaks for general scavenging. One species has even developed the ability to probe with twigs for insects in hollow parts of trees."

In this passage, Ruse's identification of selection with adaptation is quite explicit. The fact that he is assuming what he set out to prove could not be more evident.

That evolution and natural selection are synonymous, so that to prove that the former has occurred provides proof of the effectiveness of the latter, is also assumed by Charlesworth:

> "Probably the most general relevant prediction of the theory of natural selection is that episodes of rapid evolution should coincide with periods when the direction of selection is changing; this seems to be borne out at many different levels of evolution. Insecticide resistance evolves in populations exposed to a new insecticide. The molluscs of Lake Turkhana changed when the level of the lake altered. The drosophila of Hawaii evolved an array of diverse species as they colonised an archipelago with numerous vacant ecological niches. And modern mammals underwent their period of most rapid evolution and diversification after the dominant land reptiles of the Cretaceous era went extinct."

But how do we know that these instances of rapid adaptation to new conditions are the result of natural selection? We do not, *unless that is we have already assumed, as does Charlesworth, that natural selection and adaptation are one and the same — unless in fact, we start out by assuming what we set off to prove.*

Von Bertalanffy was fully aware of this subterfuge:

> "The principle of selection is a tautology in the sense that the selectionist explanation is always a construction *a posteriori.* Every surviving form, structure or behaviour — however bizarre, unnecessarily complex or outright crazy it may appear — must, *ipso facto*, have been viable or of some selective advantage, for otherwise it would not have survived. *But this is no proof that it was a product of selection.*"

Neo-Darwinism: The Dogma of Reductionist Science

Since there is absolutely no evidence for the neo-Darwinist thesis, and since it fits in so very poorly with our knowledge of the world of living things, the only reason why it should prove so durable seems to be that it fits in so well with the paradigm of reductionist science and hence with the worldview of modernism that the latter so faithfully reflects.

This was the view of Michael Polanyi. "Neo-Darwinism", he wrote "is firmly accredited and highly regarded by science though there is little direct evidence for it *because it fits in beautifully* with the mechanistic system of the universe and bears on the subject — the origin of man — which is of the utmost intrinsic interest."

This was also the view of Ludwig von Bertalanffy, who considered:

> "that a theory so vague, so insufficiently verifiable and so far from the criteria otherwise applied in 'hard' science, has become a dogma, can only be explained *on sociological grounds.* Society and science have been so steeped in the ideas of mechanism, utilitarianism and the economic concept of free competition that instead of God, selection was enthroned as ultimate reality."

Many biologists are now involved in developing a new post-Darwinian evolutionary theory. Such a theory, if it is to be a realistic one, is likely to clash with, rather than conform to, the paradigm of reductionist science, for which reason it is unlikely to be accepted until such time as that paradigm itself undergoes considerable change — and indeed itself becomes more realistic. This process is already under way. The paradigm of reductionist science is under assault across a broad front. Its transformation is indeed necessary because, among other things, it faithfully reflects the worldview of modernism which serves above all to rationalize and hence to validate the Promethean enterprise to which modern society is committed, a path that is leading to the systematic annihilation of the world of living things.

Indeed, if humans are to survive for very long, one of the requirements of their survival will be the replacement of the paradigm of reductionist science by a new ecological paradigm. This new paradigm would also reflect a very different worldview, one that would serve to rationalize and hence validate a society committed to systematically reducing the impact of our economic activities on the ecosphere and, thereby, to the extent that this is still possible, of restoring the proper functioning of the Gaian process that can alone assure that our planet remain habitable.

A POST-DARWINIAN EVOLUTIONARY THEORY

According to the Gaia thesis, the biosphere, together with its atmospheric environment, forms a single entity or natural system. This system is the product of organic forces that are highly coordinated by the system itself. Gaia has, in effect, created herself, not in a random manner but in a goal-directed manner since the system is highly stable and is capable of maintaining its stability in the face of internal and external challenges. It is, in fact, a cybernetic system, and for this to be possible, Gaia must display considerable order, indeed, she must be seen as a vast cooperative enterprise, very much as nature was seen by the Natural Theologists of the nineteenth century.

Such a view of the world of living things is, needless to say, totally incompatible with neo-Darwinism. Indeed, an evolutionary theory that would be consistent with this view of the world would be *the very negation of neo-Darwinism.* I shall suggest what some of its features might be:

Gaia as the Unit of Evolution:

If Gaia is a single natural system that has created herself in a coordinated and goal-directed way, *then Gaia is clearly the unit of evolution*, not the individual living thing as neo- Darwinists insist.

Gaia is Evolution:

Gaia is not just a contemporaneous organization of living things. She is a *spatio-temporal system.* It is difficult for us to grasp the notion of a spatio-temporal system, as our language makes a clear distinction between things and processes and our thinking is clearly influenced by our language. It is nevertheless essential that we realize that all living things have a *temporal* as well as a *spatial* component. They exist in time just as much as in space. This means that Gaia is not only an entity but also a process, and what is that process *if it is not evolution*?

If this is so, *then the Gaian process — or evolution — must display the same fundamental structure as Gaia does when seen as a spatial entity.* If the latter is a biological, social and ecological structure, then the Gaian process cannot possibly be merely physical and mechanical as the neo-Darwinists tell us; *it must clearly also be seen in biological, social and ecological terms.*

Gaia as a Total Spatio-Temporal System

But what part of the temporal process must be seen as evolving? We assume that it must be the contemporaneous process, the one occurring before our eyes. But how do we justify this assumption? I suggest that the *total* process is involved, stretching back into the mists of time. The reason for suggesting this is that the

information passed on from generation to generation of living things must reflect the experience of *the total spatio-temporal system involved and not just of part of it.*

This information appears to be organized hierarchically, the most general information, that which reflects the longest experience, being particularly non-plastic, the more particular information, that which reflects the more recent experience, being very much more plastic and hence more easily adaptable to short-term environmental contingencies. This arrangement is clearly that which best assures the continuity or the stability of the total *spatio-temporal* Gaian system. If this is so, this means, among other things, that *evolution is a long term strategy not just a set of ad hoc adaptations.*

Evolution as a Living Process

If Gaia creates herself, then the living world must be seen as dynamic and creative, not as passive and robot-like. The qualities that are tacitly attributed to the vague undefined 'environment' must be ascribed as well to the living things which it is seen as managing. Evolution is thereby no longer the mere product of natural selection from random variations or genetic mutations, but of living things exhibiting all those features whose involvement in the evolutionary process neo-Darwinists have been at such pains to deny.

Evolution as a Cybernetic Process

If Gaia is evolution, then evolution must also be a cybernetic process. Lovelock's 'Daisy World' model is a cybernetic process but a very rudimentary one. One must suppose that the cybernetic process that led to the development of a system as complex as Gaia herself must be very much more sophisticated.

Now we are beginning to understand how living cybernetic processes operate. Human behaviour, as Kenneth Craik was the first to show, is mediated on the basis of a mental model of an individual's relationship with his environment, in the light of which diversions from the appropriate pattern of behaviour are corrected.

Gerardo Reichel Dolmatoff and others have shown how the behaviour of tribal groups in Amazonia is controlled in similar fashion, the model of the tribe's relationship with its environment being formulated in the language of its mythology. I do not think that it is too outlandish to ask whether Gaia herself is not endowed with a similar model?

What is certain is that a cybernetic system must be capable of monitoring its responses otherwise it could not correct diversions from its optimum course, and hence maintain its homeorhesos and thereby its stability. How then is evolution monitored? There can only be one answer and that is ontogenetically and behaviourally. That such feedback must occur has been clear to serious students of evolution for a long time. Baldwin, Lloyd Morgan, Goldschmidt, Waddington and Schmallhausen have all proposed mechanisms that might achieve this. The case for such feedback is put very forcefully by Piaget is his excellent book. *Le Comportement Moteur de l'Evolution.* The whole issue becomes much clearer, of course, once it is realized that the information that serves to mediate evolution is not just genetic but is formulated in different informational media including the cultural medium.

Evolution is a Goal-Directed Process

If evolution is a cybernetic process, then it must be goal-directed. The reason should be clear. To say that a process is under control means that it is maintaining itself on its optimum course or 'chreod' as Waddington referred to it, that which will enable it to achieve its optimum end-state or goal — a baby in the case of the embryological process, the climax ecosystem in the case of an ecological one. This implies that there is an optimum course and also that there is an end-state or goal. If there is not, then the very notion of control becomes meaningless.

Once a system has achieved its end-state, then to say that it is under control is to say that it is capable of maintaining itself at that end-state or thereabouts, that it is in fact homeostatic. Again, this implies that there is an end-state. If there was not, then clearly it could not maintain itself there. It seems to me that one has to overcome the scientist's irrational attitude towards goal-directedness or purposiveness. Teleology is a fact of life, a fundamental feature of life-processes, including evolution.

Stability is the Goal

To say that a cybernetic system maintains its homeostasis, and that its constituent parts co-operate with it in this enterprise, is to say that its goal is the maintenance of its homeostasis or stability — in effect the same thing. This implies that Gaia does not seek to evolve, and that the changes that it undergoes are simply those that it must undergo in order to avoid bigger and more disruptive changes. They are but part of a dynamic and creative strategy for maintaining the stability of the total spatio-temporal system that constitutes Gaia. Indeed, it is only by adapting the particularities of its structure to environmental contingencies, that a dynamic system such as Gaia can best maintain the generalities of its structure and hence its stability or homeostasis.

Order and Co-operation.

If Gaia is to be capable of acting as a cybernetic system and of maintaining its homeostasis, then it must display that specific structure that enables it to do so. It quite clearly cannot be but a

random assortment of competitive individuals all frantically striving to achieve their own egotistic ends, as the neo-Darwinists maintain. Instead, Gaia must be seen, as Lovelock sees her, as a vast co-operative enterprise geared to the maintenance of its overall structure in the face of change.

Clearly competition occurs: but it is not the most fundamental relationship between living things. It is a secondary relationship. So too, there is selection, but such selection is operated by the various natural systems that make up the Gaian hierarchy, acting their constituent parts, rather than by the vague, undefined 'environment' of Neo-Darwinists. Its role, what is more, is not to assure the "survival of the fittest" (in the sense of the most individualistic, and the most competitive), but on the contrary to eliminate such undesirable individuals, since they do not fit into Gaia's co-operative structure, assuring in this way the survival of those who do fit into Gaia and thereby contribute to the achievement of her strategy.

Evolution and Anti-Evolution

It must be noted that to attribute the above characteristics to the evolutionary process is simply to bring it into line with other life-processes such as ontogeny, behaviour and indeed the Gaian life process itself as depicted by Lovelock.

It is quite clear that these are living processes rather than mechanical ones, that they are dynamic rather than passive, and orderly and goal-directed rather than random. It is equally clear that they are cybernetic processes — each sub-process being monitored so that diversions from their proper goal are corrected by the overall life process. For this to be possible they must be seen as co-operative and well co-ordinated, rather than competitive and individualistic. Why should evolution be different?

Finally, such life processes can go wrong. Nature is neither omniscient nor omnipotent. When life processes go wrong they are no longer under control. They cease to be properly co-ordinated, they become atomized and individualistic, order gives rise to disorder, and to further atomization, co-ordination ceases, competition and aggression take over. This atomization process gives rise to undifferentiated or random Gaian tissue that rapidly replaces Gaia's critical structure — that which she must display if she is to be capable of maintaining her homeostasis or stability.

When they occur at the level of the individual biological organism, these destructive processes are seen as pathological. For neo-Darwinists, however, they are the normal features of the evolutionary process. How can they be? Why should the overall life process behave in a diametrically opposite manner from all other life processes? Is it not apparent that they have got it completely wrong, that they have failed to distinguish between pathology and physiology, between the growth of a malignant tumour and the development of a differentiated tissue — between anti-evolution and evolution?

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Recognizing the Problem But Not the Solution:

The Dutch Environmental and Political Crisis

The environment of the Netherlands, one of the world's wealthiest countries, is deteriorating rapidly. The political and economic establishment agrees that they are facing a crisis — in early May, the Dutch Government became the first ever government to fall because of "the environmental issue" — but the self-contradictory belief that economies must continue to grow to pay for cleaning up the environment, is still strong. Conventional politicians have yet to follow the acceptance of the existence of the environmental crisis to its logical conclusion — a radical change in lifestyles and economic systems. In fact, the collapse of Prime Minister Lubbers' government owed more to conventional political power-broking than concern for the health of the planet.

The Netherlands is one of the most densely populated countries in the world and also one of the most 'developed'. Inevitably, it is also one of the most environmentally devastated. The country's forests suffer more from air pollution than anywhere else in Western Europe: according to the latest survey, close on sixty per cent of trees suffer some degree of defoliation. It is generally accepted that the vast majority of the country's woods, heathland, bogs and chalk grassland will not survive the next decade.

Drinking water resources are increasingly threatened. Groundwater is widely contaminated with nitrates, aluminium, cadmium and pesticides, and most of the country's streams are polluted with unacceptably high levels of agrochemicals. Straddling the bottom end of three of Western Europe's most polluted rivers (Rhine, Meuse and Scheldt), the Netherlands accumulates tonnes of heavy metals, pesticides, phosphates, organic chemicals, radioactive fission products and other toxic wastes from the industries of neighbouring countries.

Historic Report

Official (advisory) institutes are now increasingly reflecting mainstream environmental thinking in the Netherlands. At the end of last year, the National Institute of Public Health and Environmental Protection (RIVM) issued a historic report, *Zorgen voor Morgen* or *Concern for Tomorrow*. Commissioned to serve as the basis for the Netherlands' environmental policy into the next century, it gives an admirably realistic and detailed analysis of the threats, current and impending, to worldwide, European, Dutch and even indoor environments.

In a public interview following publication of the report, Environment Minister Ed Nijpels summed up the situation with reference to the issue of pollutant discharge:

"With current technologies you can achieve a certain reduction, but not sufficient — perhaps thirty to forty per cent. The percentages we're talking about, 70 to 90 per cent, require entirely different production processes and a new attitude towards economy and the environment. People need to adopt new attitudes, society needs to undergo drastic changes."

In the context of the uninspired worldwide environmental debate at governmental level, the report made three important points. First, the pollutant reductions required by nature (and man) are far beyond the targets currently on the international agenda. Secondly, 'technical fixes' are not going to be nearly enough, and thirdly, the situation is so serious that, in the words of Nijpels, "a drastic change in the way we treat the environment can no longer be postponed."

By the end of 1988, the 'environmental issue' was at the centre of public awareness. In her traditional Christmas message, broadcast on radio and television to the Dutch population, Queen Beatrix spoke of nothing else: "Gradually, the earth is dying and the inconceivable — the end of life itself — is becoming conceivable. What we are now experiencing is not the destruction of the world at one stroke but in a silent drama...We are now faced with the challenge of finding a new relationship with nature, characterized by respect for ecological balance, caution and careful management."

In early January, the major federations of employers and trades unions came up with a joint pledge, "to prevent further deterioration of the life-supporting capacity of our environment and initiate a process of improvement". According to the unions, "international competition can no longer serve as an alibi for not taking action".

The Establishment Backlash

Since then, however, nothing has been heard of practical steps that are being taken or even planned by these organizations. Other bodies, representing the sources of pollution, reacted aggressively. The federation of chemical industries, one of the most powerful Dutch industrial lobbies, warned that they would "not accept regulations on which they had not been adequately consulted".

Farmers' organizations protested that they were being made into a scapegoat and presented an "environmental plan" of their own, recommending a variety of technical fixes. Establishment economists and bankers played down the urgency of the crisis and shouted that there had to be more economic growth to pay for protecting the environment.

Others have been less reactionary, and more realistic. In mid-March, a group of 50 economists led by Nobel Laureate Jan Tinbergen wrote an open letter to the government, appealing for implementation of the measures that necessarily follow from the analysis of *Concern for Tomorrow*, and claiming that this implies basic changes in economic thinking and lifestyle. The Dutch environmental movement responded with similar pleas, and started working out a 'shadow' policy document.

The Political Crisis

At the beginning of May, the political crisis came. It had become clear that between the various government departments, and the interests they rep-

resent, fundamental conflicts were emerging now that an ecological analysis had to be translated into a policy programme. Within the coalition cabinet of Christian Democrats and Liberals, these conflicts led to considerable tensions, and Prime Minister Lubbers spent a week fighting for, and eventually achieving, consensus among his colleagues. It seemed as if the potentially historic parliamentary debate could start. However, this was not to be. There was no chance for a debate on the real crisis, for the Liberals forced a political one, by rejecting a couple of minor details in the policy programme and bringing the government down.

Political Bankruptcy

On the surface, the Liberals' main objection concerned the cabinet's plan to abolish an income tax deduction on travel to and from work. Although not finalized, the plan was to use the extra revenue to encourage use of public transport. At one level, their unexpectedly tough stand was seen to reflect the growing worries of motorists. At another level, political commentators said that the crisis was not about cars or environmental policy, but was in fact an excuse to bring down a government that, in the Liberals' view, was no longer taking their party seriously.

In fact, the political crisis in the Netherlands is a result of the bankruptcy of ideas in all mainstream political parties, and the refusal of powerful economic lobbies to accept that their premises are fundamentally flawed. It is now acceptable to say that the world is in an ecological crisis. It is equally acceptable to say that fundamental changes are unavoidable. But the implications of all this for switching off the very motor of destruction — economic growth and unlimited consumer demand — were too hot for anyone to handle.

Subordinating the Environment to Production

In mid-May, the National Environmental Policy Programme was belatedly presented by a government out of power, in a country choking from photochemical smog (a recurrent nationwide problem "caused by the sunshine", as the newsreaders say). The policy programme, described by the government as being based on the Brundtland concept of 'sustainable development' and on the RIVM report *Concern for Tomorrow*, was rightly scorned by the country's major environmental organizations.

"With this plan, the environment can be written off", said the director of 'Natuur en Milieu', pointing out that a policy aiming to save only twenty per cent of the country's woodland and allowing for a further fifty per cent increase of motorized traffic could only be characterized as a fiasco. "All the focus is being placed on end-of-the-pipe technologies, such as treatment plants and processing of hazardous wastes", Friends of the Earth Netherlands complained. "This plan subordinates environmental policy to a doubling of production and consumption in the next two decades."

The Netherlands does not differ fundamentally from any other affluent industrialized nation; where it does differ, in the context of the current debate, is because some Dutch institutes have realized the full scale of the problem and thought out its implications, giving official weight to the radical analysis of the ecological movement. The stunning successes of the Green parties in the recent Euro-elections gives a pointer as to what lies ahead for governments which do not start to apply this analysis.

Nigel Harle

Books

Ethics and Ecoholism

ENVIRONMENTAL JUSTICE, by Peter S. Wenz, State University of New York Press, 1988, 363pp.

How vigorously Peter Wenz chews the ethical cud! Virtually all of ethical theory, from the Virtue of Wealth Theory (bequeathed by the Puritan work ethic) to Ecocentric Holism (Aldo Leopold states; "A thing is right when it serves to preserve the integrity, stability and beauty of the biotic community. It is wrong when it tends otherwise") passes through his hard-working jaws.

Where is our ideal theory of Justice? Where is the rationally-consistent, scrupulously-fair theory that will arbitrate between humans themselves and between humans and the environment?

The Virtue of Wealth Theory

Wenz begins by detailing the inadequacies of the Virtue of Wealth Theory, pointing out that people soon pursue wealth, not as a reward for honest labour but as an end in itself. It was John Wesley who pointed out that "As riches increase, so will pride, anger and love of the world." In England, the theory was neatly conceptualized by the word 'gentleman' and the theory still, to Wenz's chagrin, retains a powerful hold over the imagination of the American public who are blind to the excesses of big business but take a grim satisfaction whenever welfare swindlers are caught out.

The Libertarian Theory

What then of the Libertarian Theory, whereby "Individuals should be allowed to do what they want, as long as they respect the right of everyone to do the same"? The theory is much in vogue today, but its dogmatic insistence that private property is essential to individual liberty renders it fatally flawed. As Wenz points out, property rights ultimately rest upon theft. America belonged to the Red Indians, England to the British Celts. Nor is this an academic point — indigenous peoples are being driven out of their rainforest territory at this very moment. And what about the rights of animals whose habitat is destroyed by human activity?

Property rights are indeed a difficult subject with many interesting legal and environmental implications. For example, according to common law, it was once held that land ownership extended to the "periphery of the universe". The invention of the aeroplane changed that. American law now holds that the United States itself has "complete and exclusive national sovereignty in the airspace". So, if the birds of a chicken farmer living next to an airfield die of fright there is no automatic redress. But, if property-owners do not own the airspace, do they own the right to clean air on their own property?

Here we come upon a fascinating paradox at the heart of the market system. The freedom to own property is held to be essential and yet, if industry is not free to pollute that property, then industrial 'civilization' will end in a series of court actions. Take the case of Versailles Borough v McKeesport Coal & Coke Co in 1935. The plaintiffs, suffering from the sulphides emitted by piles of burning tailings took the mining company to court. Judge Musmanno, admittedly during the Depression, ventured the opinion that "Much of our economic distress is due to the fact that there is not enough smoke in Pittsburgh..." Therefore, within the Libertarian Theory, we find the liberties of industrialists and the liberties of property-owners in head-on collision.

The Efficiency Theory

Adam Smith's advocacy of laissez-faire economics is dear to modern monetarists and free marketeers. The guiding principle behind the Efficiency Theory is that competition produces efficiency. But does it? In fact, as Wenz points out, competing corporations soon decide there is an easier way to make money than through constant competition — it's called a monopoly. And here Efficiency Theory enthusiasts find themselves caught in a cleft stick: legislation is needed to limit monopolies and yet they are opposed to legislation.

America has anti-trust laws but is it desirable that monopolies should always be curtailed? When the Automobile Manufacturers Association collaborated on the development of pollution control devices, the State of California brought an anti-trust suit against them. Chrysler stated in its brief, "Competition would not sell (automobile pollution control) devices — the citizens rejected them even when the law required them. Competition will not create the...automobiles...(the government) says we need. Indeed, competition creates an intense pressure *not* to produce such automobiles...The competitive instincts, which the anti-trust laws encourage, are the precise opposite of those which conduce to improvement of the environment."

Of course, efficiency is hardly much of an altar to worship at these days when it could mean that we destroy the biosphere, and hence ourselves, that much quicker. Notwithstanding these theoretical and practical flaws, however, the Efficiency Theory still dominates today's political thinking.

Human Rights

And what about human rights? Do they exist when there is no law to uphold them? Jefferson held it to be "self-evident that all men are created equal" — by which he meant men and not women. But wherein does this equality lie? In any society beyond the hunter-gatherer men are born into situations of material inequality, not to mention Natures' unequal distribution of mental and physical equipment. And, when we talk of human rights, do we mean negative rights, the right to remain unmolested, or positive human rights of the sort outlined in the UN Universal Declaration of Human Rights, "Everyone has a right to the standard of living adequate for the health and well-being of his wife and family"?

Kant concluded that human beings were ends in themselves and should never be used as a means. Could they then be used to increase someone else's profits in a

market system? Yes, they could — so long as they were not used *merely* as a means and worked like slaves. Animals, on the other hand, lacking freedom and reason, are, according to Kant, "there merely as an end. That end is man." Kant, however, disapproved of cruelty to animals and sought to prevent it by the argument that those who were cruel to animals would be cruel to humans which was why "In England butchers and doctors do not sit on a jury because they are accustomed to the sight of death and are hardened."

But what if human beings lack freedom and reason? Psychological studies suggest that humans all to frequently behave in an irrational manner, driven by biological impulses, genetic programming and social conditioning. And even if humans do possess freedom and reason, is it not logically arbitrary to distinguish them from all other species on these grounds? Birds might as well decide they are superior to all other species because of their possession of wings and beaks.

Tom Regan argues in *The Case for Animal Rights* (The University of California Press, 1983) that animals are 'subjects-of-a-life' because their lives can be better or worse for them. Thus they have inherent value, deserve our respect and, according to Regan, the same rationale applies to animals as to humans. But a wild boar cannot take a leopard to court for assault, nor are police likely to protect the sheep against assault from a wolf. Faced with these difficulties Regan reaches for the same divisive weapon that Kant used. Because the wolf lacks freedom and reason, he argues, it has no moral responsibility and cannot therefore violate anyone's rights.

Utilitarianism

Perhaps, suggests Peter Wenz, Utilitarianism can be used to sort out this terrible confusion. In Jeremy Bentham's day, when the biosphere seemed limitless, the Utilitarian theory that ethical worth consisted of the greatest good of the greatest number must have seemed a benign philosophy. Bentham was by no means opposed to animal rights, believing that: "The French have already discovered that the blackness of the skin is no reason why a human being should be abandoned without redress to the caprice of a tormentor. It may one day come to be recognized that the number of legs, the viscosity of the skin, or the termination of the *os sacrum*, are reasons equally insufficient for abandoning a sensitive being to the same fate.

". . .even if humans do possess freedom and reason, is it not logically arbitary to distinguish them from all other species on these grounds? Birds might as well decide they are superior to all other species because of their possession of wings and beaks."

The question is not. 'Can they reason?' Nor 'Can they talk?' but, 'Can they suffer?' It is not, therefore, at all far-fetched to include animals' well-being in utilitarian calculations.

Wenz finds that utilitarian theory has its uses in condemning the infamous Draize test on rabbits. The amount of 'winsomes' (a unit of utilitarian good) gained by the consumers of a new cosmetic is totally outweighed by the amount of 'gruesomes' (a unit of utilitarian bad) suffered by the unfortunate rabbits. However, successful vivisection experiments which lead to a large increase in 'winsomes' for humans would not be condemned. Utilitarianism, unfortunately, has an emphasis on maximizing the human population and, as it regards happiness as fulfilled in terms of material consumption, maximizing productivity. As such it is hardly an eco-friendly philosophy. Nor does it concern itself with the future of the planet.

As a theory of justice, utilitarianism also has its drawbacks. A theory which is concerned with the good of the majority suggests that minority interests could be sacrificed for the greater good. A society might decide to segregate those infected with AIDS, for example, to protect the healthy majority of the population. This would be unjust to AIDS sufferers and thus utilitarianism, a theory of justice, would advocate unjust actions.

Kant's Ethical Viability

Is ethics a mere cud after all? Or is it some inextricably complicated Gordion Knot that needs a philosophical knife to slice through the tangle of competing interests? Enter Emmanuel Kant with his single test of ethical viability. For an action to be good, says Kant, it must be universalizable. Thus it cannot be said, 'Let everybody shoot themselves', because if it was put into practice there would be no humans left and the imperative would be self-contradictory. However, that leaves a wide range of undesirable activities which can slip past the categorical imperative. 'Let every man shoot his grandfather', 'let every man kick his wife'...exit the categorical imperative.

Another logical knife to slice the ethical knot is proposed by John Rawls. In *A Theory of Justice* (Harvard University Press, 1971), Rawls suggests that justice can be defined simply as the result of the *procedure* that is used to reach it — just as a game can be defined by its own rules. His procedural theory resembles Linguistic philosophy wherein philosophic difficulties were to be solved by looking up troublesome concepts in the dictionary. However, lots of injustices have obviously been sanctioned by law and Rawls has to refine his position. He states that justice will result if people decide the rules in a self-interested manner. But then surely the powerful will make rules in favour of the powerful? Ah yes, says Rawls, but those deciding the rules must act through a 'veil of ignorance' whereby, blind to their immediate interests, their real interests will emerge and just procedural rules will be arrived at. Wenz makes short work of this idea, as we may imagine. But could Cost-Benefit Analysis provide the answer?

Cost-Benefit Analysis

Wenz points out that Cost-Benefit Analysis which has its roots in the Efficiency Theory and Utilitarianism, is particularly subject to manipulation. He quotes the infamous Tocks Island Dam study of 1960, made by engineers, which calculated recreational facilities as the largest benefit of the project while omitting the enormous cost of highways necessary to enable the public to reach the facilities.

Indeed, many crucial environmental features are ignored by Cost-Benefit Analyses. Neither animals nor plants can put in a bid to save their habitat and such important matters as unpolluted air have no influence in the market place. The unborn are also at something of a disadvantage when it comes to Cost-Benefit Analyses; they can no more put in a bid than a micro-organism can. Wenz amusingly calculates that, at a 5 per cent discount rate, one human life today will be worth 489.6 billion future lives in 489.6 years — which gives us very little justification to concern ourselves about the future!

Ecoholism

Wenz concludes his survey of ethical theories with an examination of Biocentric Individualism and Ecocentric Holism. If we extend the circle of moral concern from men, to women, to animals, why not extend it to all living things? This is the position of Paul Taylor in *Respect for Nature* (Princeton University Press, 1986) who holds that, "although goal-orientated organisms like trees and protozoa do not have a conscious life...yet they have a good of their own around which their behaviour is organized." The difficulty with the view that all things have inherent worth is that life involves predatory behaviour. Is it fair for a human being to kill a few million TB bacilli? Yes, says Taylor. That is self defence. Can we eat a lettuce? Yes, that is minimal harm. Can we cement a few million microorganisms in the footings of a new library? Yes, says Taylor. But you must make restitution. Wenz points out the difficulty of making restitution to individual microorganisms. Some biocentric individualist thinkers try and get themselves out of difficulties by the splitting of hairs. Robin Attfield in *The Ethics of Environmental Concern* (Basil Blackwell, 1983) maintains that plants and bacteria "could have a moral *standing* and yet have an almost infinitesimal moral *significance*."

Wenz finds a number of arguments in favour of Ecocentric Holism, which puts the continued health of environmental systems as the central moral prerogative. He suggests it could be argued that, as evolution has produced us, the principle of 'Process-Harm' applies to it, that is the principle of leaving well alone or making good what damage is done. He also argues that evolutionary processes should be treated as ends in themselves. Where Wenz finds himself at odds with Ecocentric Holism, however, is where it is concerned with the biotic community and not with the individual. He is worried about J. Baird Callicott's remark (*The Search for an Environmental Ethic*, Random House, 1986) that "the population of human beings should, perhaps, be twice that of bears." "Thus the implications of Ecocentric Holism seem to be misanthropic", writes Wenz. "Tom Regan justifiably calls such an extreme unqualified holism 'environmental fascism'".

Wenz believes that "Any adequate theory will have to take into consideration property rights, human rights, animal rights, the quality of experience, financial costs and benefits and the distribution of benefits and burdens," Where is the theory to do all this?

"Hume pointed out that descriptive and prescriptive statements are of different logical types. 'Is' does not imply 'ought'. Thus, from the statement 'The biosphere is being destroyed' we cannot logically derive the prescription 'We must halt the destruction'."

Wenz comes up with a pluralistic theory. From Ecocentric Holism he wishes to take the implication "that we should try to avoid degrading ecosystems and causing the extinction of species" and to integrate this with a bit of utilitarianism, a bit of common sense, a bit of Cost-Benefit when appropriate and so on. As a sort of glue to stick this ramshackle system together, Wenz suggests a concentric circle theory stating that our moral concerns diminish the further we are removed from our family, community etc. — a theory that implies racism, much to Wenz's discomfort. But this is only a minor difficulty. Wenz is in the position of a man who has pushed several ethical Humpty Dumpties off the wall and then tries to stick them all together to make a coherent whole.

The Nature of Reality

Napoleon Pig with his famous "All animals are equal but some are more equal than others" philosophy was not the only ethical thinker to split hairs. It happens all the time. And a believer in, say, racial superiority could easily give Wenz's creaking ethical structure a push in the right direction. Even within a community, a lobby like NASA could claim that they were engaged in an ultimate quest for mankind and therefore deserved a huge share of the national budget.

In fact, what Wenz's excellent survey demonstrates, without intending to do so, is that most ethical theories of justice are doomed to failure because of the nature of reality. Take the reality of the food chain. A tiger eats a deer — the deer has its life terminated while the tiger enjoys a high protein meal. Hardly a transaction equally advantageous to both parties. When a hunter-gatherer kills a monkey there is a similar divergence of interests. When agriculture replaces forest, forest fauna lose, whereas humans gain an increased food supply. When industry replaces agriculture then this creates environmental havoc for some and desirable artefacts for others.

Conflicting Interests

Most ethical theories tear themselves apart on this conflict of interests, a difficulty which increases the wider one casts the ethical net. If animals, plants, microorganisms, the biosphere are included in any conventional moral calculation it is impossible to reach a moral conclusion on any subject whatsoever. How on earth can it be said of any human activity 'This is good' or 'This is bad'? A man eats a slice of bread. Is this good or bad? Good, one might say, because everybody needs food. But supposing the man is a serial killer — is it still a good thing for him to be fed? Let us suppose the man is a street-cleaner and not a serial killer. Is is now good for him to eat a slice of bread? Yes, you may say. But what if the bread is grown by intensive-farming methods that are destroying agricultural land for future generations? And so on. In fact, all moral systems — with the single exception of Ecocentric Holism — are based upon a grotesque process of *moral abstractionism*. Moral abstractionists abstract real processes and events from the totality of experience and then judge them in this entirely illusory void. Thus, if we think of automobiles only as attractive purring machines that take us from A to B then it clearly follows that automobiles are a good thing and everyone ought to have one. If the biosphere is limitless then the abstractionism of utilitarianism applies and it follows that we want as many people as possible living as well as possible on planet earth.

Unfortunately, many Western thinkers are intensely urban in outlook. To them, the city is the world and the supermarket a self-perpetuating cornucopia of good things. All you need to feed from the supermarket is money and money can be minted and distributed. The same goes for industrial products. The poor of the world simply need more supermarkets, money and cars. They belong, therefore, to the 'developing world', despite the fact that current development policies are antithetical to the welfare of both humans and the biosphere. Western thinkers are also prone to 'speciesism'.

"Nothing has value except by law", Kant maintained, by which he meant

human law. Until the advent of humans capable of freedom and reason there was nothing of moral value in the world. Thus the half-comprehended miracle of evolution would be, according to a great ethical thinker, an entirely amoral process until human beings acquired freedom and reason. And now this same creature of freedom and reason, after a mere hundred and fifty years of uninhibited industrial activity, is poised to destroy the entire biotic community, including himself. So much for value, law, freedom and reason!

Ecocentric Holism actually emerges from Wenz's scrutiny in much better shape than he gives it credit for. Because the concern of Ecocentric Holism is not with the individual organism but with the biotic community, Ecoholism suffers from none of the problems of individual-based systems. Individual-based systems tie themselves in knots trying to figure out how there can be no winners or losers in their moral universe. How can there be justice for the lion and the deer? For the property-owner and the industrialist polluting his property?

These problems cease to exist within the framework of Ecocentric Holism. The deer population, left to itself, would overbreed and destroy its own habitat. The lion, therefore, in eating individual deers is helping the deer population to survive. And, of course there cannot be equal justice for the polluter and the polluted. The polluter must simply cease to pollute — unless his product is vital to limiting ecological damage on a larger scale.

Hume: Cutting the Gordian Knot?

Absent from Wenz's comprehensive survey is a mention of the telling thrust that David Hume, the great Scottish philosopher, delivered to all ethical imperatives. Hume was that rare sort of philosopher who, when he clambered into his logical longboat, boldly took to the main — instead of rowing to the nearest cove to split hairs. Peter Wenz maintains that "beliefs about prescriptions are acquired in the same general way as are beliefs about descriptions." Hume wickedly pointed out, however, that descriptive and prescriptive statements are of different *logical* types. There is no necessary connection between the two. 'Is' does not imply 'ought'. Thus, from the statement 'The biosphere is being destroyed' we cannot logically derive the prescription 'We must halt the destruction'.

There is an antidote to Hume, fortunately, and that is the Hypothetical Imperative beloved of Kant. With perfect logical consistency we can say, 'If the human race is to survive we must cease destroying the biosphere on which that survival depends.' It is logical, it is chilling and it is true. In a world of renewable resources, say that of the hunter-gatherer, Ecocentric Holism would seem a superfluous philosophy — indeed its precepts would be embodied in religious beliefs — but, with our biosphere showing signs of damage and man-made climatic change, Ecocentric Holism has come of age, it has reached its historical moment of truth. Although Wenz does not quite appreciate the crucial importance of Ecocentric Holism — he is aware of environmental dangers but underestimates the immediacy of the threat to the biosphere — one must remain grateful to him for his scrupulous and exhaustive study of ethical theory, enlivened by legal and environmental data.

Joe Potts

Back to the Future

THE STOLEN FUTURE: How to Rescue the Earth for our Children, by Patrick Rivers, Green Print, London, 1988, £5.99, 256pp.

It is usually assumed that if a nation has a great period of political freedom and material progress — as in the 'golden ages' of Greece, Rome, Britain and America — then this will be followed by a still greater period for which the foundations have been laid. But, in fact, these great civilizations invariably decline and fall. They spend too much and save too little; they value everything in terms of money; they merge the small and the local into the huge and the central; they abjure taxation and bribe the unemployed with 'bread and circuses' — the ancient world's equivalent of the media. They raise wealth by looting — today by over-exploiting the earth's resources. They attempt more than their resources will enable them to achieve. We see this happening in America and beginning in Britain. Libertarianism is confused with freedom, and order is preserved by complex laws said to be justified by state security.

One major reason why these civilizations fail is, as this remarkable book stresses, because material progress usually creates a vast urban environment inimical to the human condition; then the ability to cope with the problems that arise with increased wealth is weakened by mass neurosis, fear of thought, panic and violence when expectations are not fulfilled, and the inflation which masks the lack of the means to meet the demands and needs of the population as a whole. The people want illusory reassurances that all is well when they suspect it is not. These reassurances are provided by obsolete and unsustainable philosophies and economic theories — as in most Western nations today.

Patrick Rivers' book attempts, in a vast historical sweep — rather after the manner of Toynbee's *Challenge and Response* — to trace the defects in our way of life that enable us to be so easily misled. Rivers agrees with Ronald Higgins that the ultimate enemy must be ourselves (Higgins 'Eighth Enemy') for allowing and encouraging such a situation to develop.

As this cycle occurs with such frequency, it suggests that there must be something profoundly amiss in human nature which so far we have been unable to overcome. The writer and educator, Law-

rence J. Peter, gave as his diagnosis that "We promote ourselves to the level of our incompetence". This 'Peter principle', says Rivers, can be applied to nations which cannot resist promoting themselves beyond their competence and indeed beyond their moral rights. Though the great religions condemn this impulse ('The meek shall inherit the earth', 'It is easier for a camel to pass through the eye of a needle than for a rich man to go to heaven') we officially accept the religion but continue as before, as doubtless will be the case with the new Green philosophy.

However, although nations are indifferent to their souls, they are not indifferent to their survival. And before long they will be confronted by the fact that if they wish to survive they will have to live more in conformity with religious teaching.

Since Christianity has been castrated by history, we must try a new approach. This is what Patrick Rivers attempts with passion, fervour and intelligence. Books of this kind are inspired by suffering; those who feel themselves at one with nature feel every injury to nature as if it had been a wound in their own being.

Rivers quotes Albert Schweitzer as saying that it is "incomprehensible that our generation, so great in achievements of discovery, could be so low spiritually as to give up thinking." In an earlier chapter, on the other hand, Rivers offers Koestler's theory that we have over-developed the cerebral cortex at the expense of the rest of the mind. In other words, we can invent, argue logically and so on, but in Schweitzer's sense of the word we cannot think — or should we say 'reflect'? We have neglected the spiritual element of our being. Furthermore, our education deprives our brains of sensory experience as it is mainly intellectual. Shakespeare summed this up when he wrote: "Love hath reason; reason none."

In contemporary industrial society, almost all reasoning is without love. We reason purely to increase profit and productivity. We may love our family, but our love does not extend far beyond that. Today, the North mercilessly exploits the nations of the South — they are not the family and to love them would interfere with the eternal laws of economics. Yet even the family is disrupted in a culture which has no regard for society but only for the competitive individual.

The Stolen Future endeavours to trace the way we have developed a self-destructive personality when, apparently, we had such a good start. We have made a Faustian bargain with our own Mephistophelian brain power ('brain' not 'mind') by which we have exchanged our souls for material wealth. To recreate ourselves we must look back to our origins and study human nature under different conditions. The past should not be assumed to be inferior to the present. The human nature of today is not fixed; history records boundless differences. It may be all potentially in our genes, but our genes express themselves very differently in different cultures. There are alternative cultures that relate us far more closely to nature and to each other. If our children are to survive and lead fulfilled lives we must use our sensibilities and imagination to create such an 'econaissance', bitter though the resistance to this will be.

Patrick Rivers' analysis of the defects of our present culture in terms of the needs of our archetypal nature is an outstanding achievement and we must hope it will be read by millions. It synthesises much of the most advanced science (such as the Gaia Hypothesis) and anthropology to argue for an alternative to the destructiveness of contemporary lifestyles. Rivers cites his own experience of living more happily on less to prove his ideas are not 'all in the mind'.

The finer points of Rivers' argument may be challenged, but the overwhelming

evidence supporting the main theme is undeniable. Unless we change ourselves, war and overpopulation will finish us off. We need quality not numbers, self-sacrifice not war. The reason that orthodox-thinkers see no logical justification in self-sacrifice is that they cannot comprehend that they are sacrificing their own children by maintaining a standard of living and an environment that is not sustainable.

Robert Waller

The Earth as Supermarket

RED OR GREEN FOR FARMERS (AND THE REST OF US), by Richard Body, Broad Leys, Saffron Walden, 1987, £3.95, 164pp.

In his earlier volume *Farming in the Clouds*, British Conservative MP Richard Body noted that "there is evidence that the agrochemical industry has had an excessive influence over the Ministry of Agriculture to the detriment of us all and I have marshalled a great deal of it together for a third book to be published after this." The volume under review is presumably that promised.

It is a curate's egg of a book. The first 90 pages contain his analysis of the agricultural 'treadmill' on which the British farmer is caught. This is useful, even if by now little of it is new. The remainder of the volume is either vague or dubious or, in some sections, quite simply misleading. The first eight chapters appear to have been used by the writer to promote his views on the necessity for free trade and above all his campaign for British withdrawal from the European Community Common Agricultural Policy (CAP). Even the second part of the book entitled 'Green Farming' contains only one rambling chapter on 'Biological Farming'.

Most of this part of the book is, however, more preoccupied with "setting the consumer free", with removing any remaining limitations on the power of the purse as the final arbiter in agricultural matters. Once British farmers have been freed from the constraints of the CAP, he argues, they will once again have access to those cheap imported feed stuffs on which the 'efficiency' of British farming was long based. Free trade will not only provide farmers with cheap feeding stuffs, but will also provide the British consumer with those cheap imported foods which are essential if wages are to be kept down and Britain is to regain its competitiveness in international trade.

Those who read *Farming in the Clouds* will remember Body's amazing comments on Brazil where "if all the forests were uprooted...the land is so rich that it would yield enough cereals to give every member of the human race six pounds a day, yielding 9000 calories...." That three years later Richard Body is still far from any real understanding of ecological issues is illustrated in the present book, as early as page five, by his inaccurate assertion that "the lowest cost in money terms is, as a general rule, the lowest cost in terms of natural resources. Every ecologist is a natural free trader." He is reluctant to accept that the workings of the free market philosophy which has been inflicted on so many nations — and from whose effects the peoples and the ecosystems of the entire globe may never fully recover — are scarcely compatible with his loudly proclaimed support for the 'Green' option.

His basic worldview is expressed when he declares; "Protectionism, whether of food or anything else, is an intrusion upon the consumers' freedom of choice. Under conditions of full and genuine free trade...the consumer has the maximum choice. He can roam the world and what he wants he has, provided only he can afford the price. Free trade thus becomes more than a freedom but a right too. It is the right to satisfy one's wants in a fair and honest way." That this "right" is negated for millions of people by his casual qualification, "provided only he can afford the price", is a fundamental contradiction Body never faces up to. His philosophy puts an end to any guiding concept of morality in our dealings with our fellow beings.

Body's analogy that a free market is like a continuous general election because "All the time millions of people can cast a vote with their money for brand X in preference to brand Y; and if too many people abstain from voting because they have not enough money to buy what they would like businesses fail and so go bankrupt", has, even in the 'affluent' societies, only a superficial validity. Businesses may collapse — but the food transnationals and agribusiness grow ever more powerful. In the Third World, those peasants who can no longer produce their own food, because the cultivable land is used by transnational corporations to grow off-season and exotic vegetables or flowers to be flown to the cities of the wealthy nations, are frequently in no position to exercise their "right" to buy or vote. They are forced to abstain and many millions die. What Richard Body is promoting is what Charles Condamines has termed "a single global supermarket...(where) between the various potential customers, only purchasing power indicates the one which will become buyer." The already apparent results of this — that a German pig or a Dutch cow are better fed than millions of Third World children — show the moral bankruptcy of such a system.

Body's refusal to adopt a global and truly ecological perspective is underlined by his discussion of food grain imports into Britain. He is enthusiastic about the cheapness of British milk, pork, eggs and poultry meat, made possible because the feed stuffs used by Britain's farmers "were the cheapest in the world." That this cheapness was due in large measure to exploiting peasant producers of groundnuts, cereals and oil seeds throughout the Third World, and the continuous transfer of soil fertility from all over the globe, is passed over. He extols the cheapness with which wheat could be imported from North America or Australia and passes over the fact that such cheap imported grain is to a considerable extent the result of a reckless exploitation of soil and fossil water resources; that every tonne of grain produced by Australia is estimated to 'cost' 13 tonnes of top soil; that total US soil losses are estimated variously at between two and six billion tonnes yearly — and that the remaining soil and the water systems are saturated with herbicides, pesticides and the residues of artificial fertilizers. Yet, ignoring the ecological costs of these "efficient" monocultures, Body can still offer us the salutary reminder that "Without soil there is no life for the human race."

Concluding his case for free trade Body states, "Finally, but not the least important of all, is the ecological argument for free trade." However, it is an "ecological argument" which assumes that all the resources needed for the production of food — land, labour, fuel, fertilizer, livestock, capital equipment — "can be quantified in money terms" and that "free trade enables the different kinds of food to be grown in the regions where resources are used most cost effectively" (starvation wages being a positive element in such a system presumably). However, it is virtually impossible to quantify the ecological costs noted above in money terms. If such things *could* be costed into food production — or if one day a transformed and organic farming stopped "discounting the future" —

then food prices are likely to go up rather than down as Body claims. To continue to transport food around the world at enormous cost in terms of energy and pollution is the opposite of an ecological approach which would emphasize food being produced as close to where it was consumed as was environmentally feasible.

Body is reticent about how his vision could be implemented other than by removal of subsidies and free trade. (He would also give financial support to the farmer who "is a steward of the countryside" rather than "in the food-producing chain" — apparently on either/or choice.) Citing New Zealand approvingly for having removed price supports to farmers, he looks forward to British consumers eating more cheap NZ butter, cheese and lamb under free trade. He ignores the reality that today NZ farming and rural communities are in complete disarray with thousands of farmers having been driven off the land in large part because of low prices (a sheep fetches the same price today as in the 1950s). In a tortuous argument he claims free trade would encourage Third World countries to expand food exports (while the price of food is nevertheless to come down) so they can buy the means to industrialize to provide jobs for their hungry people who could thus buy imported food.

Body argues in terms of economic policies, but in economic terms there is no necessary reason why land should be used to grow food at all, let alone cheap, basic, foodstuffs. Within Europe this was decisively demonstrated by Robin Jenkins' study of a Portuguese peasant community (*The Road to Alto*) where, in little over a decade, the impact of market forces replaced a centuries-old and sophisticated system of irrigated food production by a monoculture of eucalyptus (with disastrous results in both ecological and human terms). In the Third World, the only way land will be used for basic foodstuffs is if it is controlled and used by those who need the food — the mass of people who have been progressively thrown off the land and marginalized because of precisely the type of liberal economic policies Body espouses.

For our part, we can only agree with René Dumont who, after sixty years as an agronomist, concludes in his final book that such economic liberalism, by ravaging lives and environments all around the globe, has created '*Un monde intolérable*'.

Keith and Anne Buchanan

BOOK DIGEST

Books which are covered in the digest may be given full-length reviews in forthcoming issues.

- *THE DEMISE OF NUCLEAR ENERGY? Lessons for Democratic Control of Technology*, by Joseph G. Morone and Edward J. Woodhouse, Yale University Press, New Haven and London, May 1989, £20 ($27) (hb), 172pp.

A diagnosis of the decision-making processes which led to the current disastrous state of the US nuclear power industry. The authors argue that the ills of the 'first' nuclear era stemmed not from any inherent problems with nuclear technology, but from a series of short-sighted political and economic decisions. They optimistically conclude that small scale, democratically controlled reactors can ensure a future for nuclear power.

- *FORCES OF CHANGE: Why We Are the Way We Are Now*, by Henry Hobhouse, Sidgwick and Jackson, London, April 1989, £17.95 (hb), 264pp.

A reinterpretation of history as spurred, not by the actions of mankind, but by three forces — population growth, disease and food supply — which form a self-balancing triangle. Hobhouse believes that recent advances in controlling disease and increasing food supply have led to the population explosion which will eventually be halted or even reversed by the limits to the other two sides of the triangle.

- *CHANGING THE FACE OF THE EARTH: Culture, Environment and History*, by I.G. Simmons, Basil Blackwell, Oxford, May 1989, £14.95 (pb), 487pp.

This history of the human impact upon the natural environment ranges from pre-agricultural times to the present and considers the consequences of current trends. A theme of the study is that access to energy is a key variable in our relationship with nature and that current exponential growth in energy use has brought this relationship to a critical stage. A timely, comprehensive, well illustrated and fully-referenced work.

- *IN DEFENSE OF THE LAND ETHIC: Essays in Environmental Philosophy*, by J. Baird Callicott, State University of New York Press, 1989, 325pp.

This collection of essays brings into a single volume J. Baird Callicott's decade-long effort to articulate, defend and extend the environmental philosophy of Aldo Leopold. Callicott confronts the philosophical questions of how an evolutionary and ecological ethic can bridge the gap between *is* and *ought* and how the intrinsic value of nonhuman organisms and the biosphere itself can be justified.

- *THE ECO WARS: A Layman's Guide to the Ecology Movement*, by David Day, Harrap, London, June 1989, £12.95 (hb), 360pp.

Day's sense of the ridiculous enlightens the many anecdotes and facts in this book, a guide to the anti-ecology as much as to the ecology movement. It catalogues the stupidity, often bordering on the farcical, which lies behind human cruelty to animals and each other and the destruction of the natural world.

- *THE ENDS OF THE EARTH: Perspectives on Modern Environmental History*, edited by Donald Worster, Cambridge University Press, 1988, £8.95 (pb), 341pp.

An excellent overview of current work in the fast-growing discipline of environmental history. The authors address the historical relationships between climate, food supplies, population, technological innovation and social change, the 'ecological imperialism' of the colonial era, and current attempts to conserve resources and regulate humankind's destructive impact on nature.

- *ACTION AT THE GRASSROOTS: Fighting Poverty and Environmental Decline*, by Alan B. Durning, Worldwatch Paper 88, January 1989, 70pp. *NATIONAL SECURITY: The Economic and Environmental Dimensions*, by Michael Renner, Worldwatch Paper 89, May 1989, 78pp. Worldwatch Institute, Washington $4 each. Available from Worthyvale Manor, Camelford, Cornwall, PL32 9TT, UK, £2.50 each.

Action at the Grassroots is a guardedly optimistic account of the growth of church, trade union and environmental citizens' groups worldwide. These groups are the only vehicle for bringing about sustainable societies but, although rapidly increasing, their numbers are small, and the forces they are fighting against — the entrenched interests of autocratic governments and multinationals — are strong. In *National Security*, Renner argues that we need a new definition of national security 'environmental security'. Whereas 'military security' offers only increased wasteful spending, aggression and possible annihilation, 'environmental security' needs co-operation between nations and seeks to protect and restore.

Patrick McCully

Letters

Ethics, Gaia, and the Contradictions of Existence

Dear Sir,
Edward Goldsmith's characteristically forthright exposition of the distinctions between 'technospheric' and 'biospheric' ethics ('Towards A Biospheric Ethic', Vol. 19, No. 2) is certainly challenging. Rejecting a 'technospheric' thesis based on notions of free will, moral choice, competition, individualism, progress and objectivity, Goldsmith opts instead for a 'biospheric' ethic, which he derives from their antitheses — the notions of instinct, intuition, co-operation, community, stability and subjective experience.

By setting out the arguments in such a way, Goldsmith reduces the discussion to a level reminiscent of the sterile 'Nature' versus 'Nurture' debates of the 1960s and 1970s. But a more 'Gaian' or ecological approach would reject such reductionist and one-dimensional arguments, by recognising that, as Hegel argued, contradiction must be reconciled and accommodated on another dimension, and not allowed to clash in endless, 'gladiatorial' combat.

Indeed, Jim Lovelock and Andrew Watson's 'Daisyworld' is such a beautiful model exactly because it shows how the competitive struggle between daisies of different hues (or shades of grey) generates homeostasis and regulation. Far from contradicting Darwinian Theory, Lovelock's 'Gaia' derives from it, to show how 'Nature' is simultaneously competitive and communal: organisms need competitors, just as *yang* needs *yin*, in order to maintain equilibrium.

Attempts to show that 'man' is somehow outside natural law, that morality is free of natural or material constraints, are, as Goldsmith correctly notes, misdirected. But the corollary is not that there is no such thing as morality, nor that what goes for morality is somehow 'naturally' ordained. 'Mores' we should recall are 'customs' — culturally prescribed norms of living. Human beings' capacity for culturally derived behaviour *is* unique (at least in degree) and we must reject utterly 'vulgar materialistic' arguments, such as those of Marvin Harris, which conclude that "free will and moral choice have had virtually no significant effect upon the direction taken thus far by evolving systems of social life."

On the contrary, what we have to reconcile is that human behaviour is *both* culturally derived, and, to an extent, conscious and 'free' (and yes plastic) *and* naturally defined and circumscribed. As Marshall Sahlins puts it, "we must take as the distinctive quality of man not that he must live in a material world, circumstances he shares with all organisms, but that he does so according to a meaningful scheme of his own devising. In which capacity mankind is unique..." We must therefore take the decisive quality of culture to be that it gives each mode of life the properties that characterise it: "not that this culture must conform to material constraints but that it does so according to a definite symbolic scheme which is never the only one possible."

Mikhail Bakunin made the same point a hundred years earlier:

"What is authority?. Is it the inevitable powers of the natural laws which manifest themselves in the necessary concatenation and succession of phenomena in the physical and social worlds? Indeed against these laws revolt is not only forbidden — it is even impossible. We may misunderstand them or not know them at all, but we cannot disobey them; because they constitute the basis and fundamental conditions of our existence: they envelop us, penetrate us, regulate all our movements, thoughts and acts: even when we believe that we disobey them, we only show their omnipotence.

"Yes, we are absolutely the slaves of these laws. But in such slavery there is no humiliation, or, rather, it is not slavery at all. For slavery supposes an external master, a legislator outside of him whom he commands, while these laws are not outside of us: they are inherent in us; they constitute our whole being, physically, intellectually and morally: we live, we breath, we act, we think, we wish only through these laws. Without them we are nothing, *we are not.* Whence, then, could we desire the power and the wish to rebel against them?... The liberty of man consists solely in this: that he obeys natural laws because he has *himself* recognised them as such, and not because they have been externally imposed upon him by any extrinsic will whatever..."

A closer look at the vernacular cosmologies that Goldsmith (justly) espouses, shows how they are themselves attempts to reconcile the contradictions, 'absurdities' and 'contingency' of human existence; sick pills for Sartre's 'nausea'.

"Say what you like this Life's a Fiction and is made up of Contradiction." (William Blake).

Yours faithfully,
Marcus Colchester,
Cob Cottage,
Chadlington,
Oxfordshire,
England.

Edward Goldsmith Replies:

To say that a society is imbued with the biospheric ethic is to say that its behaviour is governed by the laws of the biosphere, and hence that the society is capable of acting as a differentiated part of the biosphere.

If, on the other hand, the society is imbued with the technospheric ethic then its behaviour is governed by the laws of the technosphere — basically those of modern economics. It is worth noting that although that behaviour which is currently leading to the destruction of the world of living things violates the laws of the biosphere, it violates none of the laws of modern economics. In fact, the corporations which are annihilating nature are doing so in strict accordance with the precepts of modern economics. For that reason, I think that my distinction is a valuable one. The two ethics are necessarily opposed to each other.

Jim Lovelock and Andrew Watson's Daisy World was designed to show how a cybernetic system need not be teleological, but it is a very simple and rudimentary cybernetic system. As I point out in my article 'Gaia and Evolution', (p.147, this issue) a very much more sophisticated mechanism is required to explain the evolutionary process, one which to me is inescapably teleological (although admittedly, Jim Lovelock would probably not accept this).

I must agree with you of course that competition is a fact of life, but this does not mean that it is the ordering principle in nature as is suggested by neo-Darwinists and sociobiologists. It is merely a regulatory mechanism.

I have never suggested that there is no such thing as morality, quite the reverse. Moral decisions may appear to be conscious and free, but I do not think they are.

It appears too that Bakunin felt the same way. The generalities of our worldview are necessarily non-plastic, otherwise our behaviour patterns could not display any continuity. Of course its particularities are plastic and it is of these that we are conscious, and it is when we take decisions based on these particularities that we are exercising our 'free will' — or rather the relatively 'free' particularities of our culturally controlled 'will'.

My article 'Gaia and Evolution', explains why I think that neo-Darwinism cannot conceivably be reconciled with the Gaia thesis.

Edward Goldsmith

Earth First?

Dear Sir,
Your issue on Deep Ecology (Vol. 18, Nos. 4/5) raises many points that will no doubt be discussed and analysed for some time. As one of the Earth First!-ers who contributed — in a minor way — to some past debates, I greatly enjoyed reading some other perspectives on our recent activities.

In his article 'Deep Ecology and Subjectivity', Grover Foley faults Deep Ecology

for not making an issue of the Bomb. An obvious reply is that an enormous number of people and organizations are already addressing this issue and I know of no Deep Ecologist that would quarrel with anything Foley might care to say about either the Bomb or its perpetrators. I am more inclined to wonder why Foley's question should not be turned around: why are so few nuclear activists concerned (or even aware) of the dangers from mass extinction, global warming and the general dismemberment of planetary ecosystems? The long term effects of the much feared nuclear winter are not much different from the consequences of environmental destruction. History will show that the preoccupation with nuclear war, however understandable, was a huge tactical mistake if our environment goes down the drain while all the progressives were staring at the Bomb.

In 'Eco-philosophy and Deep Ecology', Henryk Skolimowski feels we should adopt a variety of Teilhardian cosmology — pruned of its original racism — which he claims is validated by evolution. 'Man as consciousness of the universe' has been promoted by Teilhard, New Agers, Postmoderns and various Greens, and even some 'proto-Deep Ecologists', for example Robinson Jeffers, have toyed with the idea. I see two problems here. First, 'Man as consciousness of the universe' is suspiciously close to the old 'man as master of the universe'. In some postmodern mythologies we even read of 'man as co-creator of the universe'. If the hubris of established cosmologies is responsible for the evils of the present technocratic worldview, then many of the new postmodern cosmologies offer little improvement. Why bother about living ecologically if you are a 'co-creator of the universe'?

Another major problem with these cosmologies is their mis-reading of evolution. Is consciousness really the main goal of evolution? It might look that way if we confine our attention to our own particular lineage but if the claims of Skolimowski and others have any meaning, they must apply to evolution as a whole. The entomologist J. B. S. Haldane was once asked what his career studying insects had revealed to him about the nature of God. "An inordinate fondness for beetles", he replied. Indeed, one of every five living things is a beetle; by far the most evolutionary creativity has gone into this order of insects. With the recent rainforest canopy fogging experiments uncovering a huge and hitherto unknown insect fauna, the diversity of beetles may be vastly greater than even Haldane imagined. There is no evidence of a push toward consciousness among these beetles and their outburst of diversity is explained rather well by the classic Darwinian processes. As Stephen J. Gould has frequently reminded us, the proper paradigm of evolution is a bush, not a ladder. We are at the apex of our branch, *Deuteronoda suturalis* (Coleoptera, Chrysomelidae) is at the apex of its branch. If evolution really has an overall goal, an unbiased biocentric observer would have to conclude that that goal is the production of beetles to live in rainforest canopies.

Brian Tokar takes issue with Deep Ecology over the population question in 'Social Ecology, Deep Ecology, and the Future of Green Political Thought'. He discusses at length factors other than population which cause environmental degradation: overconsumption, growthmania, multinational corporations, economic inequities. So, who says otherwise? Certainly not anyone who writes for *Earth First!* Even a cursory look at the works of such "eco-rednecks" as Foreman, Abbey, Miss Ann Thropy and Tom Stoddard reveals that most of the time their rhetorical cannon are lined up on the same targets approved by Tokar, Bookchin and others in the 'Social' camp. *But*, they also keep reminding us that five billion and climbing is not a healthy situation, however progressive or postmodern society becomes.

Now, lets look at the other side of the issue. When cornered, social ecologists (here I use the term broadly to include such thinkers as Francis M. Lappé, Tokar, many Greens and ecofeminists, as well as Social Ecologists such as Murray Bookchin and his associates) usually admit that population growth will have to stop somewhere and excessive numbers of people do indeed undermine social progress. However, they repeatedly allow their positions to be represented as '[fill in approved social problem], not overpopulation causes world hunger'. Undoubtedly, redistribution of food surpluses, say, would give short term relief to billions, but additional billions would soon literally eat up all the gains. And, if coerciveness in population control is troubling, how do social ecologists propose to effect the massive redistributions of land, economic muscle and political power that are at the heart of their agenda? This, not what is written in *Earth First!*, is the 'simplistic' view of population.

Yours faithfully,
R. Wills Flowers,
Member, Florida Earth First!,
1208 Victory Garden Drive,
Tallahassee,
Florida,
USA.

The Benefits of Efficient Logging

Dear Sir,
It is annoying that, at a time when sustainable development is called for, one possible solution, that of plantation forestry, is so condemned by *The Ecologist*. What, after all, is more sound, from a 'green' philosophy, than forestry? Admittedly, there have been mistakes, but we have learnt from them and improved our methods as a result.

As has been said, there is a place for industrial plantations, and high quality land in areas with high densities of subsistence farmers may not be one of them, but it is not just the creation of plantations that can transfer pressure of use elsewhere. Other land use changes, such as the creation of a nature reserve, can do just the same. Careful land-use planning is essential before such changes are made. However, I do not think that the criticisms which have been made of tree planting in India can be fully justified. There does seem to be a conflict between using land for trees and for food crops. It must firstly be explained that most communal tree planting is voluntary, and on land too poor for agriculture. Where cultivated land has been used the decision has been made by the land owner — either individually or by a community. There seems to be something seriously wrong with a system where trees are more profitable than food, but where they are it is only natural that forestry is favoured.

As for the species used, eucalypts *do* have a role to play in many reafforestation plans. They are an ideal species for starting forestry projects off, as their rapid growth is psychologically encouraging, even though they may not provide all the needs of the rural poor. It takes time for skills in forest restoration and management to be developed, both in forest departments and in communities, but as skills develop other species can be used. Even where eucalypts are planted for industrial purposes the waste wood available for the poor is likely to be greater than that from a crop of many other species.

Indeed, criticism of plantations is often wide of the mark, for surely what is being criticized is the inequitable distribution of land resources and benefits from the planted trees, rather than the plantations themselves. Plantations, may not protect the soil, the fauna and flora, and the water resources as mature mixed forest might — they were never designed to. However, with good management they can do so adequately, on a sustainable basis, and infinitely better than the logged, or degraded sites that they often replace.

Much rubbish has been written about our environmental problems, often with little basis in fact. For example, a link between changes in rainfall patterns and deforestation has been searched for for well over a century, with little success. The major problem is not that climate *will* change, but that it might, and that we are playing a grand game of Russian roulette.

At present, logging is a wasteful practice, but to decrease its environmental impact it may be more appropriate to make it more efficient, rather than to try and stop it completely. Such a call must be compared to a call for cars to have catalytic converters, or for paper to be recycled. Additionally, a call to stop deforestation is similar to trying to ban the internal combustion engine, or the use of all forest products — possibly good for the environment, but practically impossible to achieve.

Yours faithfully,
J.H.R. Heuch,
Department of Forestry,
University of Aberdeen,
St Machar Drive,
Aberdeen,
Scotland.

Classified

DIARY DATES

THIRD ANNUAL GAIA CONFERENCE

To be held from 8th - 10th November 1989 at the Worthyvale Manor Conference Centre.

Title: Gaia and Symbiosis

Speakers include Professors James Lovelock, Lynn Margulis, Brian Goodwin, Peter Saunders, Ricardo Guerrero and others.

As numbers are limited, early booking is advised. Please write for details to:-

The Conference Organiser, Worthyvale Manor, Camelford, Cornwall PL32 9TT, or telephone 0840 212711.

THE INSTITUTION OF ENVIRONMENTAL SCIENCES has the following open meetings for environmental practitioners during 1989/90: Oct 3 1989—Environmental Impact Consequences of Renewable Energy Options. Nov 7 1989—Environmental Impact of 1992. Nov 28 1989—The Work of the Select Committee on Environment, what is it and what does it achieve? Jan 9 1990—Green Products. Feb 6 1990—How are the Environmental Policies of Political Parties Changing? March 6 1990—Common Ground between Environmental Scientists and Lawyers. May 9 1990—Water Quality: A View from outside the Industry. Venue: Commercial Gas Centre, 139 Tottenhall Road, London. Details from Roy Waller, 26 Salisbury Road, Carshalton, Surrey SM5 3HD, UK. (Tel. 01-647 5015).

Brazil Network (GB) announces the 4th National Conference AMAZONIA—Whose Environment? Whose Struggle? Carjas, Deforestation and Development. Held 30th September to 1st October 1989 in Sheffield. Details from Brazil Network, c/o SCAU, 73 West St., Sheffield, UK.

A SECOND INTERNATIONAL WATER TRIBUNAL (IWT II) will be held in Western Europe in September 1991. The Tribunal will last 5 days. The Tribunal will question the operations of international organisations causing problems in different parts of the world. Besides chemical pollution by industry and agriculture, charges will focus on six themes: quantitative water management (including dams), mining, oil spills, the consequences of the sea-water rise brought about by the greenhouse effect, domestic sewage and erosion. Cases will also consider the effect on oceans, coastal waters, wetlands, groundwater, rivers and water cycle. Cases will be selected so that all the continents are represented. Details from: International Water Tribunal, Damrak 83—I, 1012 LN Amsterdam, Netherlands (Tel. 31 20 240610).

ECOLOGY 89 CONGRESS to be held in Gothenburg, Sweden 28-31 August 1989. Title: From Problems to Strategies and Solutions. Details from Henrick von Arnold or Peter Torgilsson on 46-31 10 91 00.

PEOPLE, TREES AND WOODS, 19 to 21 September 1989 at Riccarton Campus, Heriot Watt University. Details from Hilary Talbot, CRRAG Secretary, School for Advanced Urban Studies, Rodney Lodge, Grange Road, Bristol BS8 4EA, UK. (Tel. 0272 741117).

THE GREEN ENERGY CONFERENCE. An International Symposium on energy and sustainable development held 14 to 17 September 1989 at the Botanical Garden, Montreal, Quebec, Canada. Further details from Energie et development viable, 445 rue St Francois Xavier, Suite 12, Montreal, Quebec, H2Y 2T1 Canada.

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MISCELLANEOUS

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PERSONS OF INDIAN DESCENT wishing to explore Indian approaches to Holism and Green Politics please contact Sandip on 01-737 1804 (evenings).

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23rd September 1989 10.00am-6.00pm

ARCHITECTURAL ASSOCIATION, BEDFORD SQUARE, LONDON, W1

For further details contact

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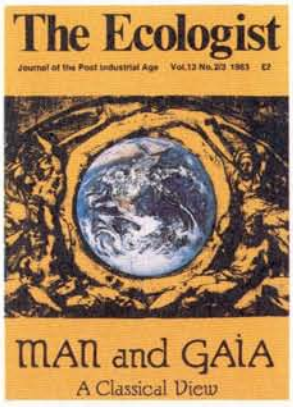

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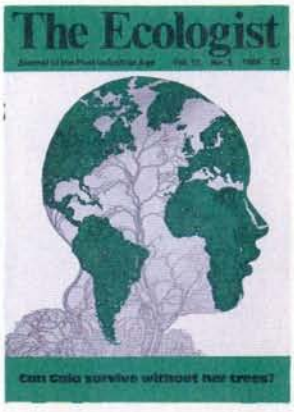

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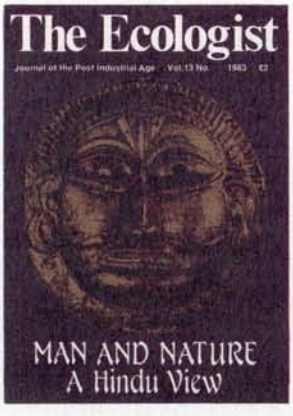

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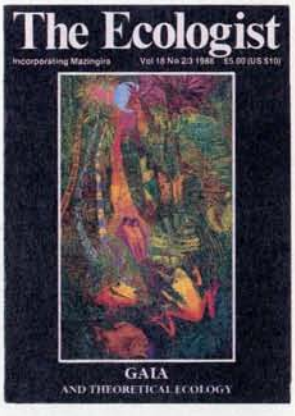

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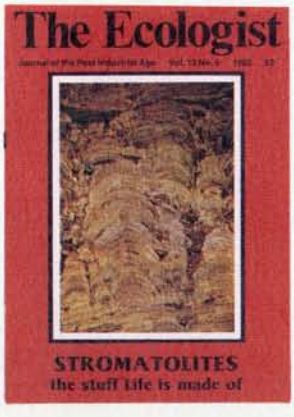

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