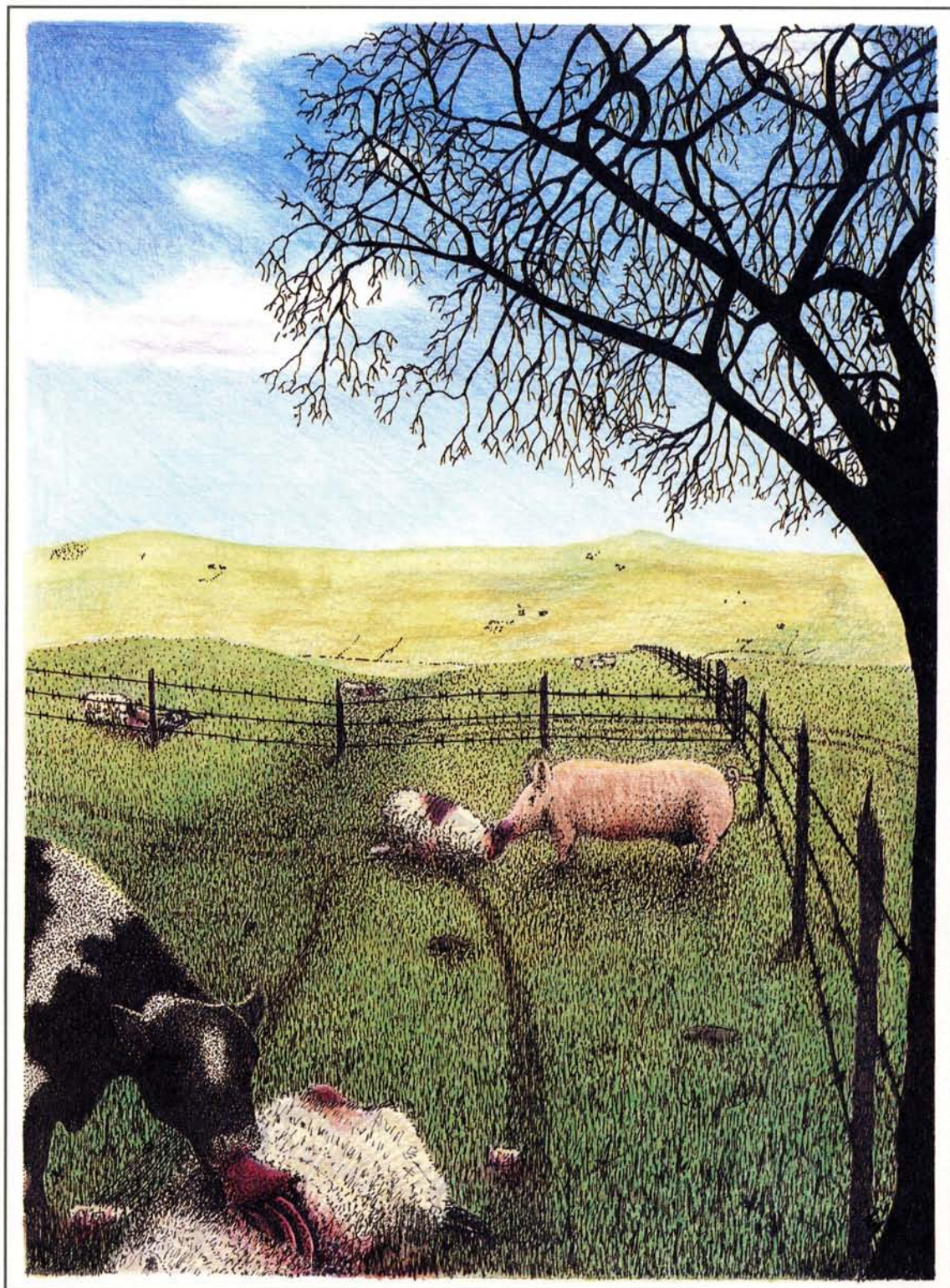


The Ecologist

Vol 21 No 3 May/June 1991

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- A Message for DuPont and ICI
 - The Folly of the Tehri Dam
 - Nuclear Power and CO₂
 - Climate and the Ozone Layer
 - Ecology Denies Neo-Darwinism
 - Logging in Cameroon
-



Cow Eats Sheep:
The Madness of BSE

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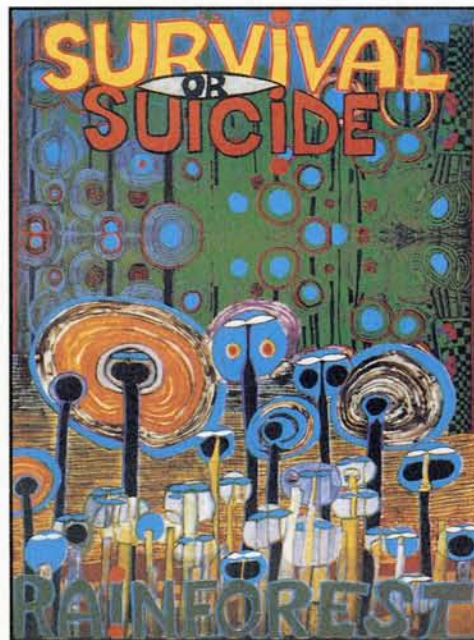
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Editors

EDWARD GOLDSMITH
NICHOLAS HILDYARD
PETER BUNYARD
PATRICK McCULLY

Associate Editors

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World Rainforest Movement
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RICHARD WILLSON
(England)

DONALD WORSTER
University of Kansas
(USA)

EDITORIAL OFFICE, CORNER HOUSE,
STATION ROAD, STURMINSTER
NEWTON, DORSET, DT10 1BB, UK.
TEL +44-258-73476
FAX +44-258-73748
E-MAIL GN:ECOLOGIST

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BSE, or "mad cow disease", is the disastrous consequence of the adoption of unsafe farming practices. Despite bland reassurances from the British government, the evidence suggests that there is a considerable risk to human health. Drastic measures may be required to eliminate the epidemic, including the slaughter of perhaps six million cattle.

Building a Disaster: The Monumental Folly of India's Tehri Dam 123

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If completed, the Tehri dam will be the largest in Asia. Its construction is going ahead in an earthquake-prone valley in the face of vociferous protests. It appears that only economic recession or a withdrawal by its Soviet backers can halt the dam.

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The threat of global warming is now being used as a justification for the expansion of the nuclear industry. However a major expansion of nuclear power would lead to huge increases in CO₂ emissions from the nuclear industry due to the need to mine and process progressively lower quality uranium ores.

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Concern over the depletion of the ozone layer has been concentrated on the biological effects of increases in ultraviolet light. However ozone losses in the stratosphere could also have far-reaching consequences for climate.

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Cover illustration by Brendan Farren.

The Ecologist is printed on recycled paper whitened with hydrogen peroxide.

A Message to the Executives and Shareholders of E.I. DuPont de Nemours and Co. and Imperial Chemical Industries, Ltd.

Over the next half century and beyond, the ozone depleting chemicals produced by DuPont and ICI will be responsible for death, disease and environmental damage on a massive scale. From their past record it appears unlikely that the executives of these companies are particularly concerned about this. However in the near future DuPont and ICI will be held to account, quite possibly legally, and certainly by the general public, for at least some of the damage they have done. When this happens, legal liabilities and consumer boycotts could force these billion dollar companies to the wall.

DuPont intend to continue producing CFCs for another nine years (when CFC production in the industrialized countries is to be phased out under the Montreal Protocol) and ICI for another six (in line with an EC agreement). Much worse, both companies intend to produce ozone depleting CFC substitutes for another half century. However if DuPont and ICI are to have a chance of saving themselves from public opprobrium and legal humiliation they must stop the production of ozone depleting substances immediately and do as much as possible to prevent the ozone depleting substances which are currently in use from being released to the atmosphere. Although it is already far too late to prevent widespread ecological damage, the chemical companies must take action now to limit the scale of the disaster they have caused.

These are not alarmist words. Data collected by NASA and released this April by the US Environment Protection Agency, show that over the last decade ozone has been destroyed at twice the rate previously thought, over a much wider area and for a longer period of time. Over North America, Europe and Northern Asia, the ozone layer has thinned by four to five per cent. At the latitude of Britain, winter ozone loss has reached eight per cent and now extends into early spring. Over the Southern Hemisphere, ozone losses averaged two per cent higher than in the north and the period of depletion lasted even longer. The EPA Administrator William Reilly, has described the figures as "stunning information". "It is unexpected, it is disturbing and it possesses implications we have not yet had time to explore." Not for the first time, the atmospheric scientists have had their worst-case scenarios exceeded.

Cancers, Cataracts and Climate

The EPA now expect 12 million more cases of skin cancer and 200,000 related deaths in the US alone in the next 50 years. Previously, 500,000 skin cancer cases and 9,300 fatalities were forecast. According to UN Environment Programme figures, a one per cent global reduction in the thickness of the ozone layer could lead to up to 150,000 extra cases of blindness due to cataracts caused by ultraviolet light. This depletion has already been exceeded. Increased exposure to ultraviolet light can also suppress the human immune system. UNEP considers that ozone depletion could therefore increase the incidence and severity of all those diseases which have a stage involving the skin. Examples include

measles, chicken pox, herpes, malaria, TB and fungal infections. The effectiveness of vaccination programmes could be seriously compromised; people immunized through UV-treated skin could even be rendered more — rather than less — susceptible to the targeted disease.

The head of the EPA's air pollution programmes, Eileen Claussen, has said that the effect of such a rapid ozone depletion on crops and ecosystems is "potentially terrifically damaging". Increased ultraviolet radiation reaching the earth will lead to eye diseases in animals, reduce the yields of many crops and alter the composition of natural ecosystems. The productivity of some types of plankton may be seriously diminished. There could also be reductions in the amounts of nitrogen taken up by soil microorganisms leading to a nitrogen deficiency for plant systems such as rice paddies. There is also the possibility of ozone depletion leading to substantial changes in the earth's climatic systems (see John Gribbin, *this issue*). CFCs, of course, also have a direct effect upon climate as they are powerful greenhouse gases.

Corporate Responsibility

DuPont and ICI are not the world's only producers of ozone depleting chemicals but they are very much the largest, and have a powerful influence on the policies of the other manufacturers and the users of their products. They therefore bear a heavy burden of responsibility. DuPont, the largest and oldest chemical corporation in the US, patented CFCs in the 1930s. It now satisfies 15-25 per cent of the global CFC market. It is also the biggest producer of the ozone destroying halons. In the mid-1980s its CFC sales were worth \$600 million — only two per cent of its total annual sales of \$30 billion. ICI sold around 40 per cent less CFCs than DuPont in 1989. ICI is estimated to be responsible for around half of global production of the ozone-destroying solvent, carbon tetrachloride.

These companies claim that not only are they aware of environmental concerns, but they are actually helping to solve them. ICI's advertising boasts its "World Solutions" to "World Problems". Politicians echo their claims. At a ceremony in February to open an ICI plant which produces one of the new CFC substitutes, Prime Minister John Major, declared that "industry and technology are finding a solution". Industry had the resources and know-how to solve environmental problems.

This may well be true for some environmental problems. But it would be extremely naive for shareholders to believe that DuPont and ICI are able to stop the depletion of ozone. Even if they had the will to do this they could not. There is no known way of removing CFCs from the atmosphere. It can take a decade for a CFC molecule to reach the stratosphere; it can take centuries for it to cease destroying ozone. Of the molecules of CFC-12 already in the atmosphere, almost 40 per cent will still be there in 2100 AD, and 15 per cent another century later. Even if all CFC production had stopped in 1990, stratospheric ozone depletion would increase until at least 2010; with a phase-out by the end of this century as

proposed under the Montreal Protocol, the maximum ozone depletion will not occur until around the year 2020.

Crippling Costs?

It can only be a matter of time before a victim of skin cancer or an eye cataract takes out litigation against the CFC producers for personal injury arising from ozone depletion. If a case were to succeed the costs to the companies would be crippling. In the US alone, injury claims could run into trillions of dollars. Similarly it could well be possible to take out a suit against the producers for injury to the environment. Damage to the environment caused by the Exxon Valdez oil spill, massive in its local impact but hardly significant when compared to the global depletion of the ozone layer, has resulted in the Exxon corporation being made to pay \$1.1 billion in fines and damages.

While the Valdez disaster was due to incompetence rather than design, the CFC producers have known for nearly 20 years of the possible effects of their products. In fact both DuPont and ICI carried out research into less ozone damaging alternatives to CFCs during the 1970s, but dropped this work in 1980 or 1981. According to the Washington-based Environmental Policy Institute, "the suspension of research on alternatives by the corporations was probably more closely related to the arrival of the Reagan-Bush Administration [which was expected to be anti-regulation] than to the state of scientific or regulatory concern in 1980 . . . It was not until late 1986 that DuPont resumed serious work on alternative chemicals, more than a year after the Antarctic ozone hole was determined to be a serious and new phenomenon." Six years of research into less or non-ozone destroying CFC substitutes was thus lost — years during which global production of the two most damaging CFCs increased from 737 to 825 million kilograms.

In their defence, the chemical companies could point out that the growing rate of skin cancers among fair-skinned populations is largely due to the growing desire of these people to expose their sensitive skin to the sun. Future increases in cancers and cataracts could thus be avoided if people stopped sunbathing and put on sunglasses and hats. But the companies have always known that fair-skinned people like suntans. It should not be left to anyone who wants to spend some time in the sun to change their habits to accommodate the irresponsibility of DuPont or ICI.

More importantly, the majority of the world's population have no choice but to work outdoors. Although most of these people are dark-skinned and are thus unlikely to develop skin cancers, they are very much more vulnerable than people in the North to cataract-induced blindnesses due to their lack of access to surgical facilities. Furthermore, plankton fry, cattle and corn plants will not be able to protect themselves with shades and sombreros.

Fighting Against Regulation

The chemical industry may claim that responsibility for the effects of ozone depleting chemicals lies with the regulators rather than with the producers. However it is largely the corporations themselves which have decided the restrictions on their products. Since the link between CFCs and ozone was first postulated in the mid-1970s, the chemical industry has fought hard against any measures to regulate CFC production. When US environmentalists were lobbying for a ban on CFCs in aerosols, DuPont ran full-page newspaper advertisements arguing the need for more research. A 1975 advertisement in the *New York Times* claimed that if "reputable evidence" showed that CFCs depleted ozone "(DuPont) are prepared to stop production of the offending compounds."

A particularly cynical move by the chemical industry was the

reclassification in the late 1980s of the "partially halogenated" or "soft" CFCs. These were renamed "HCFCs", thus evading tighter restrictions under the Montreal Protocol and the negative consumer image of the name "CFC". HCFC-22 is now increasingly used as a substitute for CFC-12 and currently contributes three per cent of the ozone-destroying chlorine in the atmosphere. The marketing literature for DuPont's "DYMEL" brand of aerosol propellants, one of which is HCFC (or CFC) -22, claims that:

"Not regulated by federal laws restricting the use of CFCs in aerosols, DuPont's family of DYMEL propellants opens rich new opportunities for aerosol packagers. Environmentally safe and low in toxicity, DYMEL propellants can generate consumer preference and product marketability."

Alternatives to CFCs

An adjudicator in any legal action against a CFC producer would probably weigh up the costs and benefits of CFC use. The horrific environmental costs have been described above. That there have been considerable benefits, notably in medical uses and refrigeration, is indisputable. That there were and are no alternatives to the use of CFCs is a fallacy. What is more, the vast bulk of CFC usage has been in products which could in no way be described as having improved the human condition.

CFCs were banned from most aerosol uses in the US in 1978 and soon after in Canada and Sweden. Yet the use of CFCs in aerosols elsewhere in the world continues to this day. Up to 1989, half of the CFCs consumed in Britain were put into spray cans. Had the rest of the world implemented an aerosol ban in 1978, cumulative worldwide CFC emissions would have been halved. Many of the other products and processes which use CFCs, such as foam packaging and dry cleaning, could also have easily been phased out with no loss to humanity or the environment. Mixtures of soap and water and other harmless chemicals can replace the use of CFCs and other ozone depleting substances as cleaning solvents. Halons can easily be replaced by carbon dioxide in most of the fire fighting equipment in which they are used.

It is in the refrigeration sector where the debate over CFC substitution is most fierce. DuPont and ICI and the industry lobby which they help fund, the ironically named "Alliance for a Responsible Chlorofluorocarbon Policy", claim that there is no suitable replacement to CFCs except for the new chemicals which they are developing, the "hydrochlorofluorocarbons" (HCFCs) and "hydrofluorocarbons" (HFCs). Although much less damaging than the worst CFCs, HCFCs are both ozone depleters and greenhouse gases; HFCs contain no chlorine and thus do not destroy ozone but are greenhouse gases. The Montreal Protocol currently allows for HCFC production to continue until 2040, largely because of vigorous lobbying from the industry. It imposes no restrictions on HFCs.

However the main barrier to the uptake of non-halocarbon coolants is not technical; it is the vested interests of industry. ICI, for example, while investing over £100 million in plants to produce HFC 134a, has done no research into non-halocarbon refrigerants such as propane or ammonia. The latter gases, unlike the new CFC substitutes, are cheap and cannot be patented. Were they to be widely adopted, ICI and DuPont would lose the huge profits they hope to make worldwide from patents and licensing fees on HFCs and HCFCs and their production processes. The refrigeration industry, meanwhile, is waiting for its present CFC suppliers to provide it with "drop-in" replacements for CFCs so that it will not have to change substantially its production methods.

Given what is now known about the state of the ozone layer and the threat from global warming, as well as the numerous alternatives to halocarbon compounds, the long term production of these substitutes for the sake of a few hundred million dollars in profits can only constitute a crime against humanity and the environment.

Public Image

Even if DuPont and ICI do manage to survive any legal actions taken against them they will still face huge problems. Already in the US a consumer boycott against DuPont is starting to gain momentum. It can only be a matter of time before a similar campaign is started against ICI. Friends of the Earth US are currently supporting a DuPont shareholder who has gone to court to force DuPont to debate a resolution at its next annual meeting calling for a CFC phase out by 1995.

As ozone depletion accelerates and cancer rates soar, citizens' actions against DuPont and ICI will intensify. Despite the huge sums of money at the disposal of their PR departments, the public image of ICI and DuPont worldwide will sink lower than that of Exxon in Valdez or Union Carbide in Bhopal. The farmer gazing at his stunted crops, the hotel owner looking at the empty beach, the holidaymaker who remembers the days when the sun gave pleasure not cancer and blindness, will know who is responsible.

DuPont and ICI are responsible for a massive change in the chemical composition of the atmosphere, with disastrous consequences for human health and natural ecosystems. They should, and very probably will, be held to account for this unprecedented and intolerable act of ecological vandalism. When this happens the value of the companies' shares will tumble. By failing to halt the

production of ozone depleting substances now, the executives of these companies are therefore acting against the interests of their shareholders. The shareholders should thus put pressure on the boards of ICI and DuPont to take action. Both in the interests of the environment and humanity, and in the interests of the companies themselves.

Patrick McCully

Readers who wish to protest about the continued production of CFCs and the adoption of unacceptable substitutes can write to:

Edgar S. Wooland Jr., Chairman and Chief Executive Officer, E.I. DuPont de Nemours and Co., 1007 Market Street, Wilmington, DE 19898, USA.

Tel. +1 302 774 1000 Fax. +1 302 773 3857.

Sir Denys Henderson, Chairman, ICI Ltd., 9 Millbank, London SW1P 3JF.

Tel. +44-(0)71 834 4444 Fax +44-(0)71 834 2042.

A 23-page briefing document on ozone depleting substances and the ozone layer prepared by Patrick McCully in October 1990 is available from *The Ecologist's* editorial office. Price £4.50 (plus £0.50 for overseas postage).

FAO Replies to *The Ecologist*

Dear Sir,

Private journals like *The Ecologist* can play a useful role in criticizing the work of publicly funded bodies such as FAO. It is even acceptable to criticize — under the name of FAO — the general international consensus on how agricultural development should be tackled. However, your special issue of March/April entirely devoted to an attack on FAO goes in two respects beyond the limits of responsible journalism.

First and more important, it propagates through pseudo-scientific analysis the myth that traditional production systems can meet the needs of populations rising at rates of between two and three per cent annually. By rejecting the adoption of modern technology it would condemn the developing nations to a state of permanent bondage, obliged to import ever rising quantities of basic foodstuffs and other products (including paper) from the industrialized countries. It may be significant that the only government in recent times which has totally abolished the use of modern technology was the Pol Pot regime in Kampuchea.

Second, it personalizes its attack on Edouard Saouma as Director-General, distorting his views, and holding him responsible for policies and programmes that are set by the member nations themselves through an elaborate process of technical consultation and political approval. In asking governments to withhold payments to FAO, it is calling on member nations to punish themselves for not agreeing with *The Ecologist*.

FAO is ready to discuss serious issues in a serious manner with serious organizations and people. Unfortunately, you do not seem to wish your review to come into this category.

Yours sincerely,

Richard Lydike

Director of Information

FAO

Via della di Caracalla

00100 Rome

Dear Mr Lydike,

As a general comment, we are sure that both our readers and the more than 60 groups which are now participating in our campaign

will be as disappointed as ourselves that FAO has signally failed to address the substantive issues we raised.

More specifically, we would make the following points in response to your letter:

1. Nowhere in the entire issue of *The Ecologist* did we say that we are opposed to modern technology or to technological change. On the contrary, throughout the issue, we stressed the innovativeness of farmers and their receptiveness to new techniques. What we did say — and we hold by this — is that we are opposed to the imposition of inappropriate technologies, modern or otherwise. We are surprised that FAO does not share this view.

2. Whilst we fully acknowledge the issues raised by population growth, we do not accept that traditional or other low-input farming systems are unable to meet the needs of growing human numbers. On the contrary, in an era of high population growth, the primary goal of agricultural policy should surely be to maximize food security and, in our view, this is best achieved through low input systems allied to a "food first" policy in which the satisfaction of local needs is primary and in which local self-reliance is encouraged through the strengthening of local markets. You do not address this key plank of our argument.

We would add that, in our view, it is not population growth that is undermining the viability of traditional/low-input farming systems but rather the intensive, export-oriented agricultural development policies that FAO so actively encourages. This point is well-documented within the *Ecologist* issue.

For our part, we extend an open invitation to an FAO delegation to meet with us to discuss our differences and we reiterate our previous requests to FAO to co-operate in arranging such a meeting.

The Editors

STOP PRESS: *The Ecologist* has just received a 32-page document from FAO entitled 'The Disinformation Campaign of *The Ecologist*'. We will reply to this in detail in a future issue. Readers who wish to receive the document should write to Mr Lydike at FAO.



PA/Jim James

British Minister for Agriculture John Selwyn Gummer and his four-year-old daughter Cordelia eat beef-burgers in an attempt to persuade the public that BSE does not pose a threat to human health. The Government has repeatedly claimed that "British beef is safe", despite the lack of evidence to support such an unequivocal assertion.

The BSE Time-Bomb?

The Causes, the Risks and the Solutions to the BSE Epidemic

by

Richard W. Lacey and Stephen F. Dealler

Bovine Spongiform Encephalopathy, popularly referred to as "mad cow disease", is a disastrous result — certainly for cattle, and possibly also for humans — of the failure to deploy safe farming practices. The measures required to eliminate BSE altogether may need to be draconian. This is particularly deplorable, as the disease has in effect been self-inflicted by unsafe farming methods. The British government's response to the BSE epidemic has been characterized by political expediency and unwarranted platitudes, rather than concern for public health.

Until the furore over salmonella in eggs in late 1988, most members of the British public were unaware that the remains of food animals were returned to the same species in their feed.¹ Up to this time, it appears that even many farmers did not realize the

nature of the source of their feedstuffs. Labelling legislation required only details of gross nutrients and additives to be given.

However, officials at the Ministry of Agriculture, Fisheries and Food (MAFF), their agricultural and veterinary advisers, and the feed industry must have been aware of the practice of adding animal remains to feedstuffs. Moreover, the international veterinary community must also have known as scientific papers were appearing in the 1980s that mentioned the effect of "concentrates"

Richard W. Lacey is Professor of Clinical Microbiology, Department of Microbiology, University of Leeds, Leeds LS2 9JT, UK. Stephen F. Dealler is Senior Registrar in Microbiology at the University of Leeds.

or "protein supplements" on the animal under test. Such feed components are derived from rendering plants which process the offal and bones from farm animals.

The Rendering Industry and the Supermarket Culture

Up to the end of the 1980s, the rendering industry was highly successful — in financial terms — and provided the only simple and cheap means of disposal of unwanted components of food animals and poultry. Consider a major broiler unit comprising 10 huts each harbouring 40,000 chickens with eight "crops" per year. It is likely to be sited where there is no local capacity for disposal of the unwanted and inedible products. So after mechanical slaughter and preparation, the feathers, intestines, heads and feet of the three million broiler chickens each year are processed in the rendering plants to create two useable products: fat or tallow used in soaps and cosmetics, and a protein rich food, made into a powder after grinding with bones and products from other sources. In the 1950s and 1960s, some of this powder — described as bone meal — was used as an agricultural and horticultural fertilizer.

But as the scale of intensive farming increased, its two associated problems also increased; the provision of the feed and the disposal of the unwanted remains. The recycling of the rendered offal to incorporate into feed seemed to provide a cheap solution to both these problems. Thus, during the 1970s, the extension of

intensive farming to ducks, some cattle, turkeys, to greater numbers of pigs and even to fish farming, was dependent on the activities of the rendering plants. This practice does of course occur in other countries, although the scale seems to be greatest in the UK.

The resultant food, whilst providing some concerns over microbial safety and nutrition, has become cheap. Indeed, the success of the "supermarket culture" depends on the availability of the cheap products. Furthermore farmers have been, and still are being encouraged by MAFF — on the grounds of "efficiency" — to produce such food.

So, by 1987 and 1988, much of the UK's requirements for meat and poultry were being fulfilled by a system that was potentially dangerous. Intensive farming, the animal feed industry, the rendering plants and the supermarkets were all participating in a carefully balanced system to provide the consumer with cheap food. It is against this background that the reaction of the British government, and MAFF in particular, to the "mad cow disease" epidemic must be assessed. The only other important point is that by the late 1980s many scientists were increasingly insecure — from threats of closure of specialized units, from cuts in university and research council funding, threatened closures of hospitals and veterinary schools and the existence of a political dogma that required their greater "accountability".

Warning Signals

The first cases of Bovine Spongiform Encephalopathy probably occurred in late 1985, and by the end of the following year the disease was being reported from many parts of the UK.² By 1987, the scale of the epidemic was confirmed.³ However in the light of farming practices begun during the 1960s, the disease should have been anticipated. The following should have sounded warning signals to MAFF many years ago that feeding animals with their own remains or those from similar species is particularly dangerous.

- The human degenerative brain disease Kuru was established by the 1950s as being due to an infectious agent acquired by cannibalism in the Fore tribe, New Guinea.⁴
- The agent causing scrapie in sheep was known to be similar to that which caused Kuru. When it passed from one species to another its properties changed, including its subsequent host range.⁵
- The human infection Creutzfeldt-Jakob disease was due to a similar agent capable of transfer to many mammals under laboratory conditions.⁶
- This group of infectious agents, first known as slow viruses, now referred to as virinos or prions, has been known to be exceptionally resistant to physical agents for many years.^{7,8} In particular its resistance to heat was published in 1978.⁹

It was also known by the 1970s that the diseases resulting from these infective agents (Transmissible Spongiform Encephalopathies or TSEs) took some years to develop, so they are diseases largely of old age in the mammal concerned. It is therefore not surprising that the milk cow, living typically 8-10 years would be the most likely to manifest this infection.¹⁰ Beef cattle are typically slaughtered at 2-3 years, pigs at 5-6 months and sheep at less than 2 years.

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PERMACULTURE

Contaminated Animal Feed

The fact that agriculture has been buffeted by a series of food problems in recent years, BSE in cows, salmonella in poultry, the contamination of cattle feedstuffs with lead, is not an unfortunate coincidence. It is the inevitable result of changes in the way we raise our livestock.

Animal feeds were once fairly simple blends of cereals and other basic products, usually home-grown and mixed on the farm. Now, a massive agricultural feed industry produces complex mixes of often a dozen or more ingredients, blended to specified nutritional standards for each kind of livestock. As well as primary products such as wheat and soya bean meal, a wide range of by-products such as maize gluten, distillers' waste, cotton seed cake, citrus pulp and milling offals are brought from all over the world. The UK is the largest importer of animal feedstuffs in the world: in 1987 alone it imported feed components worth nearly 700 million dollars.

Contamination of the Food Chain

The problem with such a massive and complex system is that it is open to many risks from contamination which can be notoriously difficult to detect and control. In one infamous incident in 1973, thousands of livestock in the US state of Maine were killed when the highly toxic poly-brominated biphenyl (PBB), was added to cattle feed in mistake for magnesium oxide. By the time the public realised the significance of the disaster, due largely to the persistence of one determined farmer, PBB contamination had moved down through the food chain.

Various other similar incidents have been recorded, though perhaps on a smaller scale, and doubtless many other cases have gone unnoticed. The ones known to me from my own experience inside the industry include a boatload of starch which had failed to find its market as a wallpaper paste and was sold as an animal feed ingredient

instead. At that time, wallpaper starch contained a fungicide based on mercury. In the 1980s, an undiscovered toxin in a load of cassava killed all livestock it was fed to.

In 1960, over 100,000 young turkeys died from eating groundnuts contaminated with aflatoxins, toxins which are produced by moulds and are some of the most potent carcinogens ever discovered. Strict control is now kept over aflatoxin levels in foods and animal feedstuffs, but the real lesson was never learned. There are upwards of 800 similar toxins produced by moulds yet no effective control over the sale, import or use of mouldy feedstuffs has ever been introduced, and mouldy feeds are still a major potential source of toxins that might enter the foodchain.

Agroecosystems and Agribusiness

A basic cause of the problem lies in the way in which agriculturalists and those associated with the industry are trained to understand and manage it. Agriculture is viewed simply as "agribusiness", a series of cash flows, profit margins, inputs and outputs and technical manipulation of animals, soils and plants. However, agriculture remains the management of a series of ecosystems and can only basically be understood and managed as a system of cycles of minerals and water, food webs and energy flows. This agroecosystem approach to agriculture has been almost totally neglected. From fertilizer policies that pollute waterways and water supplies, to the misuse of pesticides, the industry is littered with the results of blunders which result from the failure to manage agricultural ecosystems. The present problems with animal feedstuffs are only the most recent examples.

Drennan Watson

Drennan Watson is a consultant in land use, environment and rural extension based in Aberdeenshire, Scotland.

Government Action

In April 1988, Sir Richard Southwood was asked by MAFF to set up a working party to advise on BSE.¹¹ Southwood was Professor of Zoology at Oxford and had previously given advice to the Government on a number of issues, including the organization of biology in universities. The other three members were retired eminent scientists, although none had any notable experience with TSEs. In June 1988, Southwood recommended that the carcasses of affected animals should be destroyed. This was never implemented adequately as most carcasses, instead of being incinerated, were dumped in landfill sites — a most unsatisfactory procedure because of the extreme hardiness of the infective agent.¹²

In November 1988, Southwood recommended that the ban on the use of ruminant-based protein for ruminants should continue indefinitely. This was an extraordinarily narrow recommendation, as it permitted the continued feeding of the remains of rendered pigs and poultry to the same species. What is more, Southwood maintained that they "could not be wholly sure that rendering as currently practised would eliminate the agents caus-

ing BSE". The extreme toughness of these agents is of course responsible for these doubts. Surely the logical approach would have been to curtail the whole unsafe system of feeding animals with pooled rendered protein? This was the first of many examples where the problems associated with BSE were recognized but the action taken was incomplete, inadequate or unenforceable.

The full text of the Southwood report was published in February 1989. Its key conclusion was that:

"From present evidence, it is likely that cattle will prove to be a 'dead-end host' for the disease agent and most unlikely that BSE will have any implications for human health. Nevertheless, if our assessments of these likelihoods are incorrect, the implications would be extremely serious".¹³

However by February 1989, insufficient time had elapsed to know whether BSE might spread spontaneously or experimentally to other mammals. There was not any evidence as to whether cattle would prove a dead-end host. Since then, BSE has been successfully transmitted to mice and a pig by experiment, and has probably infected cats and zoo animals such as oryx and antelopes and their offspring.¹⁴⁻¹⁸ So, we now know that cattle are not a "dead-end" host, and we agree fully with Southwood's condi-



A dead cow being taken for incineration. The recommendation in Sir Richard Southwood's report that BSE-infected carcasses should be incinerated was never adequately implemented due to a shortage of incineration facilities. A comprehensive programme against the BSE epidemic would require the disposal of millions of cattle carcasses. The burying of infected carcasses is unsatisfactory as the BSE agent can survive for several years in the soil.

tional comment that "the implications would be extremely serious".

This has largely been ignored by much of MAFF and certain sectors of the media. In particular, ministers have continued to quote Southwood's assertion that it is "most unlikely that BSE will have any implications for human health", out of context, both literally and temporarily.

The final and most decisive recommendation of Southwood was "that this [the rendering plant] method of disposing animal waste should be changed so as to eliminate these novel pathways for pathogens". This is in effect saying that modern farming methods are unacceptable, and perhaps it is not surprising that only phrases or sections of this and other reports have been used for specific purposes. When an advisory committee such as that set up by Southwood meets, a number of civil servants will contribute to the debate and the membership of the committee will have been vetted. The Government can therefore anticipate that at least certain sections of the resulting report will be favourable to their policies. If the worst had come to the worst in this case and the Southwood report had been unambiguously hostile to MAFF, its publication could have been delayed or suppressed.

The Tyrrell Report

Southwood recommended the establishment of a second committee to look at certain aspects of BSE. The chairman was Dr David Tyrrell, a retired virologist, and members did include those with particular expertise in TSEs. Their report was presented for publication in June 1989, but for some inexplicable reason it was not published until January 1990. This caused a substantial delay in the prohibition of certain infected tissues entering the food

chain. Moreover, these tissues were never removed from items already available at retail outlets — and presumably some dried, canned and frozen foods that contain substantial amounts of beef offal are still being purchased and consumed.

The most disturbing paragraph in the Tyrrell Report is as follows:

"Many extensive epidemiological studies around the world have contributed to the current consensus view that scrapie is not causally linked with Creutzfeldt-Jakob Disease (CJD). It is urgent that the same reassurance can be given about the lack of effect of BSE on human health. The best way of doing this is to monitor all UK cases of CJD over the next two decades".¹⁹

It is true that there is no evidence linking sheep scrapie with CJD (there is also no evidence linking BSE with scrapie). It is also true that it would be desirable for reassurance to be given that BSE will not infect humans. But surely this should only be considered after the reas-

suring evidence has been obtained. This illustrates much of the Government's attitude to food safety: the prime intent is to reassure the public; that is to maintain the commercial *status quo*. The taking of any curative action is very much a secondary consideration, particularly if it is costly.

The last sentence of this paragraph of the Tyrrell report, quite amazingly states that such reassurance is to be achieved by seeing how many more people die of CJD in the next 20 years. Already CJD accounts for about one per cent of deaths and was probably acquired from eating beef many years ago, before the BSE epidemic.^{20,21} So the experiment to see what happens has started.

The reason we believe that Creutzfeldt-Jakob Disease was acquired from eating beef is that TSEs are mainly acquired through the oral route and the only natural hosts for them are mammals. It follows from this that we have to scrutinize meat products very carefully. There is a consensus that sheep products are not the cause of CJD.²² Pig products are consumed when the animal is typically five months old and would be most unlikely to contain the infective agent. Moreover CJD is most common in the Middle Eastern Jewish population which would presumably not consume pig products.²³ Cattle products are therefore the most likely source on account of the relative old age of the animal at slaughter.

The Nature of the Infectious Agent

The realization that BSE may well not be caused by the scrapie agent from sheep has added urgency to the need for further knowledge about these agents in general.²⁴ Previously, this alarm had been counterbalanced by their seemingly low degree of infectivity to mammals. But it is now thought that BSE has

resulted from the amplification of this type of agent many thousandfold, so that *between one and five per cent of cows and cattle in the UK may be infected*.²⁵ The elimination of these infective agents presents a truly daunting task.

Much of the work on these agents has been performed on sheep scrapie and Creutzfeldt-Jakob in humans, but it is reasonable to assume that the properties of the group as a whole are similar. The first feature of note is their size, being smaller than all characterized viruses. Under experimental conditions, mice can be infected with a high inoculum and develop the disease over months; more generally the incubation period varies from a year or so in rodents, two to four years in sheep, four or more years in cows, and upwards of 20 years in humans.²⁶ There is good evidence from mice that low inocula cause longer incubation periods than do higher doses.²⁷ The agent does not appear to provoke an immune response.²⁸ This gives rise to the serious concern that low initial exposure to the BSE agent in beef products will not be expected to stimulate immunity in man. *Rather, the risk will be expected to correlate directly with the amount of the infective agent consumed over the years.*

Once one of these infectious agents has passed from one host to another, it may alter in properties, including its subsequent host-range specificity.²⁹ Whilst there is agreement that all these infective particles are small, there is no consensus as to their composition. Indeed no such agent has been physically isolated with confidence. It is likely that detailed characterization of these substances will be associated with major new discoveries of cellular biochemistry; this represents a pressing research challenge. Whatever these particles do contain, they must have the capacity to replicate and persist in the mammal for many years.

The heat resistance of these agents is prodigious. Cooking — even canning — will not eliminate them. Recently, Gajdusek and colleagues in the USA have shown that a small amount of infectivity can survive after exposure to 360°C for one hour.³⁰ Similarly, autoclaving (heating substances under high pressures) under conditions that kill all other infective agents is not effective;

The uncertain nature of these infectious agents will continue to pose a major hurdle in the analysis of these infections, particularly as regards the possibility of BSE infecting humans.

neither is formaldehyde.³¹ Concentrated bleach (generating at least two per cent available chlorine), does have some effect, but only very strong acids and alkalis are likely to be certain in their destruction.³² The infective agents seem also to be resistant to any dose of irradiation that is usable in practice.³³

Virus or Prion?

There are two discrepant views on the chemical nature of the infective agent. One is that the agent is a type of virus, containing a small core of RNA or DNA within a tightly packed protein coat.³⁴ This would explain its resistance to proteolytic enzymes, including trypsin and its ability to replicate and survive. However, the presence of any nucleic acid, normally destroyed by irradiation,

is seemingly difficult to reconcile with its extreme physical toughness. The alternative view is that it is a prion, a proteinaceous substance that is somehow able to induce the production of large amounts of itself, and contains no nucleic acid.³⁵ Indeed two different types of protein — PrP protein and scrapie associated fibrils — have been found in tissues to be associated with infection. It is possible that both are produced by the host as a result of infection, or it is just possible that one or both are the actual infections. It is difficult to see how a particle containing no nucleic acid could be

The available evidence suggests that there has been a carefully orchestrated manipulation of public opinion by the Government in order to avoid taking action.

so successful in spreading and persisting in tissues. However new biochemical theories abound to explain this.

Thus, the uncertain nature of these infectious agents will continue to pose a major hurdle in the analysis of these infections, particularly as regards the possibility of BSE infecting humans. *It would seem perilous for any claims to be made that beef products are generally safe in the absence of this knowledge.* Beef could be contaminated by the infective agent in three ways: the inevitable presence of nerves in muscle, the presence of lymphatics, and possible contamination by central nervous system material following removal of the brain and spinal cord by saws in the abattoir.³⁶

Recommendations for the Elimination of BSE and Related Organisms

The available evidence suggests that there has been a carefully orchestrated manipulation of public opinion by the Government in order to avoid taking action. The main reason for this is the sheer scale of the action that would be needed. The cost of compensation for replacing say six million infected cattle could run into billions of pounds. Moreover, the adverse international publicity this would generate might effectively put the UK into quarantine with loss of food exports, tourism and even a substantial part of our industrial base. In addition, establishing new BSE free herds on new grassland would be almost impossible without taking into public ownership much of our farmland. The fact that the Government has failed to even contemplate these requirements attests to the massive scale of the problem, and any repetition in the future must be prevented by taking action now.

1. Rendering Plants

There is a clear case for the total prohibition of the use of the bone meal fraction from rendered animal and poultry remains in animal feed. Rather, this product should be used as a fertilizer for cereal crops. Protein supplements for animal and poultry feeds should be obtained from fish or vegetable sources. It may be difficult to ensure that such a recommendation be enforced. One way might be to put all the rendering plants under direct government control. There will also need to be legislation and surveillance procedures that ensure imported products comply with these stipulations.

2. Replacement of BSE-infected herds with BSE-free stock

Since there is no way of identifying symptomless but infected animals, there is pressure to develop BSE-free herds now. These herds would presumably have to be kept in new pastures and thoroughly cleaned buildings. These detailed proposals should eliminate BSE, but will be extremely costly to implement.

(a) There should be an intent to rear no further calves from infected herds as vertical transmission of the disease from cow to calf is now presumed to take place.

(b) Any calf born in the near future from a cow belonging to an infected herd should be destroyed.

(c) Milk-producing cows at the end of their useful lactation should be slaughtered and incinerated. The carcass should not enter any part of the food chain.

(d) Beef cattle should be slaughtered as young as possible — preferably under 18 months of age. Careful removal of meat from the carcass might produce some relatively safe product say for people over 50. The brain, spinal cord and body cavities containing "high risk" material should not be manipulated. After removal of meat, the remainder of the carcass should be incinerated.

(e) A system of introduction and documentation of BSE-free stock will be required. Every BSE-free animal should be required to be identified according to a pedigree indicating its source and subsequent movements.

(f) Urgent research must be done to quantify the extent that herds are infected, but not showing signs of disease. Subsequently, any infected herds should be managed by procedures as outlined above.

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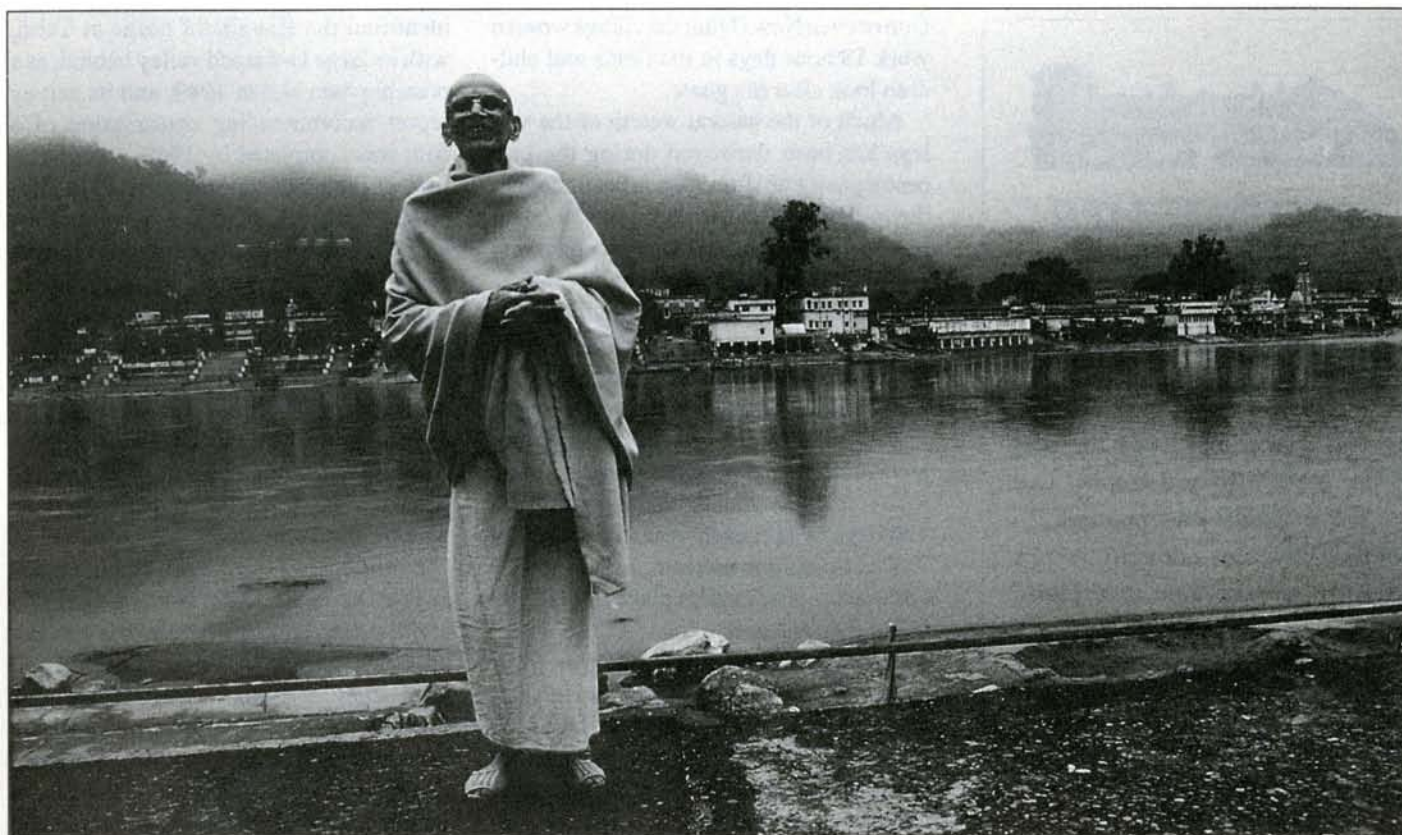


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Raghu Rai/Magnum

Chipko activist Sunderlal Bahuguna addresses opponents of the Tehri dam during a protest fast. Fierce opposition to the massive dam has not yet managed to halt the project. The construction of the main dam is set to commence later this year.

Building a Disaster: The Monumental Folly of India's Tehri Dam

by
Fred Pearce

One of the most controversial dams in the world is currently under construction in an earthquake-prone valley in the western Himalayas. Vocal protests against the project have gone unheeded against a backdrop of geopolitics, corruption and vested interests. It appears that only economic recession or a possible last minute withdrawal by its Soviet backers can halt the Tehri dam.

There are new occupants in the old palace high above the town of Tehri in the western Himalayas. Until 1949, it was the home of the kings of Tehri-Garwhal. Now it is in the hands of the Tehri Hydro Development Corporation and its Soviet technical advisers, who want to drown the valley below with the largest dam in Asia.

The yellow palace is perched on a V-shaped hill overlooking the confluence of the rivers Bhagirathi and Bhilunguna,

tributaries of the sacred River Ganga. The building looks across the steep-sided Bhagirathi gorge to the facing hilltop, on which sit a series of concrete barracks. This is the first phase of Tehri new town. The buildings are earmarked by the authorities as the homes for more than 20,000 people who will be moved from the old town of Tehri in the valley below when it is flooded by a 244 metre-high dam less than a kilometre downstream of the town.

Few politicians have visited Tehri to see what their decisions are inflicting on the lives and the landscape of this Himalayan valley. The nearest airport and rail-

way stations are in the lowland towns of Dehra Dun and Rishikesh, four hours away by bus. The bus ride itself is instructive. Everywhere, the valleys are starved of the investment they need, and despoiled by investment that they do not. Agriculture in most villages is on the wane. Only a few communities along the valleys that funnel into Tehri have been helped with the simple technology that could lift water from their rivers to irrigate fields. Still fewer in the area have electricity. Magnificent hill terraces, the products of centuries of labour, lie abandoned while village men leave their farms for jobs in towns such as Dehra

*Fred Pearce is a freelance writer on environmental matters. His latest book is **Green Warriors: The People and the Politics Behind the Environmental Revolution** (Bodley Head, 1991).*



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Dun or even New Delhi; the village women
work 18 hour days in the fields and chil-
dren look after the goats.

Much of the natural wealth of the val-
leys has been destroyed during the past
century as the hill forests have been chopped
down, first by Victorian British colonialists
seeking timber for railway sleepers and
more recently by Indian industrialists.
Lately, foresters have met opposition from
the Chipko movement, which is based in
the Tehri-Garwhal district. Large signs on
the roadside announce European Com-
munity funds spent on tree planting pro-
jects. But many hillsides have become
rocky, soil-less and barren. A region with
120 days of rain each year, the source of
violent floods downstream, is dotted today
with cactus plants and in places looks little
better than a desert.

All this is distressing. But none of it
prepares the visitor for the sights and sounds
of Tehri itself, a vast construction site in
the middle of the Himalayas. Even before
work on the main dam begins, probably
later this year, the river is filled with silt
from construction work. The town is
blanketed with dust and, day and night, is
rent with the noise of an endless stream of
trucks rumbling across the bridge over the
Bhagirathi and onto the dam site. The
residents are treated as if they did not exist.
They are told nothing of what is going on
and are lied to contemptuously.

For weeks last autumn, construction
managers denied what everybody could
hear — that their men were blasting rock
from the hillsides at night — until early
one morning a large rock flew over the hill
and crashed through the roof of a house
next door to the home of the local chief of
police.

The History of the Dam

Yet this is just the end of a long beginning.
During almost 20 years of fitful construc-
tion activity at Tehri, since the dam was
first approved, diversion and overflow
tunnels have been dug through the
mountainsides and now the river itself is
turned aside by a coffer dam, which will
keep the river bed dry while the main dam
is built. Several hundred local people were
moved out from construction sites a dec-
ade ago and relocated in shacks on stony
allotments carved from forests close to
Dehra Dun airport. (The rumour is that the
airport may soon be expanded and they
may have to move again).

The Geological Survey of India first

identified the Bhagirathi gorge at Tehri,
with its large U-shaped valley behind, as a
possible dam site in 1949, and its survey
report recommending construction of a
dam was completed by 1969, winning its
first government approval in 1972. But
progress on the ground has been slow,
largely because the dam remained a project
of the state government of Uttar Pradesh,
which had trouble raising the funds. Ironi-
cally, considering the state's declared
desperate shortage of electricity, a smaller
uncontroversial "run-of-the-river" hydro-
electric project on the same river, which
would have been generating power for
some years by now, was cancelled to make
way for the Tehri dam.

In the early 1980s, work all but ceased
at Tehri as construction workers moved to
another dam site elsewhere in the state. But
all that changed in 1986 when Mikhail
Gorbachev, carrying an open cheque book
for funding energy projects, visited India
for a summit with the then Prime Minister,
Rajiv Gandhi. Officials from the Soviet
Union and India had hoped to put aid
roubles into nuclear power, but negotiations
failed. According to reports at the time, the
Tehri dam project, which had been dis-
cussed with Soviet officials on and off
since 1983, was picked up at short notice to
fill the diplomatic gap and provide a deal to
be signed at the end of the trip. Usha Rai,
a journalist with the *Times of India*, says that
"the decision was taken quickly because
the Russians were eager to assist India in
some field. It was a political decision taken
at the highest level and disregarding the
advice of the Department of the Environ-
ment."

At this stage, the project came under the
direct control of the central government in
New Delhi, though much of the driving
force to ensure its completion came from
the political establishment of Uttar Pradesh,
based in Lucknow. All the electricity
generated at Tehri will be sent directly by
pylon to the state grid at Meerut, 250
kilometres away, largely to power industry
in the lowland cities. It will also send extra
water for state irrigation canals, though
much less than originally intended, and for
taps in Delhi. Meanwhile, as water and
electricity heads south, villages such as
Seiran will remain without power to lift
water the two metres from the Bhagirathi
to irrigate their own fields.

Local Opposition

Like most such projects, the Tehri dam has

been imposed on the locals with little or no consultation before or since the decision was taken. (Indeed nobody is sure when, or indeed whether, the final decision to build the dam has been given at all). But opposition has been intense and vocal. Hotel keepers, market stallholders and civil servants all voice their opposition to the dam. The Tehri Bandha Virodhi Sangharsh Samiti (Anti-Tehri Dam Struggle Committee) has had the support of all the political parties in the town since its formation in the mid-1970s.

The central figure in the opposition throughout that time has been a Tehri lawyer, Virendra Saklani. A former freedom fighter from pre-independence days, and subsequently an activist with the Chipko movement, Saklani, now in his mid-70s, is frail and suffers bouts of asthma. Days before my visit in November 1990, his campaign had been dealt what seemed a body-blow. The Supreme Court in New Delhi had turned down his application, first made in 1985, for dam work to be halted on the grounds that the Government had not properly considered critical seismological evidence. That evidence pointed to the danger of a large earthquake in the region destroying the dam and drowning towns downstream such as Rishikesh and Haridwar, where up to 200,000 people live.

The court, according to Saklani and allies in Delhi such as N.D. Jayal at the Indian Trust for Art and Cultural Heritage (INTACH), had proved hostile to the application from the start. While ruling themselves not competent to decide on the merits of the seismological case, the judges found that the Government had gone through the proper procedures.

I met Saklani and several of his fellow activists at his home in the town. It was their first impromptu meeting since the court decision, but Saklani refused to be downhearted. He would resume the legal battle, he said. His only regret was that he had not followed his own instinct at the start of his campaign by pursuing the case in the local courts. Instead, he had taken the advice of top lawyers in New Delhi. They had been impressed at a series of decisions by the Supreme Court in the early 1980s which had established that citizens had environmental rights that could be considered on a par with human rights guaranteed under the Indian constitution. They persuaded him to take his case there. Now, having failed in New Delhi, Saklani and his compatriots intend to start afresh in the local courts.

The campaign against the Tehri dam received new impetus last year when it was very publicly joined by Sunderlal Bahuguna, the now-legendary leader of the Chipko movement. Bahuguna and his many activists found national and international fame with their tactic of hugging trees to prevent them being chopped down, and from Bahuguna's series of long marches through rural India gathering support for the protection of forests. In December 1989, he embarked on a ten-day hunger strike at the dam construction site aimed at halting the project.

Bahuguna's hunger strike won plenty of favourable attention in the Indian media, helped in part by his son, Pradeep Bahuguna, who is the local Tehri correspondent for several national papers. But locally, the strike was not an altogether happy affair, attracting the attentions of local supporters of the dam as well as opponents.

When he spoke to students at the Tehri campus of the University of Garhwal, Bahuguna was howled down and forced to leave. And days later, supporters of the dam ransacked the camp set up by Bahuguna at the dam site. Several of his supporters were beaten up. There were persistent rumours that student leaders had been "bought" by the Hydro Development Corporation or contractors, but it is equally true that many students and townspeople support the dam.

Despite this undercurrent of local antipathy, the hunger strike won a concession from the new and sympathetic environment minister in New Delhi, Maneka Gandhi. She promised that construction work would cease while new studies into seismological risks were carried out. But the real power to say "yes" or "no" to the project appears to rest with the Ministry of Mines, which is masterminding the project, and the inner cabinet of the Indian civil service known as the Committee of Secretaries. After Maneka Gandhi attempted to impose a green stamp on decision-taking in her ministry last year, she was swiftly stripped of most of her ministerial responsibilities.

Bahuguna has now moved from his Chipko ashram in the hills to Serain, a small village in the Bhagirathi valley which will be drowned by the Tehri dam. He has pledged to stay there whatever happens.

Corruption, Blight and Speculation

Last September, with no clear resolution of any of the outstanding issues over the dam, the Government released 1.5 billion rupees (£45 million) of new funds. Though ostensibly this was for research, for work on the river bed and for helping existing oustees from the dam site, it was swiftly diverted into an orgy of apparently corrupt

Green Warriors

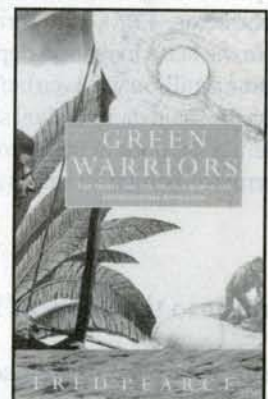
THE PEOPLE AND THE POLITICS BEHIND THE ENVIRONMENTAL REVOLUTION

by Fred Pearce

Leading environmental journalist Fred Pearce probes the origins, philosophies and motivations of the campaigners whose activities increasingly dominate the political agenda.

He looks at the people behind the worldwide network of environmental groups: the lawyers and media professionals; the radical priests and their flocks fighting land barons in Amazonia; and the scientists who are driven to public platforms to explain their fears for the future of the planet.

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compensation payments to land speculators, and construction work resumed.

For the people of Tehri and the surrounding villages, the argument over the dam creates a cruel dilemma. For 20 years, since initial approval was given by the central government in 1972, the town has been blighted. The local hospital, which serves villages for many miles around, desperately needs investment. So does the university campus. The sewage and water supply systems have been left untended. According to Vijay Negi, a Chipko activist and passionate opponent of the dam: "Many people now just want the dam to go ahead. They say that the indecision is unbearable. People want new hospitals, roads, shops, but until the uncertainty is ended and the move to New Tehri made, they fear that no investment will come. There is a sense of resignation; even the annual whitewashing is not done and people have grown used to unhygienic conditions." Many shopkeepers and other business people in Tehri want the dam. They hope for improved prospects once everybody has been moved to the new town, especially since the state government has promised to relocate its district headquarters there — indeed, a few offices have already moved. Many professional people have voted with their feet and moved away, part of the flight from the hills that has infected the whole region. Many others, including an implacable member of the anti-dam committee, Kailish Uniyal, live there only at weekends.

Few locals are employed on the dam site because contractors prefer to truck in labourers from the neighbouring state of Bihar, and others with no ties to the region. But for some locals, the dam is a honeypot, a rare instance of money from central coffers penetrating the hills. The prime local contractor, J.P. Gaur, formerly an official in the state irrigation department, has become a millionaire even before work begins on the main dam. Uniyal says most of the dam's supporters in the town have been corruptly bought in one way or another.

Dipping Into the Flow of Money

In an atmosphere of corruption, scams and ruses proliferate. Close to the village of Serain, local landowners have since September built a series of ramshackle houses. Locals claim that the houses were built solely in order to claim compensation from the authorities for their eventual inunda-

tion. Once the cheque arrives, the houses are taken apart and rebuilt down the road, ready for a new round of compensation. Negi says that at least one householder has bricked up a couple of windows and opened up new ones before claiming compensation on his house for a second time.

Locals allege that government officials collude in this, taking a percentage. They say that compensation claims filed by out-

By a perverse logic, the Government now unofficially advises that, whatever the pros and cons, too much money has already been spent for it to be possible to cancel the project.

side speculators are processed within weeks, while some genuine claimants have to wait years and then find mysterious deductions from their compensation for "administrative costs". But the corruption now runs deep. Many locals, says Negi, have adopted a new adage: "As the Ganga of money is flowing, let's take a dip into it". Negi admits that a flood of compensation money in recent months "has damaged our movement. People who were strongly against the dam have been lured away."

Whatever the truth about the corruption charges, Negi says that "the very fact of giving cash compensation for loss of land and homes in a region like this, where many village people are not used to handling large sums of money, is like throwing the people to the wolves. They are exposed to middle men who offer to obtain them land in Dehra Dun, and many simply spend the money on various vices. Where will they go when the waters rise?" Originally budgeted at two billion rupees, more than four billion rupees have already been spent on Tehri before work on the main dam even starts. The official price tag in 1986 was 13 billion rupees (then worth about £500 million), with unofficial estimates today ranged around £2 billion. By a perverse logic, the Government now unofficially advises that, whatever the pros and cons, too much money has already been spent for it to be possible to cancel the project.

The Earthquake Risk

Since reviving the Tehri dam project in 1986, the Indian government has been besieged on all sides by opponents. Soviet engineers were quickly voicing misgivings over the design of the dam, which they feared would not withstand a large earthquake. They want a more resistant core to the earth and rockfill dam and a base 400 metres wider than the intended 1100 metres. And tumbling into the in-trays of officials in New Delhi came a disturbing series of reports from Indian seismologists. They warned that the dam site was highly prone to earthquakes. It is just 15 kilometres from the boundary between the Indian and Eurasian continental plates, the most likely source of earthquakes in one of the most seismically active regions in the world. Furthermore, the section of the plate boundary that runs near to Tehri is part of a 700 kilometre long "seismic gap" — that is, a section of the boundary where the absence of major recent earthquakes leads seismologists to believe that there must be a buildup of tension in the rocks that will lead to a large earthquake.

The seismologists say that an earthquake could happen at any time. The seismic gap extends along the Himalayas from Kashmir, where an earthquake in 1905 measured 8.6 on the Richter scale, to Bihar where a quake of magnitude 8.4 hit in 1934.

The implications of these findings were obviously vital for the 200,000 people living immediately downstream of the Tehri dam site, in towns such as Rishikesh and Haridwar, which could be inundated by a tidal wave unleashed by a dam breached in an earthquake. The findings also represented a difficult legal problem for officials since the action launched by the Tehri lawyer, Virendra Saklani, alleged that the Government had ignored the seismological issues.

In the past 18 months, a complex scientific debate has developed over whether the Tehri dam could withstand the kind of earthquake likely to hit the region during the likely life of the dam. It has become a battle between independent seismologists, who argue that the risks are high, and the Government's earthquake engineers, mostly from Roorkee University, who have all along insisted that their structure will be safe. For the most part, the Indian government has relied on its engineering advisers from Roorkee for guidance — even when resolving technical conflicts involving members of that university.

The aftermath of the Vaoint Dam disaster in Italy in 1963. Two thousand people were killed when a landslide crashed into the reservoir behind the 120 metre dam, causing a huge wave to surge over the dam and into the valley below. The hillsides along the valleys to be flooded by the Tehri dam have been affected by a number of major landslides. These are likely to become more common due to erosion caused by the frequent raising and lowering of the water in the Tehri reservoir.

Manipulating the Statistics?

A key moment came in April 1990 with the report of an expert committee, set up by the Government under the chairmanship of the Director-General of the Geological Survey of India, to look specifically at the seismic hazards at Tehri. The committee concluded that critics of the dam had been right to argue that an earthquake measuring more than eight on the Richter scale was possible in the region, while the dam had only been designed to withstand a quake measuring 7.2. (The Richter scale is logarithmic: a quake measuring 8 is 10 times the strength of one measuring 7.) But the committee argued on the basis of new calculations that the dam could after all stand the stresses likely to be imposed on it by this larger quake.

One man who smelt a rat was INTACH's N.D. Jayal, a former senior civil servant who had left the Environment Ministry in 1985 at the height of an earlier round of controversy over Tehri. Jayal has backed Saklani's legal campaign and claims that the revised figures for the dam's sturdiness have been manipulated because any change in design specifications "would imply a total redesigning of the dam at a prohibitively uneconomic cost."

The expert committee denied the charges of foul play. They said that they were reassured about the robustness of the dam by calculations of the degree of shaking, measured as "peak ground acceleration", likely at the surface at Tehri. These calculations rely crucially on estimates of how much the shaking will weaken between the plate boundary, the nearest likely source of a quake, and Tehri, 15 kilometres away. Using a formula taken from a 15-year-old paper written by an American seismologist, James Brune, the expert committee concluded that the worst likely peak ground acceleration at the dam site would measure 0.446g ("g" is the rate of acceleration due



Popperfoto

to gravity). This, they said, was safely within the design specification for the dam of 0.5g.

Hard Rocks

While the expert committee was dominated by earthquake engineers, who should know about the ability of their dam to withstand earthquakes, it also contained the country's best-known seismologist, Vinod Gaur, who should have been the source of authority on the extent of the earthquake risks. But Gaur said later that the calculation of peak ground acceleration was not his own but had been supplied by the dam's backers. Within days of the report's publication, Gaur admitted to misgivings about its reliability and referred the data to Brune, the originator of the formula on which it was based.

Brune wrote back that the formula had been misapplied. His original calculation had been made for a specific site in the Imperial Valley of California, where soft sedimentary rocks would lead the effects of an earthquake to weaken quickly as the shock waves passed through rocks. In the hard rocks of the Tehri region, Brune said, this "attenuation" would be much less marked. So the quake would lose much less of its force than had been assumed while travelling from the plate boundary to Tehri.

Moreover, Brune warned of other unexamined factors. There were, for instance, known faults in the local rocks near Tehri, including one in the river bed close to the

dam site. Some of these, such as the large Mahr fault which probably runs directly beneath Tehri, might be connected to the main plate boundary and could bring the force of a large quake much closer to the dam. Also, there was the possibility of surface rocks amplifying the ground acceleration rather than reducing it. All in all, said Brune in a letter that Gaur forwarded to the Government's Ministry of Mines, it would be folly to build a dam at Tehri that could not withstand a peak ground acceleration of at least 1g, twice that allowed for in the current design.

The Government promptly referred this letter to yet another expert, Jai Krishna, a former vice-chancellor of Roorkee University. Krishna had a record of supporting the Tehri dam plan and had acted as a consultant to the Hydro Development Corporation. He was, as Jayal complained to the Government, "neither a seismologist nor an independent expert". By September 1990, Krishna had rubber-stamped the expert committee's original decision, leaving the Supreme Court free to rule that the Government had taken all the advice necessary on the matter.

However, in December 1990, Brune visited India, making a trip to the Tehri dam site itself and lecturing both in New Delhi and at Roorkee University. He left India with the impression that he had persuaded some of the engineers at the university that his calculations were correct. "There is no question," he says, "that accelerations near 1g might be produced at Tehri dam. The question is, what is the probability, and what risk is acceptable? In

my opinion this question deserves much more investigation."

No Data, No Problem

The problem is that scientific investigation into seismic risks is the very thing that the Government has been most reluctant to fund throughout the long history of the project. This may have been a deliberate tactic.

Several government scientific advisers I spoke to said that they had felt unable to oppose the dam outright because of the lack of data. They had felt the onus was on them to justify a veto, rather than on the dam's backers to demonstrate its safety.

Sunil Roy, who chaired a working group looking at the environmental impacts of the Tehri dam in the early 1980s, failed after six years to find common ground between environmental opponents of the dam and the engineers in his group, who were implacably pro-dam. In a personal letter in 1986, appended to his final report, he complained about the failure of the Government to institute seismological research projects recommended unanimously by his committee six years before. His letter concluded: "I have chaired innumerable committees and groups in India and other parts of the world. I have never encountered such an unbending dogmatic approach to all issues which were not positively framed to ensure continued work on the Tehri dam, whatever the cost."

The failure to collect basic data extends far beyond the question of seismic hazards. There is little data, for instance, on the amount of snow that falls in the headwaters of the Bhagirathi, feeding the glacier from which the river flows. And there has been serious criticism of methods for collecting data on silt load in the rivers, which is essential for calculating how long the reservoir will last before it silts up. Government statistics suggest the reservoir has a life of at least 100 years, but critics point out that its data ignores the "bedload", the rocks and other debris that roll along the river bed, especially during monsoon floods, without becoming suspended in the water itself.

Independent investigations by the Wadia Institute of Himalayan Geology at Dehra Dun calculate that the dam may have a life of only 30-40 years. This would be on a par with the experience of other reservoirs in the Himalayas, where siltation rates have been from two to five times greater than anticipated.

Another topic that has escaped detailed investigation is the likelihood of landslips into the reservoir itself. The hillsides are composed of twisted and shattered shales and are obviously fragile. An early study by the Geological Survey of India pinpointed the remains of a number of major landslips along the 80 kilometres of river valleys to be flooded by the dam. It warned that slips would increase because of erosion caused by the constant raising and lowering of the water level in the reservoir. This risk has since increased with the decision to use the reservoir primarily to provide "peak load" electricity, implying rapid and frequent releases of water and refilling of the dam. Landslips will increase the build-up of silt in the reservoir, but a major slip could also push a tidal wave over the top of the dam itself, causing flooding downstream. Such an accident in Italy 20 years ago killed 2000 people.

Too Late To Stop Now?

It is still impossible to judge whether Tehri dam will be built or not. Several opponents I spoke to, both environmentalists and scientists who had sat on government advisory committees, told me that it was too late, the battle had been lost. Too much money had been spent, both on civil engineering and bribes, they said, and in India a committed state government had too much clout to be told No. (Further south in the Narmada valley, for instance, the power of the Gujarat state lobby would make it all but impossible for the central government to call a halt to the Sardar Sarovar dam scheme, whereas the equally contentious Narmada Sagar scheme upstream in Madhya Pradesh may be allowed to slip out of sight because the state government is less wholeheartedly committed).

But the people of Tehri and the dozens of threatened villages in the valleys around may yet be saved by the declining health of the Indian economy and particularly its growing debt crisis. The project, after all, makes increasingly little economic sense, as a study by the Government's Auditor-General three years ago concluded. Even official cost-benefit analyses show it to be only marginally beneficial to the national economy and, as a study commissioned by Jayal's INTACH has exposed, these figures have been shamelessly massaged to present a rosy picture. For instance, they hopelessly undervalue natural resources such as the fields and forests of the Bhagirathi valley that will be destroyed.

The finance ministry in New Delhi has yet to give its final approval to the dam, and the influential planning commission, which coordinates government spending, is also biding its time. They both may prove more inclined to dig their heels in at the eleventh hour than the Environment Ministry which, despite having serious reservations about the project, advises that it cannot go against the combined decision of the Committee of Secretaries. The Environment Ministry's approval, nonetheless, is conditional on completion of a number of planning exercises.

And nobody can be sure of the Soviet Union's commitment. The project is so tarnished with uncertainties — not least the fears voiced by the USSR's own earthquake engineers who say the dam would not be allowed in the Soviet Union — that it can hardly emerge as a shop window for Soviet dam-building expertise. And it hardly seems decent for a country in the grip of domestic chaos and relying on foreign food aid to be throwing a billion roubles in aid at a country that now, whatever its other travails, has food to export.

The Gandhian tradition in India, exemplified by Bahuguna, will always be implacably opposed to vast projects such as the Tehri dam. Its case does not rest on seismology, still less on cost-benefit analysis, but on an entirely different philosophy from the mainstream about economic and social development and the relationship between humans and the natural world. But the economic and seismological uncertainties surrounding Tehri have now grown so great that even the state technocrats, the inheritors of the tradition of Gandhi's successor, Nehru, who famously called large dams "the temples of modern India", may want to call a halt. They may, to cover their retreat, invoke the sanctity of science, of the sacred Ganga or of the balance sheet. But for the majority of the people of the Bhagirathi valley it matters only that the dam be halted. And that the old palace be vacated once more.

Further Reading

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Vijay Paranjpye, 'Evaluating the Tehri Dam: An Extended Cost-Benefit Appraisal', *Studies in Ecology and Sustainable Development* 1, INTACH, New Delhi, 1989.

More details on the seismological case against Tehri can be found in Fred Pearce, 'The dam that should not be built', *New Scientist*, 26 January, 1991.

Nuclear Power and Carbon Dioxide

The Fallacy of the Nuclear Industry's New Propaganda

by
Nigel Mortimer

The increasingly beleaguered nuclear industry is now highlighting the threat of global warming as a justification for its continued expansion. The industry argues that it produces no carbon dioxide and that nuclear power is therefore a key element in any plan to reduce emissions of this greenhouse gas. However an analysis of the entire nuclear fuel cycle shows that nuclear power is responsible for much larger carbon dioxide emissions than several renewable energy options and efficiency measures. Furthermore, a major expansion of nuclear generating capacity would result in huge increases in CO₂ emissions from the nuclear industry due to the need to mine and process progressively lower quality uranium ores. Nuclear power is an expensive, unsustainable, dangerous and ineffective option in any realistic strategy to combat global warming.

Following the oil shock of 1973-74, nuclear power was promoted as the cheap and safe answer to apparently quickly depleting resources of fossil fuels. This image was strengthened by the second oil shock of 1979, but it could no longer be maintained during the glut of relatively cheap oil that resulted from the third oil shock in 1985. In the United Kingdom at least, the justification used by the nuclear lobby changed quite fundamentally and nuclear power was touted as an essential means of providing fuel diversity and preventing the disruption of electricity supplies by industrial action, principally in the coal industry. However, despite such attempts at self-justification, the nuclear industry worldwide continued to suffer a crisis of confidence, initially from private and public investors in the face of mounting capital costs and poor power plant performance, and then from the general public, largely in response to the accident at Chernobyl in 1986. Distrust for nuclear power, from both investors and the public, remains, compounded by concern over low-level radiation from routine emissions, fears of

nuclear weapons proliferation, doubts about the technical feasibility of nuclear waste disposal, and uncertainty surrounding the economics of decommissioning nuclear power plants.

It is against this background that the industry is now portraying nuclear energy as an important means of reducing the growth of global carbon dioxide emissions, which are responsible for about 55 per cent of anthropogenic global warming.¹ The principal sources of carbon dioxide are the combustion of fossil fuels and deforestation. According to the conclusions of the Intergovernmental Panel on Climate Change (IPCC), the global average temperature can be expected to rise between 1.5°C and 4.5°C by around 2030 if CO₂ emissions continue to increase at current rates. This, in effect, establishes a timescale of about 40 years during which practical action on global warming must take place.

Carbon Dioxide from Nuclear Power

Concern about the impracticability of nuclear power as a solution to global warming has been widely expressed; generally, in relation to replacing one major environmental problem with another, and, more specifically, in terms of the uneconomic

nature of nuclear power in comparison with more feasible solutions such as energy efficiency.² Although these and similar concerns are important, it must be realized that the present justification for nuclear power is essentially based on two simple claims. First, that nuclear power does not emit CO₂; and second that it can, in some way, make an important and, by inference, a sustained contribution to ameliorating global warming.

These two claims were examined in evidence prepared for Friends of the Earth and presented to the public inquiry into the proposed construction of a Pressurized Water Reactor (PWR) at Hinkley Point in Somerset, South West England.³ This evidence, now referred to as "FoE9" used the technique of energy analysis to estimate the direct and indirect emissions of carbon dioxide from a PWR and its associated fuel cycle, operating under a range of basic assumptions. Energy analysis consists of measuring the total energy required to supply any given product or service.⁴

Table 1 gives average estimates of the amount of CO₂ released, directly and/or indirectly, by generating or saving one unit of electricity by various methods. Two different emissions estimates are given for different nuclear power fuel cycle scenarios. The first is for the current situation in which a PWR uses nuclear fuel obtained

Nigel Mortimer is Head of the Resources Research Unit in the School of Urban and Regional Studies at Sheffield City Polytechnic, Pond Street, Sheffield S1 1WB, England. The views expressed here are those of the author and not necessarily of the Polytechnic.

from typically good quality ores, with a grade (concentration) of 2,000 parts per million of uranium, enriched 90 per cent by the widely established gas diffusion technique and 10 per cent by the more energy efficient gas centrifuge technique. This division reflects the present split of commercial enrichment capacity available worldwide. Under these circumstances, the majority of CO₂ emissions from nuclear power arises from the generation of large quantities of electricity for uranium enrichment. Corresponding to the existing situation in the United Kingdom, it is assumed that 80 per cent of this electricity is provided by fossil fuel-fired power stations with the remaining 20 per cent being supplied by nuclear power itself.

The second nuclear fuel cycle scenario given in Table 1 allows for increased dependence on nuclear power and the adoption of new commercial enrichment methods. This scenario consists of a PWR operating with present high quality ores but with enrichment entirely provided by the gas centrifuge technique. In addition, it is assumed that all the electricity used in this future nuclear power system is supplied by the nuclear power station itself, thus reducing CO₂ emissions substantially. This result can be compared with that determined in a study published by the US Department of Energy for a Boiling Water Reactor (BWR) and its associated nuclear fuel cycle, presumably incorporating gas centrifuge enrichment. PWRs and BWRs constitute the majority of current commercial nuclear power generating capacity.

Two important conclusions can be drawn from Table 1. The first is that there is good agreement between the results presented in FoE 9 and those derived or obtained independently from other sources. Hence, it is unlikely that the results are fundamentally flawed. The second conclusion is that nuclear power does, in fact, cause CO₂ emissions, albeit indirectly. Although these emissions are, at present, quite small in comparison with coal- and gas-fired power stations, the current nuclear power system releases more CO₂ than renewable sources of energy, such as hydro, wind and tidal power, and energy efficiency measures, such as loft and wall insulation, and low energy lighting. Hence, these options are currently more effective for abating carbon dioxide emissions than nuclear power.

It may appear that the estimate for future nuclear power CO₂ emissions given in Table 1 shows that nuclear power could achieve emission levels as low as renew-

METHOD	Total Carbon Dioxide Release (g CO ₂ /kWh)*			
	FoE 9	San Martin	Donaldson et al.	IAE
COAL				
conventional power station	1210	964	—	—
pressurized fluidized bed and combined cycle power station	813	—	—	—
GAS				
conventional power station	573	484	690	—
combined cycle power station	409	—	—	—
NUCLEAR				
current PWR and fuel cycle	47	—	48	54
future PWR/BWR and fuel cycle	4	8	—	—
RENEWABLES				
hydro power	16	10	—	—
wind power	11	7	—	—
tidal power	11	—	—	—
ENERGY EFFICIENCY				
glass fibre loft insulation	5	—	—	—
polystyrene foam cavity wall insulation	5	—	—	—
low energy lighting	2	—	—	—

* Grams of carbon dioxide per kilowatt-hour equivalent. CO₂ release figures from:
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Personal communication from the Institute of Applied Ecology, Darmstadt, Germany, July 1990 (estimate for a PWR operating in West Germany).

Table 1. Associated carbon dioxide emissions from selected methods for generating or saving electricity

able energy sources and energy efficiency measures. However this scenario assumes that all electricity is provided by nuclear reactors. The unavoidable consequence of this assumption is that the worldwide demand for uranium would be dramatically increased. Although there is at present a glut of uranium due to unrealized plans for nuclear power growth, any substantial expansion of nuclear power will put considerable pressure on uranium resources, resulting in the inevitable use of poorer quality sources of uranium.

Limits to Nuclear Power

The issue of using progressively lower quality sources of uranium was addressed in FoE 9, which demonstrated that al-

though CO₂ emissions from the use of fossil fuels in uranium mining and ore processing are relatively small with current ores, these would increase in inverse proportion as ore grades fall. In theory, it would be possible to reach a point at which so much fossil fuel was consumed in extracting uranium from low grade ores that as much carbon dioxide could be released in generating one unit of electricity from a nuclear power station as from a fossil fuel-fired power station. Under such circumstances, nuclear power would no longer have any attractions as a method of carbon dioxide abatement. The point at which this would occur is referred to as the "ore grade limit".

Taking the previous assumptions about enrichment by the gas centrifuge method alone and complete electricity supply by

nuclear power, then the ore grade limit is 100 parts per million. With this grade limit, known uranium resources, excluding current and previous centrally-planned economies, would amount to approximately six million tonnes.⁵ Adopting a policy of recycling unused uranium and plutonium recovered from spent nuclear fuel by reprocessing (not widely practised at present) might reduce the ore grade limit to 60 ppm and increase available uranium resources for nuclear power to about ten million tonnes.

The severe constraints imposed by this ore grade limit on the potential of nuclear power as a means of combating global warming can be demonstrated by way of a simple, though particularly relevant, example. If the electricity generating capacity of the world, excluding current and previous centrally-planned economies, was provided by nuclear power, then six million tonnes of uranium would only be adequate for 23 years and 10 million tonnes of uranium would only last 46 years.⁶ Hence, it is difficult to believe that nuclear power based on existing commercially viable technology can be regarded as a sustainable contribution to solving global warming.

Of course, it is unreasonable to expect that nuclear power can replace all existing electricity generating capacity in the timescale for action on global warming. However, if for practical purposes nuclear power's share of world electricity generating capacity is reduced, then more CO₂ emissions will be released in fuel enrichment, the ore grade limit will increase and available uranium resources will fall. For example, using recent calculations based on a comparison of nuclear power with combined cycle gas power station technology, the estimated ore grade limit would rise to 158 ppm if nuclear power accounted for 50 per cent of world electricity generating capacity. This would restrict useable uranium resources to just over five million tonnes — 24 years' supplies assuming a nuclear generating capacity of approximately 1500 gigawatts (GW = 10⁹ watts) which is consistent with certain scenarios for nuclear power for 2020.^{7,8} Again, this limits the importance of nuclear power as a contributory solution to global warming.

Most publicity promoting the case for nuclear power acknowledges that, in comparison with resources for conventional fossil fuels, uranium resources are limited if used in thermal reactors. One nuclear industry source states that "used in the type of reactors now in operation, the world's

uranium supplies that are recoverable at a reasonable cost would be unlikely to last more than 50 years."⁹ As the answer to this problem the industry usually, quite glibly, invokes the fast breeder reactor as a means of transforming severely limited uranium resources into a much larger potential source of energy (see Box). In theory, the use of fast reactors could increase the energy available from uranium resources by

a factor of 60. In practice, however, it is not clear how this would be achieved on an expanded global scale without encountering basic plutonium shortages, not to mention serious problems with waste disposal, power plant decommissioning and nuclear weapons proliferation. In fact, the fast reactor is an essential component of the case for nuclear power — a case built around a technology which is not expected

The Fast Breeder Failure

The fast reactor is the elixir in the nuclear dream — the technology that will allow nuclear power to defy the constraint of finite supplies of uranium. Theoretically, these reactors, termed "fast breeders" as they produce more plutonium than they consume, could increase the energy available from the world's uranium supplies 60-fold.

The fuel in the core of a fast reactor — a mixture of uranium and plutonium — is surrounded by a "blanket" of uranium. Unlike conventional "thermal" reactors, there is no moderator to slow down the neutrons which cause the chain reaction which powers the reactor. During the reaction, the fast neutrons escape from the core and react with the uranium blanket to form plutonium which can then be reprocessed to make new fuel. However spent fuel from fast reactors is much more radioactive than that from conventional reactors and reprocessing presents both technical and safety problems.

The operation of fast reactors is intrinsically dangerous. The coolant normally used is liquid sodium which can catch fire on contact with air and explode on contact with water. More worrying is the plutonium fuel used in the reactors which presents numerous concerns over environmental contamination and its use in nuclear weapons. Development of fast breeder reactors would dramatically increase international trade in plutonium.

In the 1950s and 1960s, at the height of nuclear optimism, it was thought that hundreds of fast reactors would be operating by the end of the century. In fact, research reactors around the world have been plagued with problems and the fast reactor is on the verge of extinction. In 1955, the world's first fast reactor — the

EBR-1 — suffered a core meltdown and came less than a second away from exploding. In 1966, the Fermi fast reactor came close to exploding with terrible consequences for the nearby city of Detroit. During the early 1970s a large fire broke out in the secondary cooling circuit of the 350MW Shevchenko reactor by the Caspian Sea.

In Europe, the largest fast breeder, the French "Super-Phénix" at Creys Malville, 40km from Lyon, has suffered a series of sodium leaks and has been shut down for much of its short life. It is estimated that this white elephant has cost between \$2500 and \$3000 million. Super-Phénix contains some five tonnes of plutonium fuel, enough for several thousand atomic bombs, as well as 5000 tonnes of sodium coolant.

Huge costs combined with technical problems have led the British government to slash the funds available to the experimental fast reactor at Dounreay in Scotland which is now likely to close in a few years. The UK Atomic Energy Authority has estimated that another 20-25 years' work, and £3300 million in R&D and construction costs would be needed before a commercial fast breeder is feasible.

In March 1991, the nuclear elixir showed once more that it is the taxpayers' poison when the German government finally gave up the development of its prototype fast reactor at Kalkar near the Belgian and Dutch borders. The taxpayer has paid half the final bill of £2.4 billion, over four times the original cost estimate for the reactor which was never granted an operating licence. The Kalkar plant is now recognized as the most expensive technological ruin in the federal republic's history.

Patrick McCully

by the industry itself to be available for commercial introduction until the first or second decade of the next century.¹⁰ In this, as in other matters, the requested commitment to nuclear power still requires a substantial act of faith.

Critical Reactions

The nuclear industry has not been slow in attempting to discredit the work on which these conclusions are based. The first opportunity arose during the cross-examination of the evidence from FoE 9 at the Hinkley Point public inquiry.¹¹ Most of the points raised by the Central Electricity Generating Board at the inquiry were more extensively covered in an article published in *Atom*, the journal of AEA Technology, formerly the United Kingdom Atomic Energy Authority.¹²

The *Atom* critique accuses the work on which FoE 9 was based, of being flawed on several counts, summarized as; "(a) an unrealistic scenario is used to apply a ludicrously low time limit to the uranium resource availability; (b) any potential for additions to the uranium resource base, both from exploration and utilization of known less-conventional sources is discarded; (c) any potential for the more efficient use of uranium by fuel recycling, by introducing advanced PWRs or by reducing uranium in waste streams is rejected;

and (d) he [Mortimer] goes to surprising lengths to discuss the fast reactor using arguments that are largely based on erroneous views on uranium and plutonium availability".¹³ Additionally, it is claimed that the work is selective and subjective.

The points raised by the *Atom* critique have been answered in detail.¹⁴ These responses are summarized briefly here. First, the critique presents no evidence, in the form of alternative estimates of carbon dioxide emissions, that the results given in FoE 9 are incorrect. Indeed, the comparisons shown in Table 1 suggest that these results are sound and that the accusation of selectivity is unfounded. Second, the *Atom* critique is itself selective since it takes into account technological improvements that have not been demonstrated commercially and are not available for widespread introduction. Instead, FoE 9 is based on current practice and developments that may reasonably be considered over the timescale of global warming. Third, the critique seeks to imply that the ore grade limits presented in FoE 9 are wrong in comparison with some rather unusual results of energy analysis but the conclusion which is subsequently drawn is based on fundamental misunderstandings about the technique. Fourth, the "unrealistic" scenario criticized in *Atom* is in fact not inconsistent with some of the nuclear power programmes being proposed by the nuclear industry.

The final and probably most important

objection raised by the *Atom* critique is that speculative resources of uranium have been deliberately excluded from the work presented in FoE 9. If such resources were taken into account then the total amount of uranium available for nuclear power would rise to 25 million tonnes. However, these so-called resources were disregarded in FoE 9 because of their official definition by the OECD Nuclear Energy Agency and the International Atomic Energy Agency. These agencies state that speculative resources:

"... should not be taken to indicate that the resources will be discovered or, if discovered, made available. Because of the high degree of uncertainty of these figures it was considered unwise to use them for nuclear power planning purposes. Serious constraints may well arise on many fronts which, together with the long lead times for exploration, mine development and production, make it likely that a major part of the speculative resources may not be discovered and brought into production during the first quarter of the 21st century".¹⁵

The nuclear industry may wish to gamble their nuclear dream on the availability of uranium that may not even exist, but this might not seem entirely prudent to those responsible for planning realistic and sustainable strategies for preventing the nightmare consequences that are predicted for global warming.

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3. Mortimer, N. D. 'Aspects of the Greenhouse Effect', Proof of Evidence FoE 9, Friends of the Earth, 26-28 Underwood Street, London, July 1989.
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9. Donaldson et al., op. cit. 7.
10. Ibid.
11. In his report to the Secretaries of State for Energy and the Environment, the Hinkley Point inquiry inspector, Michael Barnes QC, concluded that, "the evidence of Friends of the Earth established that, if a more rational programme involving a modest increase in nuclear facilities were proposed in response to the threat of global warming, the available uranium resources would be likely to last for centuries (certainly until commercial exploitation of fast breeder, and perhaps even fusion, reactors) and would not constitute a significant restraint on such a programme" (emphasis added) (Barnes, M., QC, *The Hinkley Point Public Inquiries*, Vols. 1-9, HMSO, London, August 1990). It seems that the inspector does not appreciate the difference between extreme and modest nuclear power programmes. In order to make any significant impact on global warming, commensurate with the vast financial commitment that would be required, proposals for the expansion of nuclear power must be very ambitious and
12. would soon run up against resource constraints. The failure of the inspector to understand the necessary magnitude of proposals to use nuclear power in response to global warming and their subsequent uranium resource problems is disappointing. However, this is nothing in comparison with the inspector's qualified approval for the PWR at Hinkley Point which is partly based on its environmental benefits. The inspector used the evidence in FoE 9 to confirm that the associated CO₂ emissions from the power station will be considerably less than those from an equivalent coal-fired plant. This totally misses the point of FoE 9 which demonstrated that both renewable energy sources and energy efficiency measures would achieve even greater reductions in carbon dioxide releases and, what is more, unlike nuclear power, could do this in a sustainable manner.
13. Donaldson et al., op. cit. 8.
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Greenpeace/Greig

Greenpeace activists occupy the ICI plant in Runcorn, North West England, to protest at the company's continued production of ozone depleting chemicals. CFCs and other chlorine- and bromine-containing chemicals have already caused serious losses of stratospheric ozone and will continue to destroy ozone well into the next century. The possible climatic effects of this have largely been overlooked.

Climate and Ozone: The Stratospheric Link

by
John Gribbin

Public concern about the depletion of the ozone layer caused by chemicals that contain chlorine — chiefly CFCs and related products — has focused on the hazards posed by an increase in the amount of ultraviolet radiation reaching the surface of the Earth. However, this may be no more than half the problem. By reducing the concentration of ozone in the stratosphere, human activities will lead to a change in the convection and circulation patterns of the atmosphere that could have far-reaching consequences for climate.

Climate and stratospheric ozone are linked in a complex web of feedback interactions. Most obviously, chlorofluorocarbons trap infrared heat near the surface of the Earth, as well as destroying ozone in the stratosphere by a quite different process. Heat that is trapped near the surface of

the Earth (whatever does the trapping) cannot, of course, penetrate into the stratosphere, so as well as making the lowest layer of the atmosphere (the troposphere) warmer, the greenhouse effect makes the stratosphere (the region from 15 to 50km altitude, which is essentially synonymous with the ozone layer) cooler.

Indeed, a warming in the troposphere accompanied by a cooling in the stratosphere is one of the best "signals" of the onset of an enhanced greenhouse effect due to human activities. While some

doubters still argue that it is too soon to accept the evidence of global warming in recent decades as a sign of the anthropogenic greenhouse effect at work (see Figure 1), measurements made using instruments carried by balloons show that this surface warming was accompanied by a cooling of more than a third of a degree Celsius in the region just above the troposphere between the mid-1960s and the 1980s. The only simple explanation of this pattern is that the greenhouse effect is getting stronger.

John Gribbin is a science writer who finds an increasing amount of his time being devoted to global environmental issues. The issues discussed here are dealt with more fully in his books *The Hole in the Sky* (Corgi, 1988) and *Hothouse Earth* (Black Swan, 1990).

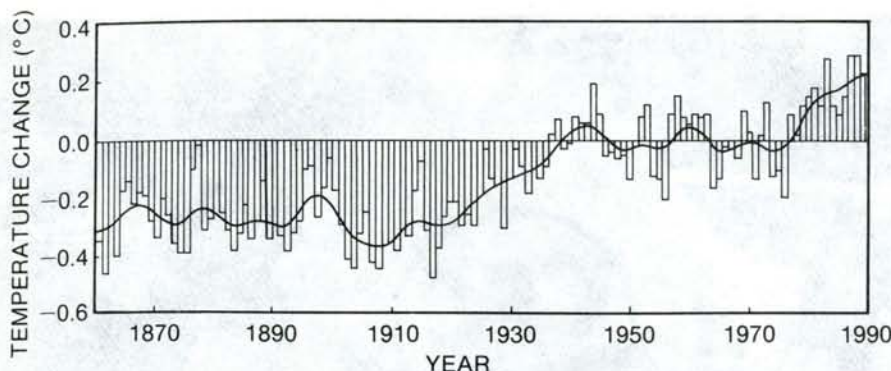


Figure 1. Warming in the troposphere. Global mean combined land-air and sea surface temperatures, 1861-1989, relative to the average for 1951-80.

Source: Climate Change: The IPCC Scientific Assessment, Cambridge University Press, 1990.

Stratospheric Cooling

Cooling in the stratosphere matters for two reasons. First, there is a direct effect on the concentration of ozone. Ozone, the tri-atomic form of oxygen, is produced from ordinary di-atomic oxygen by a series of chemical reactions which involve sunlight. These photochemical reactions are constantly both creating and destroying ozone in the stratosphere, in a dynamic process which leaves a roughly constant amount of the gas. The reactions also absorb incoming solar energy in the form of ultraviolet radiation, shielding the Earth below from its harmful effects, and making the stratosphere warmer than it would otherwise be. Cooling the stratosphere will change the rate at which the photochemical reactions take place. It is now well established that the specific reactions involving chlorine from CFCs that deplete ozone above Antarctica so dramatically in springtime require extremely cold conditions. As yet, the stratospheric air above the Arctic is not quite cold enough for the same dramatic ozone depletion to occur. But the anthropogenic greenhouse effect, trapping heat near the ground and cooling the stratosphere, is pushing conditions above the Arctic towards the state where a springtime ozone hole is more likely to appear.

The second problem associated with a cooling stratosphere is that this layer of the atmosphere acts as a "lid" on convection in the troposphere below (see Figure 2). Energy from the Sun, chiefly in the form of visible light, passes through the atmosphere and is absorbed by the Earth's surface which re-radiates the energy, mainly in the infrared part of the spectrum. Some of the re-radiated energy is absorbed by gases such as carbon dioxide and water vapour in the lower atmosphere. This is the

natural greenhouse effect, which keeps the average surface temperature of the Earth at about 15°C, some 35° warmer than it would otherwise be.

The atmosphere is therefore warmest near the ground, and cools with increasing altitude, up to a height of 15km. In the stratosphere, however, because solar energy is absorbed in the photochemical reactions involving ozone, the atmosphere gets warmer again. The boundary between the troposphere below and the stratosphere above is known as the tropopause. Weather in the troposphere is driven by hot air rising — convection. But hot air can only rise if there is colder air above it. So the warmth of the stratosphere suppresses convection and confines its effects to the troposphere, the weather layer of the atmosphere. As the stratosphere cools and the troposphere warms, convection will be able to penetrate higher, with unpredictable consequences for climate. Although this process is already at work through the anthropogenic greenhouse effect, the process will be boosted as ozone depletion becomes significant — the ultraviolet radiation that used to give up its energy in the stratosphere will then penetrate into the troposphere, and make it even warmer, while the stratosphere cools still further.

Christoph Brühl and Paul Crutzen of the Max Planck Institute for Chemistry, in Mainz have studied the impact on ozone and climate during the first half of the 21st century of likely future releases of CFCs.¹ They consider a range of scenarios based on various assumptions about the effectiveness of the Montreal Protocol and other measures in curbing the release of ozone depleting gases. But in all their scenarios the vertical distribution of ozone is changed significantly, implying large temperature decreases in the upper stratosphere.

The decrease is as much as 20°C in the

worst case studied, and 10° if the requirements of the 1987 Montreal Protocol are strictly adhered to.² The cooling is due mainly to the increase in infrared absorption near the ground by the enhanced greenhouse effect, and partly to the reduced absorption of solar radiation as a result of ozone depletion. According to Brühl and Crutzen:

"These values appear large enough that they might significantly change stratospheric dynamics, a feedback not considered in this study . . . in all scenarios, the calculated ozone depletion is most pronounced in the upper stratosphere and accompanied by a significant cooling in this region, while the tropopause region is heated. This may change the circulation patterns in the stratosphere with potential effects on ozone distribution, but also on climate near the surface".

But the calculations of the Max Planck team allow only for so-called homogeneous reactions — those that take place when all the compounds involved are in the same state, in this case, all gases. But the explanation of the extraordinary amount of ozone depletion seen in the hole over Antarctica each spring depends on heterogeneous chemistry. This involves ozone gas reacting with chlorine compounds on the frozen surfaces of tiny ice particles in polar stratospheric clouds. If such heterogeneous reactions can take place away from the polar regions, "it is likely" according to Brühl and Crutzen, "that the presented results for future total ozone development are severe underestimates". Unfortunately, there is good reason to believe that this may indeed be the case.

Volcanic Seeds of Destruction

There is a growing weight of evidence that sulphate particles thrown into the stratosphere by large volcanic eruptions can act as the seeds on which heterogeneous chemical reactions that deplete ozone occur.³ It has been known for a long time that eruptions like that of El Chichón in Mexico in 1982 do cause a decrease in the ozone concentration of the stratosphere over a period of a few years — indeed, the lowest measurements of ozone overhead ever recorded in Europe were made at Arosa, in Switzerland, the year after El Chichón erupted — but it has only been with the discovery of the Antarctic ozone hole, and a satisfactory explanation for how ozone is depleted above the polar regions, that re-

searchers have made the connection with heterogeneous reactions at work in the wake of volcanic eruptions.

If the same kind of disturbance — a major explosive volcanic eruption — occurs in the 1990s or beyond, when the burden of chlorine compounds in the atmosphere will have increased significantly since 1982, the impact will be even more pronounced. The Antarctic ozone hole each year reaches a size comparable in area to that of the continental United States; it is by no means implausible to consider the prospect of a comparable hole in the ozone layer, produced by a volcanic eruption in South America, drifting over the Amazon Basin and allowing increased ultraviolet radiation to penetrate to the surface.

Although nobody can predict exactly how any of these changes will affect the circulation of the atmosphere, one researcher has come up with what he describes as a "scary scenario". Jerry Mahlman, of Princeton University, works with computer simulations of the atmosphere, models that show how the wind patterns change under different conditions. He presented his bleak picture to a conference on ozone depletion and related problems held in Berlin in 1987, under the auspices of the Dahlem Konferenzen.⁴ He began with the observed fact that something — possibly the greenhouse effect — has caused the stratosphere at high southern latitudes to cool. In wintertime, the Antarctic stratosphere is almost entirely cut off from the rest of the atmosphere by strong winds, the circumpolar vortex, that blow around the southern ocean. Cooling of the stratosphere, the computer models show, causes this vortex to strengthen, sealing off the polar region even more efficiently. And it is in the cold, still air of the wintertime Antarctic stratosphere that the ice particles of the polar stratospheric clouds form, ready to destroy ozone in the springtime, when the Sun returns and provides the necessary stimulus for photochemical reactions.

But ozone depletion itself makes the stratosphere cooler, which encourages the development of the circumpolar vortex, which encourages ozone depletion. It may be that this feedback has helped the hole to grow during the 1980s. Reducing the temperature over Antarctica certainly increases the stability of the circumpolar vortex, and

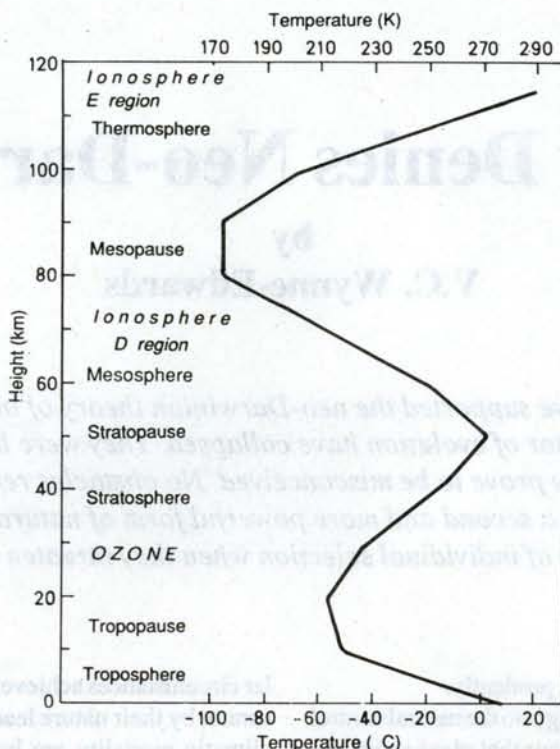


Figure 2. The layered structure of the atmosphere is defined by the variation of temperature with height. Weather systems only circulate in the troposphere because the warm stratosphere stops air rising from below. Global warming and ozone depletion are combining to raise the "lid" with unknown consequences.

Source: John Gribbin, *Hothouse Earth: The Greenhouse Effect and Gaia*, Bantam, 1990.

pushes the circumpolar winds out to lower latitudes. Of course, the effect must be limited by the extent of the region where it becomes dark enough (and therefore cold enough) in winter for the polar stratospheric clouds to form. But it is entirely plausible, according to Mahlman, that the southern high latitude region could "flip" into what is known as a purely radiative equilibrium state, with the steady circular winds dominating the atmospheric flow and with very little movement of air masses across latitude bands — no warm tongues of air licking down into Antarctica even in summer.

This picture is exactly like computer simulations of the onset of a new Ice Age in the southern hemisphere. It seems we have at least to consider the possibility that even a greenhouse warming of most of the globe might be associated with circulation patterns at high southern latitudes that "belong" in an Ice Age. Since no comparable conditions have ever been observed, the effects of this on world climate are unpredictable.

Such scare stories are usually the pre-

rogative of extreme doom-mongers. The most surprising thing about Mahlman's scary scenario is that he is far from being a proponent of doom and gloom, but is known for his caution. Although he stresses that the scenario is far from being certain to happen in the real world, and is presented as a "worst case" example of the impact of feedbacks between ozone depletion and climate, the fact that so sober a scientist should even mention the possibility shows that climate change, not increasing risk of skin cancer, may indeed be the main threat resulting from our damage to the ozone layer.

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2. The Protocol has been significantly amended since Brühl and Crutzen's study. Under the 1987 Protocol, CFC production was to be cut by 50 per cent by 2000, and production of halons (bromine-containing substances used in fire-fighting equipment) was to be frozen. At a meeting of the parties to the Protocol in London in June 1990 it was agreed to phase out CFCs and halons (except for "essential uses") by 2000. The industrial solvents carbon tetrachloride and methyl chloroform were brought under the Protocol for the first time and are to be phased out by 2000 and 2005 respectively. The CFC substitutes HCFCs were subjected to a non-binding resolution for a phase-out by 2020 if possible and 2040 at the latest. However some countries, notably China and India, have yet to sign the Protocol and it is not certain whether all the signatories will comply with its requirements. The non-compliance procedures under the Protocol are extremely weak. A number of countries have pledged to act faster than the Protocol. The EC has agreed to end the production of CFCs by mid-1997. Sweden, Austria, the Netherlands and Germany aim to phase out the use of CFCs for most purposes by the beginning of 1995. It is uncertain how much of the market for CFCs will be taken up by ozone-destroying CFC substitutes. The recent news from the US EPA that ozone depletion is currently occurring at twice the expected rate over the northern hemisphere (see Editorial, this issue) confirms the relevance of Brühl and Crutzen's study.
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Ecology Denies Neo-Darwinism

by

V.C. Wynne-Edwards

The props that have supported the neo-Darwinian theory of individual natural selection as the motor of evolution have collapsed. They were hypothetical in the first place, and now prove to be misconceived. No obstacles remain to accepting group selection as a second and more powerful form of natural selection, overriding the results of individual selection when they threaten group survival.

Animals need food and must consume it prudently.

I have spent much of my life researching into the natural control of animal numbers and the social behaviour that plays so large a part in this.^{1,2} The outcome has been to show that, in order to survive, each animal species has to be able to control its own numbers when necessary, and each individual is normally programmed through its genetic code to take a part in maintaining the balance of nature.

Animals are not self-sufficient nutritionally, as green plants are; they require a supply of organic foods that are produced by other living organisms. The feeding regimes of different species are immensely varied; nevertheless there are useful generalizations to be made. All foods are produced in a finite quantity in a given unit of time depending on circumstances. They can therefore support only a limited number of consumers per unit area; and in a world where efficiency has survival value, it is vital to keep the rates of consumption and production in balance. Consumption is governed by the consumers' population density, and it is this that animals (predictably of all species) are able to control for themselves.

A second factor complicates the balance. Foods can be compared to dividends regularly provided by a capital stock of producers. In the case of live foods, which means whole organisms or parts of them like leaves and body fluids, there is a risk that the consumers' density may increase to a level where the expendable crop has all been used up, and the consumers start to encroach on the capital stock, to the detriment of future crop production. In other words, the consumers can affect the production rate, and may therefore have to exercise control even while unfinished stocks of food remain. Most kinds of animals do depend on live foods and have to cope with this difficulty; but a minority are scavengers, eating dead organic detritus and thus contributing to the carbon and nutrient cycles. Their "target" is total consumption, but they still need to match their lifetime needs as consumers to the quantity of food produced.

In the past it was vaguely assumed that population growth was kept in check by the action of predators, disease, climate and malnutrition; but although one of these, predation, can in particu-

lar circumstances achieve this temporarily, the other three checks cannot by their nature lead to any kind of balance. Epidemic and climatic mortality are both essentially disasters, accidental in occurrence and inconstant in effects. Chronic starvation tends to be terminal, in the end destroying the food source itself. To maintain an effective balance the correcting forces have to be "density-dependent" in their action, growing stronger the further the density of consumers strays from the balance point.

In the last 30 years it has been shown experimentally that animal species when subjected to test do control their own numbers, tracking the changes in the abundance of their food supplies; this points to the likelihood that ever since live-food consumers appeared in the biosphere it has been necessary for them to hold their numbers in check. The ideal strategy must in fact be to allow the food producers to have as good an opportunity as possible to flourish themselves, and thus optimize the dividends they yield. Something approaching this state appears to be the norm in the natural world: predators actually do live in sustainable balance with their prey and, in good habitats, both prosper in each other's presence.

In practice the regulation of consumer density in any particular species takes place piecemeal on a local scale, and requires the cooperation of all the members. Each of them is already programmed through its genes to respond to present feeding conditions and the observed state of the food resources, and to take precautions that will prevent too hasty a consumption rate. There are different strategies in use, but the simplest for purposes of illustration is one that operates in many familiar species of birds. It requires male recruits when approaching maturity, and before the breeding season, to compete with their companions and neighbours for a feeding-plus-breeding territory of their own. The losers in the contest are surplus to the quota that the current food supplies can safely support, and become outcasts. Under severe regimes they are excluded from adequate food and shelter and soon fall victims to predators or other forms of mortality.

The critical factor here is that the contestants should have formed an image of the minimum size of territory that it is permissible to claim in current circumstances, and should not be satisfied with anything less. If the winners then proceed to fill the habitat with a mosaic of territories they will impose a ceiling on feeder and breeder density for the season ahead.

V.C. Wynne-Edwards is Emeritus Professor of Natural History, University of Aberdeen, Scotland.

Social Bonds

In the more advanced classes of animals including many if not all kinds of arthropods (segmented animals such as crustaceans and insects) as well as all vertebrates, social bonds are formed between neighbours of the same species. "Social" in this context means that their mutual relationships and behaviour are ruled by conventions. When competing with rivals for a territory, for example, the competitors typically confront each other one at a time, making threat displays, each watching for a sign of concession and retreat on the part of the other. If none is forthcoming, the bout escalates into more vigorous feints of attack; but it is seldom necessary to inflict physical injury before a decision is reached and one concedes victory to the other. Once established, their mutual difference in status is binding and usually long-lasting, thus averting further need for quarrelling. The possession and boundaries of a territory are also tacitly respected, enabling each owner to dominate over its neighbours if and when they trespass.

In species that live in small gregarious groups, on the other hand, known companions sort themselves into a linear "pecking order", once they have held conventional bouts against all the other members of their group. When feeding together, dominants are then able to displace anyone of lower rank from its feeding place without fear of retaliation; at times when food becomes scarce, the social regime can reduce the pressure on dwindling supplies by excluding individuals near the bottom of the scale from feeding at all. The social hierarchy is thus an alternative to property rights as a means of identifying and eliminating a consumer surplus. In practice, property rights and social dominance are often inextricably mixed.

In order to bring conservation into action before any harm has been done to the food producers, it seems probable that while a flock member is feeding day by day, its brain is unconsciously monitoring a variety of nutritional variables, such as the adequacy and quality of its present food intake, the effort it has to expend in obtaining this food, the pressure it feels from fellow consumers, its own general nutritional state, and the apparent condition of the food producers. Its genetic code must equip it with reference standards so that if any of these variables approach a programmed threshold the flock member automatically responds by lowering its social tolerance, and demanding more space between itself and its neighbours. If its companions react in the same way, the hierarchical guillotine comes into action and persists till the tension is relieved.

Facts About Red Grouse

This is not empty speculation. It has been shown, for example, by repeated experiments on a grouse moor, that a precise spacing faculty does actually exist. The territories that red grouse compete for in autumn and hold through the winter and spring vary in



N. Picozzi

The red grouse (Lagopus lagopus scoticus) depends on one species of heather Calluna vulgaris, for 90 per cent of its food. It cannot be an accident that the grouse seldom, if ever, increase their density, and thus their collective food consumption, so much as to harm the future productivity of the heather. By comparison, Calluna is frequently damaged by domestic sheep and by red deer.

average size from moor to moor and year to year in correlation with the varying quality and quantity of the heather, which provides these herbivorous birds with their staple diet. If all the territory-holding males, say a dozen, that occupy a small tract of moorland are removed as soon as their territorial boundaries have been finalized, and while there are still plenty of recent outcast males about, some of the latter will venture in forthwith, and contest among themselves for reoccupation of the ground a second time. The number that succeed in establishing territories is often exactly the same as it had been the first time, and seldom differs by more than one or two. This shows that all cock birds are programmed alike by the environmental cues they receive, to procure the same population density under the same nutritional conditions.³ If the critical conditions were to alter in the interval before the next year's territorial contest, grouse density on the same ground would change in response. In other experiments, broadcasting a nitrogenous fertilizer over a tract of moor raised the protein content of the heather and, in parallel, the density of grouse, as compared with an adjoining control area.⁴

The ability these birds possess to monitor and husband their staple food is most remarkable. Their social behaviour responds to nutritional feedbacks in a way that admits only a sustainable complement of residents and breeders to occupy the habitat. Mean territory size and its converse, population density, are adjusted so that the amount of food the birds consume through the winter is not enough to harm the future productivity of the heather, even though their diet is concentrated on the most valuable parts of the plant, namely the shoot-tips and buds that could later produce blossom and seed. It seems probable that the interaction between grouse and heather is not only regulated but optimized as well.

Independently, the social system ensures that the established members are birds of high quality, who have proved their superiority in a series of single matches. On average, only about one-third of the male contestants succeed in establishing territories; two-thirds become outcasts, doomed to die in the ensuing winter. The aggressiveness of cock birds is reflected in the size differ-

ences of their individual territories; and yet in the experiments where the original elite males were removed, the second-class males that took their place responded identically to the first ones in reaching the same population density. This must mean that, regardless of absolute differences in quality between the individuals, all cocks are subject to an overriding requirement to co-operate in scaling whatever differences in privilege there are among them up or down, in order to reach the right average density for current feeding conditions.

Deductions

When this "homeostatic" control of density and its practical function of husbanding the food supply are considered, one cannot fail to notice the corporate features it displays. There is of course a strong element of *selection between individuals* that is enforced by the social hierarchy, with its personal rivalries and verdicts on matters of life and death; but the overriding services the hierarchy provides are eugenic and prudential, and of great survival value to populations or common stocks as whole entities. Nothing brings this distinction out better than the facts related in the previous paragraph, where personal merit is seen to be irrelevant to the common goal of resource conservation. To account for the evolution of highly developed corporate traits like these, it appears that natural selection must have occurred between group and group, quite independently of the Darwinian form of selection between individuals.

In 1956 I started a Grouse Research Unit to study population regulation and social behaviour in a wild bird, for which funding

happened to be available because of the bird's declining numbers. The grouse proved exceptionally amenable to study, and the work has continued for over 30 years. This may perhaps explain why I seem so ready to base broad conclusions on evidence obtained from a single species. It is a well-established fact that many adaptations closely parallel to those of the red grouse exist not only in other birds, but widely in the rest of the animal kingdom. The social hierarchy, for example, has been found to exist wherever it has been looked for among vertebrates and insects, and the

The neo-Darwinian hypothesis cannot accept "for-the-good-of-the-species" traits, although they are everyday features of population ecology and social behaviour.

same is true of self-regulated populations. This justifies the assumption that the first of these devices invariably fulfils the identical function of facilitating the second, until and unless specific exceptions can be demonstrated. Similar reasoning applies to the connection between the operation of population homeostasis and the husbandry of food resources, except that this link appears likely to be present not only in the higher animals but throughout the whole animal kingdom.

Neo-Darwinian Theory is Inadequate

Of necessity, the perpetuation of life is the primary objective of all living organisms: nevertheless the living individuals of every species are themselves mortal. The function of this drastic adaptation is to generate an endless supply of new genotypes, all of them (except identical twins) different from one another. Without variation, evolution would stop, because that is what keeps natural selection at work. The flexibility of organisms to alter and adapt through time therefore depends very heavily on having a succession of generations. An individual itself does not evolve: it is the gene pools of on-going "demes" (sub-populations) and species that actually undergo change. Because this is so, traits that increase the viability of groups in their pursuit of immortality are bound in the long run to take priority over those that merely increase the self-advantage of individuals.

Neo-Darwinian evolutionists, however, hold firmly to the belief that natural selection can operate only on individual organisms, and that all the adaptations and advances which evolution has witnessed must have arisen by that process alone. This in turn implies that the changes in gene frequencies from generation to generation which produce evolutionary change must all, in the first instance, have increased the fitness of individuals. If that were the whole story, the traits one would expect to predominate would be a ruthless pursuit of self-advantage and prolific fecundity, in so far as the latter allowed more offspring to attain parenthood in their own generation.

What we find instead are prudent conservators of food supplies, and cooperators that compete with their rivals under set rules and accept the results as binding. Their regime depends on coercing individuals to behave as they do in the interests of posterity. The neo-Darwinian hypothesis cannot accept such "for-the-good-of-



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Cock pheasants fighting in territorial dispute. Males from most bird species have to compete with other males to gain possession of a territory or nest site before they become eligible to breed. Almost immediately a contest is over the winner's property rights are accepted by other birds. Habitats are thus divided into a mosaic of territories which sets a limit on the density of occupying birds for the coming season. (Photo: Manfred Danegger/ NHPA)

the-species" traits, although they are everyday features of population ecology and social behaviour. The hypothesis faces similar failings in other spheres, with regard to the random-acting cellular mechanisms of heredity, for example, and the existence in most animals of two disparate sexes.

Theoretical defects on this scale again point to the existence of a second, slower process of innovation and natural selection, with self-perpetuating groups or sub-populations as the separate units on which selection works. The theoretical conditions required to make group selection work have been well understood for many years.⁵ The two most important ones are, first, that the units should reproduce themselves for a run of generations (say 5 to 50) in almost but not quite complete isolation; and second, that the number of parents in each generation should be small, consisting of tens rather than hundreds of individuals.

One can picture each such unit as having a common gene pool, made up of the gene complements of all the parents added together. This pool is transmitted by them to their offspring, but gets scrambled in the course of sexual reproduction. A randomly different set of genotypes emerges as the new generation, although the total contents of the pool still remain much the same. Under these conditions, as models and laboratory experiments have shown, gene pools of neighbouring units randomly drift apart within a few generations, even though they may originally have been descended from common ancestors.⁶ They provide the second tier of continual new variation on which, this time, group selection can act. In a wild population, two such neighbouring units might also experience slightly different individual selection pressures, which add to the diversification. Differences between their gene pools could of course affect the relative prosperity of units, and in a run of generations one unit might produce more recruits and have a chance to expand while the other declined. The

respective gene pools would expand or contract with them. Distance between groups is assumed to be the main isolating factor, so that expanding groups would eventually subdivide, while the least fit ones declined to extinction.

The reason why neo-Darwinists reject group selection is that they assume these essential conditions are not and cannot be generally met in real life. They see two quite different obstacles standing in the way. The first is that animals and plants have powers of dispersal that would prevent a sufficient degree of isolation existing between small neighbouring units, or from persisting long enough to allow the units time to diverge genetically from one another; that is to say, there would be too much random gene flow. The second is that, even if somehow and somewhere a state of altruistic cooperation and food-related homeostasis had become established, selfish mutants would inevitably appear on the scene in the course of time; and, by exploiting the rich resources over and above the safety limit for personal advantage, their individual fitnesses would exceed those of the cooperators. In a few generations their genes would consequently multiply and take over, while the altruists' genes declined, eventually to extinction.

In the past few years both these objections have been shown to be fallacies based on misconceptions. Practical animal ecology has extended into the field of topographical structuring within populations, and again the research on the red grouse has played a prominent part.⁷ Entirely unsuspected beforehand, strict codes have been discovered that regulate matters of residence, dispersal and mating, and appear to comply closely with the conditions that group selection requires.

Topographical Structuring of Populations

Red grouse spend their whole adult lives in the same neighbourhood with a coterie of known companions which I have termed an "in-group".⁸ The heather moors on which they live often extend over many square kilometres, but an adult's personal acquaintance with other grouse may seldom reach further than one kilometre. Those it knows well by sight or voice retain their places for months at a time and probably number only between 5 and 50. For such large birds their lives are brief, even on moors that are free from shooting; and the chicks that hatch in May or June are full grown and, if they are males, ready to prospect for territories by September. That is the age at which recruits of both sexes normally leave home if they are ever going to do so; but their dispersals to their adult domicile are mostly very short, and although they can fly at more than 50 kilometres per hour the vast majority take up permanent residence within a kilometre or two of where they were hatched. Males, on average, are more stay-at-home than females, and have actually been known to displace their fathers and inherit their natal territories.

Out of 147 males that had been caught and "tabbed" when 4 to 7 months old and were afterwards shot by hunters, none had moved more than 5km; 98 per cent were found less than 1.5km from their place of marking. In contrast, out of 198 females marked and recovered in the same experiment, 16 per cent had moved between 1.5 and 10km, and 4 per cent beyond, including one bird at 32 and another at 42km; 80 per cent were still within the 1.5km range.⁹

Three conclusions can be drawn from these results. The first is that the great majority of red grouse are inhibited from forsaking their native patch, which means that gene flow is tightly restricted.

The second is that the high degree of isolation produced between neighbourhoods is nevertheless broken by a small but predictable proportion of females that emigrate. Thirdly, gene-coded programming also directs females to disperse, on average, significantly further than males, possibly to reduce the likelihood of incestuous matings.

Gene flow is a process that influences the performance of the groups between which it takes place, and it would be impossible to evolve a programmed array like this simply by selection at the individual level. What is needed is a selection between the varying dispersal patterns of different groups, on the basis of the relative prosperity and survival rates they help to produce. Breeding in-groups are relatively transient entities, notionally lasting between 5 and 50 generations, and provided they are numerically small, minor variations in dispersal patterns between group and group seem as likely to develop as any other trait.

Sex differences in average dispersal distance turn out not to be peculiar to red grouse.¹⁰ They are common though not universal among birds and mammals and occur in other classes of animals as well; and they can be biased either way with respect to sex. Since the sex difference is just a tell-tale sign of the existence of a gene flow control mechanism and not an essential element in its operation, the facts suggest that such mechanisms are still more widespread, and possibly a normal feature, at least among the higher animals. Presumably they serve to provide an optimal degree of isolation between group and group, at once sufficient to keep group selection active while permitting favoured traits to spread gradually from deme to deme, and eventually throughout the species. Plenty of evidence exists to show that local mating

groups are also artificially restricted in size, some of this evidence coming from breeding colonies with thousands of inhabitants.¹¹ Taken together these adaptations are so elaborate and so transparent of purpose that one can safely dismiss the possibility that they serve some other function.

Given that populations are structured in these various ways, selection will favour groups that are efficient in husbanding their food resources and, at the same time, in using their structure to generate group variance and keep group selection going. There can be no better insurances than these for securing the future survival of populations as a whole. The fact of being subdivided at all times into local gene pools each differing in minor respects from the rest, is likely to imply that whenever a lasting change occurs in the environment some local units will prove to be better able than others to cope with it. Group selection will enable these to increase, and replace those that have been less fortunate. Its characteristic resourcefulness makes spatial structuring an Evolutionarily Stable Strategy. Although there is much exploration still to be done especially in the lower animal phyla, it seems probable that it will turn out to be shared by the whole animal kingdom, and in some parallel form by plants and microbes as well.

Suppressing Non-Cooperators

Among living organisms, diversity between the genotypes derived from sexual reproduction is almost total. Consequently not all individuals in any one group or species are likely to be equally

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gifted in performing their cooperative duties. Within their own in-group, social and environmental selective forces will succeed in eliminating most of the less viable phenotypes from each generation; but some undesirables may turn out to be successful as social competitors. As a simple example, an individual might establish itself in a territory that was undesirably small, in the sense that though it produced enough food to last for the season, the habitat was left overtaxed at the end of it. If the owner belonged to a species with a one-year life cycle, it might suffer no penalty to its personal fitness; but the in-group's food resource would not be

*The validation of group selection
solves most if not all the
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bedeviled neo-Darwinian theory.*

fully recovered in time for the following year. One such offender might have a negligible effect on a group containing, say, 30 individuals per generation; but if half of them were equally destructive the group might face starvation before many generations had passed. When the cost to the group depends like this on the proportion of offenders in their midst, the strength of the resulting selection against the offending trait becomes "frequency-dependent". Notice that group selection could also fall in the same way on groups with members taking unnecessarily large feeding territories, and thus failing to make legitimate use of the crops available, at some cost to the reproductivity of the group.

It is important to appreciate that a nearly ideal response by individuals can be assured in local cooperative units, because units that more closely approach the optimum management will prosper better over the years than units less perfectly adjusted. Here adverse selection does not fall on the troublemakers one by one: *for better or worse, all members of the same unit share the same fate*. Unfortunately it is a shortcoming of frequency-dependent selection that, while it keeps the frequency of anti-social genotypes down to bearable levels, it does not eliminate the possibility that they will continue to emerge from the gene pool.

Group Selection Meets With No Obstacles

This automatic selection against in-groups that are "parasitized" by uncooperative types, negates the neo-Darwinists' second supposed obstacle to accepting group selection. Selfish individualists are not able to multiply faster than cooperators and thus supplant them, because they are permanently held down by frequency-dependent selection, and any increase on their part will only make the clamp-down worse. The neo-Darwinists are also wrong in thinking that cooperators make some sacrifice in fitness through their devotion to the common good; on the contrary they enjoy the highest fitnesses that the habitat can afford under optimal management, and that again qualifies as an Evolutionarily Stable Strategy.

The neo-Darwinists' first objection to group selection, it will be recalled, was that no natural system of mutually isolated population groups was known to exist on which group selection could effectively work. Both objections were hypothetical at the time they were first put forward, and later fully reviewed,¹² and both were made in ignorance of the fact that population structuring

was just then on the brink of discovery. These objections have now collapsed, and *nothing stands in the way of accepting group selection as the second, higher level of natural selection*, slower in action than individual selection and more powerful, being always able to quash the results of individual selection when they threaten group survival.

The validation of group selection solves most if not all the evolutionary puzzles that have bedeviled neo-Darwinian theory, some of them for more than 30 years, namely the genetical mechanisms in sexual reproduction that break up even the fittest genotypes, the differentiation of two complementary sexes, the rise of cooperative and other social behaviour and, most recently, of population homeostasis and structuring. It offers a far more realistic match between theory and fact than we have had before. It offends no one, and would probably have delighted Darwin, who knew that difficulties still remained in his theory. It completely alters one's assumptions about sociality, mutual cooperation and competition, and about the in-born motivations and obligations of animals and humans.

In writing a summary of such a wide subject I have had to leave out much supporting evidence and take some short cuts. It is 36 years since I first put pen to paper, working on my book *Animal Dispersion in Relation to Social Behaviour*, which raised the question of whether the individual selection process of evolution was capable of bringing about collective enterprises such as population homeostasis, and concluded it was not. But I was frustrated then by my inability to overcome the notorious obstacles that appeared to stand in group selection's way. It took another 20 years to appreciate the vital part that population structuring has played, and realize that the obstacles had been imaginary all the time.

Evolutionary theory enters into the planning and interpretation of much current research, particularly in the fields of animal ecology and behaviour. It seems deplorable therefore, to say the least, that so many researchers and teachers in these fields should continue to rely on neo-Darwinian assumptions when their logic has been shown to be false, and when the alternative principles of group selection have all been confirmed by experiment.

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The Last Big Rush for the Green Gold

The Plundering of Cameroon's Rainforests

by
Korinna Horta

The Government of Cameroon sees the country's extensive rainforests as a prime source of foreign exchange to help alleviate its economic crisis. Encouraged by the international development agencies, logging companies are rapidly cutting down the forests before possible restrictions on tropical timber imports into Western countries start to affect their markets. Local communities have not been consulted by either their own government or the aid agencies, and the customary land rights of the indigenous forest dwellers who stand to lose most from the logging have been totally ignored.

In terms of the ecological destruction and mismanagement of the world's tropical rainforests, Cameroon is on the frontline. To its north lies Nigeria, a country so severely deforested that it has become a net timber importer over the past decade.¹ To its south lies the Congo Basin, the world's third largest area of mostly undisturbed tropical moist forest covering the Congo, Gabon and Zaire.

Cameroon is often described as "Africa in miniature". In the north and extreme north extending up to Lake Chad, the country is covered by Sahelian savanna, the centre has the characteristics of high altitude moist savanna and the south is covered by dense tropical rainforest. The country's population of 11.2 million (1988) is concentrated in the north and centre of the country with about 40 per cent living in urban areas.

About one-third of Cameroon's 475,000 square kilometres is covered by one of Africa's most ancient forest blocks. These forests are home to tens of thousands of indigenous Baka and Bakola people. Aside from its human population, Cameroon's rainforests are extraordinarily rich in wildlife, including a high number of endemic species. Among the wildlife are primates and other large mammals, many of which are listed by the International Union for the

Conservation of Nature and Natural Resources as rare, endangered or threatened with extinction.² The country's biological wealth has led the World Bank and IUCN to classify Cameroon as a "megadiversity" country. This means that a high percentage of the world's biodiversity will be lost if Cameroon's biological resources are not adequately protected.³

An Economy Après Pétrole

Political power in Cameroon is vested in a single political party under President Paul Biya who holds both the office of head of state and of party chairman. The offices of prime minister and vice-president do not exist. Biya was "elected" with 98.75 per cent of the vote in 1988, down from 99.98 per cent four years earlier.⁴ Calls for the establishment of a multiparty system have met with persecution and police brutality. Although the Government has recently made conciliatory moves by repealing a 1962 law on subversion, Cameroon remains a police state where civil liberties and human rights are not respected. There is little — if any — public accountability of political power.

Like the rest of Sub-Saharan Africa, Cameroon is experiencing a deepening economic recession accompanied by mounting political unrest. Over the past five years there has been a steep fall in the price of oil, coffee and cocoa — Cam-

eroon's main export commodities. Even if oil prices should recover, Cameroon would not be able to increase its exports substantially as its known oil reserves are close to exhaustion and no new investments in the sector have taken place.⁵ Given the world's structural overproduction of coffee and cocoa, world prices for both commodities continue in the deepest of slumps. The result has been a deterioration of nearly 50 per cent in the country's terms of trade. Investments and imports decreased by 50 per cent and 40 per cent respectively and private consumption is estimated to have fallen by at least 25 per cent since 1986.⁶ As a consequence, Gross Domestic Product has been negative since 1985/86; in 1989 alone it fell by about 6.5 per cent.⁷

What has not fallen is the country's foreign debt burden of over \$4 billion. Still classified as a "lower middle income" country because of past oil revenues, Cameroon does not qualify for any of the current schemes of debt relief. The country is statistically too middle income to obtain debt relief under the Toronto terms and not middle income enough to be considered by the Brady Plan. In 1987, about 30 per cent of the country's export revenues were used for debt service; with further declining commodity prices, this percentage must be higher today.

Given its economic woes and the official disregard for the country's ecological wealth, both the Cameroonian government and a host of multi- and bilateral creditors

Korinna Horta is staff economist at the Environmental Defense Fund, 1616 P Street, NW, Washington, DC 20036, USA.

look at the country's large block of rainforest as a golden egg, a cheap way of generating foreign exchange earnings.

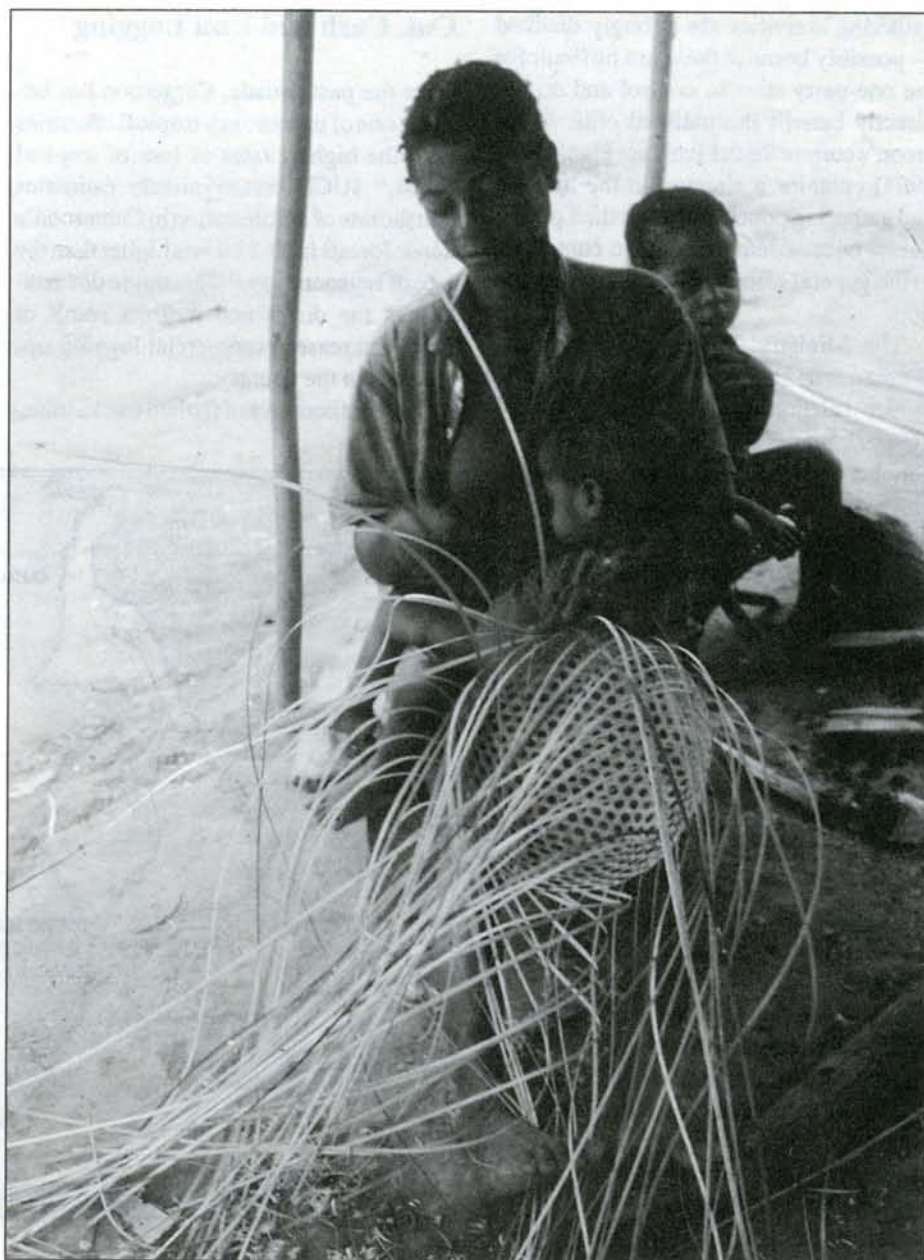
People of the Rainforest

There are few — if any — forests empty of people in Cameroon. Sometimes forest use by indigenous peoples is not evident at first glance because their way of living in and with the forest requires a high degree of mobility. Nonetheless, these forests are intermittently occupied and exploited by people whose way of life and subsistence depends on moving through the forest. Despite the fact that central Africa's rainforests — including those of south-eastern Cameroon — are sparsely populated, a larger number of people in central Africa depend directly on the forest for survival than in any other area of tropical forest in the world.⁸ This basic fact, however, is mostly ignored by the Government and the international development agencies that help design and support government policies.

Although no precise demographic studies exist, it is known that the rainforests of southern Cameroon are home to several tens of thousands of indigenous forest dwellers that European languages refer to as "Pygmies", meaning people of small stature. These hunting-and-gathering societies feel that the term Pygmy is derogatory and prefer to be called by their proper ethnic name. There are about 20,000 to 35,000 Baka people in Cameroon's south-eastern forests while the Bakola, estimated to number about 3,500, are dispersed in the coastal forests of south-west Cameroon.^{9,10}

The Baka people live as semi-nomads, spending several months wandering through the forests during the rainy season and returning to small hamlets when the dry season arrives. A symbiosis between the Baka and their sedentary Bantu neighbours has developed over many generations. Baka hamlets with their low, round thatch huts are interspersed with traditional Bantu villages. The Bantu rely on the Baka's intimate knowledge of the forest for a variety of essential products, such as bushmeat and medicinal plants. Baka medicine extracted from the forest is often the only health care available in the region.¹¹ In exchange, the Baka receive metallic objects, such as knives, an occasional piece of clothing or cultivated food.

Although some Baka have started to plant their own small gardens with plantains, maize (corn) and cassava, they re-



Korinna Horta

Basket weaving in a Baka village. The Cameroon government wants to make the 20-35,000 semi-nomadic Baka become settled farmers. The Baka can only obtain rights to the forests in which they have lived for thousands of years by converting them to agriculture and thus destroying the ecological basis of their hunter-gatherer economy.

turn deep into the forest as soon as the rainy season gets underway. The intact forests provide very well for the Baka. Their hunting and gathering activities yield a nutritional value far above what small-scale agriculturalists can expect to extract from their land.¹² The main reason may be the abundance of bushmeat that the Baka consume, ranging from small rodents to antelopes, with giant pangolins as the occasional catch of the day. Baka hunting is done by bow and arrow and by an elaborate network of snares spread out through the forest area near their overnight camp. The Baka are the experts of the forest and know how to extract resources from it without

disturbing its delicate balance. Aside from providing for the Baka's physical livelihood, the forests are essential for the social organization, culture and spiritual life of the Baka. The survival of the Baka as a people depends on the conservation of their ancestral homelands.

A Growing Stranglehold on Indigenous Peoples

The Government of Cameroon regards the country's indigenous forest dwelling peoples as backward in comparison to settled rural society. Traditional hunting and

gathering activities are strongly disliked — possibly because these are difficult for the one-party state to control and do not directly benefit the national élite. Cameroon's current Sixth Five Year Plan (1986-1991) contains a chapter on the hunting and gathering populations and their potential — once sedentarized — to contribute to the general efforts at national construction.

The Ministry for Social Affairs and Women is in charge of what is referred to as the integration of "marginal social groups", that is the Baka and Bakola peoples, into the mainstream of Cameroonian society.¹³ The goal is to lead these traditional societies to a "rational occupation of land", which probably includes paying taxes and voting for the single political party. The Baka and Bakola peoples have no opportunity to obtain legal rights to the forest lands they have inhabited for thousands of years. The law requires the "*mise en valeur*" of the forests, that is the forests must be cleared for agricultural production before legal title may be granted. At the same time, Cameroonian law establishes that populations in national parks or wildlife reserves are illegal by definition.¹⁴ The combination of these two government policies effectively denies the forest people any legal rights to the natural resource base they have depended on for thousands of years.

The Government's project for the socio-economic integration of the country's forest peoples mentions the need to reduce the exploitation of the Baka and Bakola by their Bantu neighbours. The emphasis, however, is put on the need to "disinfect" (*assainir*) the socio-economic life of the hunter-gatherers so that they can become productive members of society.¹⁵ This reflects official prejudices and reveals a complete ignorance of the social and economic benefits derived from the traditional exchange relations between the hunter-gatherers and the farmers. More gravely, efforts to sedentarize the Baka and Bakola fail to recognize the value of indigenous forest knowledge and the economic contribution of their use of forest resources on a sustainable basis.

Thus far, lack of resources has prevented the Government from pursuing its acculturation policy in an aggressive manner. At this stage, it is the pressure from commercial logging interests that represents the greatest threat to the integrity of the forest dwellers way of life.

Cut, Cash and Run Logging

Over the past decade, Cameroon has become one of the nine key tropical countries with the highest rates of loss of tropical forest.¹⁶ IUCN conservatively estimates that the rate of deforestation in Cameroon's dense forests is 10-11 times higher than the rate of regeneration.¹⁷ This tragic devastation is the direct and indirect result of vastly increased commercial logging operations in the country.

Endless convoys of flatbed trucks trans-

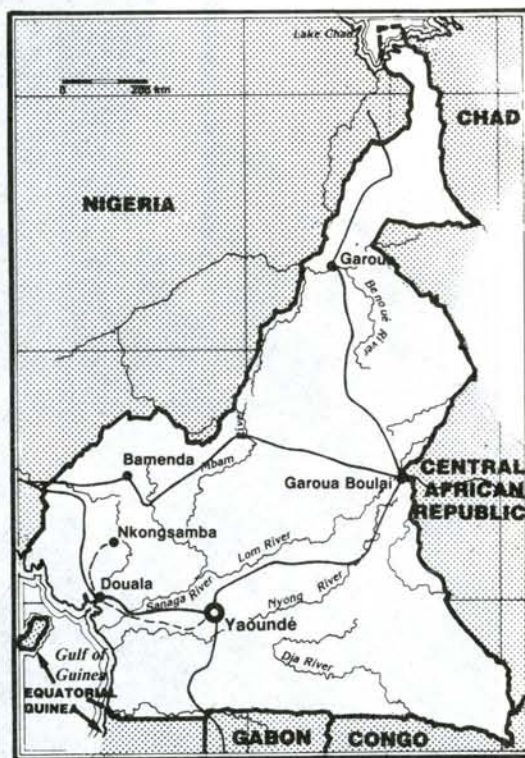


Figure 1. The Republic of Cameroon

porting large logs are a common sight on the dirt roads in southern and south-eastern Cameroon. Logs cut in the heavily exploited forests in the Yokadouma and Moloundou areas float down the river system until they reach the Congolese port city of Pointe Noire, from where they are exported. Freshly logged areas look as if they have been devastated by warfare. Although logging companies only retrieve a small number of tree species, the cutting and hauling of these trees with heavy equipment destroys everything in their path. The open access to forest lands created by logging leads to increased immigration from the centre and northern parts of the country and has already led to a massive land grab in the area of the provincial capital of Bertoua.

The logging companies are mainly French, German, Dutch and Italian. Tim-

ber exports in 1989 totalled 525,187 tonnes, of which 80 per cent were in the form of raw logs. They are often supplied by local loggers who are paid prices far below world prices.¹⁸ Government legislation and controls on logging operations in the forests are weak or non-existent. There are no legislative mechanisms or economic incentives to ensure that logging is carried out in a careful manner or to protect concessions once logging has ended.¹⁹

Logging companies fear that the emergence of the "green consumer" may eventually curtail their lucrative business. They are now bracing for an all-out rush to cut valuable timber species as long as there is still a market for it. The political upheaval in Liberia and the exhaustion of timber supplies from Côte d'Ivoire have recently increased logging companies' interest in Cameroon and the Congo basin forests in general. Timber companies are rapidly moving deeper inland, with logging areas often located hundreds of miles from the nearest seaport.

Good public relations requires timber companies to pay lip-service to "sustainable logging practices", but reality on the ground is something else. The US company Brookside Veneers, which imports Cameroonian timber through the Italian-based ALPI company, is using the services of a Chicago marketing agency to distribute information about the environmental soundness of their timber sources. It praises the progressiveness of the Cameroonian government and cites Cameroon as a leading example of harmony between industry and environmental concerns.²⁰ Another example is the German timber company, Feldmayer (HIF/TT), which boasts of its environmental awareness at home, but in Cameroon purchases about 70,000 cubic metres of round wood every year, mainly from Lebanese entrepreneurs, whose logging practices are based on the sole principle of cutting as many trees as quickly as possible.

The forests being logged are so-called "national forests" belonging to the state. In reality, these are common lands to which people living in the forests have customary rights and claims. Industrial forestry is of little importance to people who depend on the traditional contribution of the forests to their livelihood.²¹

The Bakola people in south-west Cameroon have felt the impact of the receding forest most directly. Logging concessions, sawmills and European-owned

The Tropical Forestry Action Plan for Cameroon, drawn up by FAO and UNDP, aims to expand logging dramatically. The Government is now lobbying aid agencies for the funds needed to implement the TFAP.

palm oil plantations have cut deeply into their traditional forest lands. Many Bakola appear to be part of the labour force of the French and Dutch logging concessions in the area. As they move from their traditional communities to the shacks that make up the desolate logging towns, their sense of cultural and social cohesion seems to evaporate. Alcohol consumption and prostitution become prevalent.

A similar fate is being suffered by the Baka who live in areas close to the Congo and the Central African Republic where logging companies are running extensive operations. According to knowledgeable sources, the Baka culture in those areas is being devastated.²² Njabe trees, the fruits of which provide the seeds that the Baka press into cooking oil, are becoming scarce. Now the Baka work for the logging companies and with the little income they receive buy imported cooking oil. The new settlements created by logging concessionaires face severe health and sanitation problems, unemployment and low incomes.²³

The lack of cash income in the local economy, due to the fact that the National Coffee Board has not paid the Bantu villagers for their coffee and cocoa crops over the past two years, has an immediate impact on the Baka, who have traded with their Bantu neighbours for many generations. They feel the need for items of clothing, knives and similar objects which are very difficult to obtain under current economic conditions. It is a tragic twist of fate that the logging companies are the ones most likely to fill the vacuum, at a terrible long-term cost of which the Baka are fully aware.

In areas not yet affected by logging, as along the Abong-Mbang/Lomie axis, the Baka are painfully conscious of the difficulties faced by the Baka in the logging areas further south-east. They fear for their children's future as well as their own once timber companies move into their area. Young Baka say they may have to go and



Korinna Horta

look for work in the capital. The most telling indication, the Baka say, is that the Jengi, the Baka's God, who is the spirit of the forest and essential to the initiation of young boys into manhood, has not been seen in some areas for a long time.

The International Aid Connection

The Tropical Forestry Action Plan, launched as a global initiative to stem the destruction of the world's tropical forests in the mid-1980s, revealed its major faults in the national TFAP drawn up for Cameroon by the UN Food and Agriculture Organization and the United Nations Development Program.²⁴ TFAP's line of action for Cameroon is to exploit the country's timber resources on an unprecedented scale with the goal of turning the country into Africa's largest timber exporter within the next decade. To make this timber export strategy workable, the TFAP considers it to be essential to build a 600km road to open up 14 million hectares of pristine forest in the south-east of the country. Exports are to be facilitated further by the building of a deep-water port at Grand Batanga.

Cameroon's forest-dwelling peoples are not accorded a single word in the four volume TFAP for Cameroon.²⁵ No socioeconomic surveys were undertaken and local communities affected by the proposed TFAP were never even consulted.

The Government of Cameroon is determined to implement the TFAP in order to have commercial timber exploitation play

a major role in what it calls national development.²⁶ The Government is heavily lobbying foreign aid institutions to obtain funding for the TFAP. There are unconfirmed reports that President Biya made use of his recent visit to Japan to ask the Japanese government to fund the road and port that TFAP made a centrepiece of its strategy.

The World Bank

The World Bank provided the funding for a joint FAO/World Bank forestry review which served as the base line study for the country's TFAP.²⁷ When environmentalists criticized the TFAP for Cameroon, the Bank responded by stating that it would design its own forestry project for Cameroon, independent of TFAP, thus undermining the whole idea underlying the TFAP framework — of which the World Bank is one of the co-founders — which emphasized the need for international coordination of projects affecting tropical forests.

The Bank's planned \$30 million forestry loan for Cameroon would support logging operations in some areas and promote parks and wildlife reserves in others. No socioeconomic surveys were undertaken to find out how many people live in the areas that will be opened to logging and little attention is being paid to the fact that the Government of Cameroon has a policy of expelling people from parks and reserves. Also, in spite of all evidence to the contrary, the Bank is still firmly anchored in the belief that commercial timber exploita-

tion in primary tropical forests can occur on a sustainable basis. Increased timber exports are presented as a way to benefit economic development. Having learned "green language", the Bank puts this loan under the heading "Forestry and Environment" and classifies it as a category D project, meaning that no environmental impact assessment will be required for it, in spite of the fact that production forestry will be the main component of the project.²⁸

During its pre-appraisal missions, the Bank found it very difficult to get the Government of Cameroon to agree on the conservation aspects of this loan. The Government has made it clear that it is not in a position to accept loan money at 9 or 10 per cent interest for conservation purposes. The Bank is also keenly aware that environmental organizations are sceptical of its plans for Cameroon's tropical forests and it would like to avoid blemishes on the "green image" it is trying to create for itself. This has led to the recent Bank proposal to give the Government of Cameroon a grant of \$25 million for the protection of biodiversity out of the Global Environmental Facility (GEF), a funding mechanism to be created this year within the World Bank.²⁹

While it may be a good idea to make grant money available for the conservation of tropical forests, there are serious concerns about the GEF's ability to effectively address the problem. Being located at the World Bank, the GEF will in all likelihood be subject to the Bank's rules, regulations and practice: no public access to relevant documentation and little or no consultation of communities affected by projects.

The Bank's record, combined with the

Cameroonian government's overall lack of accountability to its people, its policies on indigenous peoples and lack of concern for the devastation of the country's forests, do not bode well for a successful GEF grant. Only a more open, democratic and people-orientated process would have a chance for success. Substantial reforms would be required if the grant is to be anything but temporary balance-of-payments relief to pay off old loans and benefit the national élite.

The African Development Bank

The African Development Bank plans to finance a \$65 million forestry project in Cameroon that is being developed by FAO and probably will come straight from the list of projects that FAO put together for TFAP. The AfDB considers that "logging offers considerable possibilities since it has almost not been exploited".³⁰ In addition, the AfDB plans to spend \$130 million on road build-



Bakola hunter. The indigenous Bakola have suffered heavily from commercial activities in the forests in south-west Cameroon. Alcohol consumption and prostitution is rife among the Bakola who have settled in the logging towns and become wage labourers for the logging companies.

ing and maintenance in the country. Several of these activities will take place in the southern forests, although no concrete projects have been made public. The AfDB does not routinely conduct environmental impact assessments and has gained a repu-

Tropical Forestry Action Plan Campaign Resources

The Ecologist and the World Rainforest Movement have compiled a comprehensive 124 page dossier for activists campaigning against TFAP.

The dossier includes:

- ◆ Critical reviews of key TFAP documents and a bibliography of TFAP literature;
- ◆ Reprints of articles from *The Ecologist* and other journals on the tropical timber industry and the adverse effects of plantations;
- ◆ A paper from a World Bank consultant questioning the very notion of sustainable logging;
- ◆ An open letter to the World Bank calling for a halt to funding for projects that would entail logging of tropical forest.

The **TFAP Dossier** costs £4.50/\$9 to activists and £9/\$18 to institutions.

The second edition of the influential report, ***The Tropical Forestry Action Plan: What Progress?*** by Marcus Colchester and Larry Lohmann is available for £5/\$10 to activists and £10/\$20 to institutions.

Order both the dossier and the report and you receive a free copy of *The Greenpeace Guide to Paper*, a 56 page booklet on the environmental impact of the paper and pulp industries.

Payment by cheque or postal order to
WEC Books, Worthvale Manor,
Camelford, Cornwall, PL32 9TT, UK.
Please add £1/\$2 for p.& p.

tation for financing projects that other institutions consider too controversial.

Aside from multilateral institutions, bilateral aid agencies are also leaving their imprint on Cameroon's rainforest. Particularly notorious is the German Kreditanstalt für Wiederaufbau, which is financing major road projects in the southwestern forest areas. What appears to be a four lane highway is being built on the 115km coastal stretch between Edea and Kribi. This road passes along the immediate vicinity of two wildlife reserves which, already threatened now, will hardly be able to survive the onslaught of settlers pouring into the area once construction is completed. Ironically, these wildlife reserves represent part of the environmental component of the World Bank's planned forestry sector loan and of the GEF project for Cameroon.

The Politics of Conservation

The Cameroon example illustrates vividly what is wrong with the current approach to rainforest conservation. The principal failure consists in ignoring the reality that *conservation is a political issue for indigenous peoples and rural society in general*. Despite the constant lip service being paid to "people participation", the "natural resource management projects" in which the same old logging concessions

are re-baptized as "management concessions" are not based on the consent and active participation of the communities being affected.

In spite of all the green rhetoric, the conservation strategies of the development institutions still regard natural resource assets as commodities to be turned into cash. They count on the benevolence of private timber companies to carry out

It is surprising that the aid institutions' hard-nosed economists do not understand that the goal of timber companies is not conservation, but profit-making

logging operations in a sustainable manner, although timber exploitation in primary tropical forests has not proven to be sustainable. And this refers to sustainability in its narrowest sense, which only considers sustained timber yields as opposed to the sustainability of the ecosystem. It is rather surprising that the otherwise hard-nosed economists at multilateral development institutions do not understand that the goal of timber companies in Cameroon and elsewhere is not conservation, but profit-

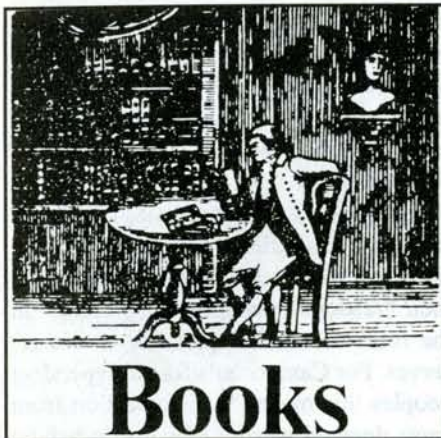
making, and that their shareholders thousands of miles away from the scenes of destruction always keep an eye on the bottom line rather than on the rights of forest-dwelling peoples or the protection of biodiversity.

In Cameroon and increasingly in other rainforest countries, multilateral institutions attach environmental components to their "resource management projects" in the form of wildlife parks or nature reserves. For Cameroon's forest-dependent peoples this means their expulsion from areas deemed worthy of wildlife habitat protection, which, like forest, are seen as sources of foreign exchange earnings because of their potential to attract eco-tourists from wealthier parts of the globe.

The not-so-hidden agenda of multilateral development institutions clearly focuses on funding projects that will generate export earnings to enable countries to stay current on foreign debt obligations, including the repayment of loans from these same institutions. Conservation projects that ignore customary land rights and fail to involve local communities in the decision-making process have little chance of success. Development projects without conservation are ultimately futile and conservation can only be successful if it is understood as a central political issue in the life of affected local communities. It involves the very basis of their subsistence, their right to land.

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Books

Electromagnetic Smog

ELECTROMAGNETIC MAN: Health and Hazard in the Electrical Environment, by Cyril Smith and Simon Best, J.M. Dent, London, 1989, £8.99 (pb), 344pp.

ELECTROPOLLUTION: How to Protect Yourself Against it, by Roger Coghill, Thorsons, Wellingborough, UK, 1990, £5.99 (pb), 192pp.

In our industrialized world, enveloped as it is in an "electromagnetic smog" generated by electrical cables and appliances and by radio, television and radar transmissions, it takes brave people to suggest that the weak electromagnetic energy upon which we are so dependent may be an insidious but major cause of ill health.

There are several difficulties inherent in attempts to "prove" that non-ionizing radiation is a health risk. However the evidence appears to be overwhelming that Nature — as Coghill repeats — has not "endowed a riskless benefit". Work in many countries has correlated radiofrequency and microwave radiation with increased risks of cancers, leukaemias and cataracts (and possibly Down's Syndrome), and power-frequency fields with miscarriage, depression, suicide, leukaemia, myalgic encephalomyelitis (ME) and "cot death" syndrome.

Best is passionate in his criticism of the authorities' reluctance to admit the possibility of a link between electromagnetic radiation and ill health. Both he and Coghill refer to the resistance of the British Central Electricity Generating Board (now the National Grid Research and Development

Centre) to reducing official permitted exposure limits and to sponsoring relevant research, and the several attempts at covering up "awkward" data.

As a physicist, Cyril Smith's exploration of the possible interactions between electromagnetic energy and biological materials includes the consideration of enzymes and membrane proteins as oscillating dielectric dipoles: living cells, because of the physical — including electrical — properties of their macromolecules and membranes, are likely to be disturbed by specific frequencies of external energy and to exhibit an all-or-nothing reaction at doses above certain thresholds.

His language is often little short of incomprehensible to anyone but a trained physicist, but one has to admire his erudition as he delves into difficult areas, admitting that not even state-of-the-art physics can explain the phenomena he courageously surveys: the influences on organisms of lunar and solar cycles; the electromagnetic connections in orthodox medicine and in alternative therapies; dowsing and ley lines; geopathic stress; holy ritual bathing prescriptions; astrology; extra-sensory perception; and the after-life. "Only when we consider living organisms at the boundaries set by physics will we see possibilities for interactions with them from beyond physics".

Coghill writes in a much less high-powered style than Smith and Best, aiming at a non-scientific audience, and his account of his own hypothesis of "cerebral morphogenetic radiation" (CMR) is eminently readable — and plausible. He maintains that the brain not only receives and sends out nerve impulses, but is also a "fully-operational radio transmission station", receiving and emitting electromagnetic radiation to maintain the body's integrity.

Coghill makes a number of recommendations for people living close to powerlines, working in front of (or anywhere near) a VDU or worried about electric fields in the home. These range from the drastic suggestion to move house if within 250 metres of 400 kilovolt powerlines (close to Smith and Best's recommended minimum safe distance of 200m), and switching off the electricity mains at night, to placing a quartz crystal on your VDU. But the book lacks addresses of suppliers of the protective devices mentioned, such as "demand switches", shielding for cables, the "Charge Card" and air ionizers; and the cat-net-like mesh for cots which he himself markets gets a very soft-sell approach.

Basic biological blunders, unfortunately, pepper Coghill's book, with wool being composed of cells, ringworm a worm, ATP an oxygen-carrier to muscles, L-dopamine a "main amino acid", triglycerides a form of sugar, and myelin containing melanin. To quote Smith and Best, however, "The ability to tolerate uncertainty is a characteristic of being adult", and it would be churlish and childish to dismiss the main thrust of *Electropollution* on this score.

Both books, in their different styles, represent the British "advance guard", in a field which may promote a revolution in the scientific and medical *Zeitgeist* in the 21st century.

Mike Adams

Mike Adams is a biology teacher in Blandford, Dorset.

A Chronicle of Courage

ASKING THE EARTH: Farms, Forestry and Survival in India, by Winin Pereira and Jeremy Seabrook, Earthscan, London, 1991, £7.95 (pb), 228pp. ISBN 1-58383-045-3.

India, at the end of the 18th century, was a largely sustainable society. Crops yielded by the land were fed back in a closed loop as compost and manure. Forests were protected as a permanent and communal asset, and forest products were harvested sustainably. There was an economical and effective education system, a well-established scientific astronomy, mathematics and medicine and a thriving and sustainable textile industry. Rural people had immense knowledge of the principles of plants as medicines, food, fertilizers, dyes, fuel, fibres and building materials, and could "read" plants at a glance. The huge range of seed types, for both rice and coarse grains, allowed seeds to be selected for every form of cultivable terrain and permitted an insurance against famine, which was virtually unknown; fields were surrounded by forest and wilderness, and crop damage was minimal. Firewood was abundant. The interdependence between soil, plant and humanity was recognized and protected. Land was treated as sacred.

The culture that changed all this and

remains in India undimmed is, by comparison with what it has replaced, simple and primitive. It depends on taxation revenues, raw materials and markets for its goods. And it can only obtain these benefits from sustainable, subsistence culture by destroying it — by cashing in the various forms of capital on which it is based and converting them into short term revenues.

Winin Pereira has described how this was done in a series of essays published in an Indian Journal, *Anusandan*, which have now been edited into a book with help from English journalist, Jeremy Seabrook. This is familiar stuff, but it demands repetition. What is not so familiar, and is more disturbing to the enlightened Western conscience, is the inclusion of appropriate technology in this indictment. Bore a well, and you provide enough water for the large farmers to grow sugar cane, but you lower the water table so that the small farmers' surface wells run dry. Give a village a grass-press, and it will sell its winter fodder and import famine.

So, we may ask, what is appropriate technology? Do we really have to accept there is no line to be drawn between that and conventional developed technology? Winin Pereira declared a plague on Western technology as a whole and went to work on farming and forestry in tribal areas which had kept faith with their own technology.

He does not describe the techniques used by the tribals in a very structured way, nor does he demonstrate that appropriate technology has no role at all. The book is a mixture of rhetoric about the multinationals, criticism of green economics, lessons in forest botany, history of the Raj and descriptions of sustainable farming systems. It is like walking into a busy Madras marketplace, with food and cloth and pesticides sold side-by-side, praised and condemned with bursts of loosely-connected rhetoric. But here is almost all I need, and who is to care if the items themselves are not neatly grouped, labelled and priced, as a tidy Western mind would prefer?

Whether sustainable technologies have any hope of wider adoption in the face of the unstoppable dismantling that goes by the name of development, is another matter. Even if this book is only a sombre chronicle of last-ditch courage, it should be read.

David Fleming

David Fleming is a business-environment consultant and Chairman of the Soil Association.

Transformation or Struggle?

GETTING TO THE 21st CENTURY: Voluntary Action and the Global Agenda, by David C. Korten, Kumarian Press, 630 Oakwood Ave., Suite 119, West Hartford, CT 06110-1529, USA, 1990, 253pp. ISBN 0-931816-85-8.

Korten, a former staff member of the Ford Foundation and former adviser to the US Agency for International Development, has written a damning critique of the development policies, ideology and infrastructure which have spread like an infection over the world in the past three or four decades.

Korten's "global agenda" is based on "people-centered development", loosely translated as a new vision which places people and their concerns at the forefront of any development solution. This is to be a people's movement not a government project, with "just, sustainable and inclusive" improvements. A feminine consciousness, based on nurturing, enabling and conserving, is to gain ascendancy over the aggressive, exploitative and competitive dimensions of male consciousness. Korten, in what now seems to be a prematurely optimistic tone, envisages a new and broadly-based commitment to democratization, begun in the late 1980s, which will overcome the petty tyrants of the world. More specifically, he advocates land reform, diversified local economies and people-controlled organizations as cornerstones of his "transformation".

However, while explicitly criticizing the economic growth ideology, Korten proposes a "system transformation as a prelude to new patterns of economic growth". Why? Why is growth that is based on more equitable premises the solution to our environmental and social woes? It seems more obvious to advocate a break from the growth ideology altogether.

Throughout the book, which sometimes too simply, identifies governments, international development organizations (big and small), and corrupt élites in the Southern countries as major perpetrators of the destructive development policies and practices, Korten largely ignores the role of multinational corporations. For example, he exposes the tragedy of countries in the South spending \$200 billion annually for military purposes — four times

the amount they receive in economic "aid". He states that "reductions in military expenditures and in the size of military forces would contribute more to sustainable human wellbeing throughout the world than would comparable increases in expenditures for development assistance." The only culprits he identifies, however, are governments (strangely his overriding concern is the armoury of Southern governments, not that of Northern governments) providing military assistance and receiving it, largely to protect their own regimes against their own people.

This conveniently hides the dirty business of the international arms traders; who answer to no-one and have no political allegiance except to their own profit. It is also multinational corporations who are manipulating governments to open Third World markets to their hazardous products, such as tobacco and dangerous pesticides and pharmaceuticals.

Korten rightly asserts that "When the state becomes supreme, there is ultimately only one real prize, the control of state power." I would add that when the market becomes supreme the sole prize is equally control of the market. However, Korten maintains a faith in business (presumably big and small) which it is difficult to share. He believes in the "essential development function" of the business sector, admittedly with some reservations, that forms the foundation for "equity-led sustainable growth".

Korten bravely defines in detail his strategy for transformation to a more equitable and just society. We are to make a substantial commitment to basic education, guarantee freedom of speech, modernize and professionalize the judiciary (and the military!), reduce restrictions on women, promote cooperatives and corporate employee ownership schemes, implement a radical redistribution of productive assets, intensify and diversify agriculture, open up rural areas with modern communication technology, and when the rural sector is in a healthy state, gradually shift priorities to expansion of urban industries. This is obviously a greatly reduced and simplified version of Korten's programme for change but it serves to illustrate a key contradiction: people-centered development is actually all about drawing people into the slightly restructured market so that they can all receive a more equal share of its benefits. Mistakenly, I had originally thought the concept was to be "people-led development", not another externally imposed global solution.

Korten is optimistic about the possibility of voluntary organizations ensuring the "beneficial transformation" of major international development agencies by forming alliances with sympathetic individuals within them. In this Korten shows a much stronger faith in the power of logical argument and persuasion than I have. How does one transform the International Monetary Fund and the World Bank, whose very existence depends on supporting a financial and trade system that is strangling the economies of Third World countries? He states that it is through the recognition of our shared plight in an overcrowded, under-resourced "spaceship" that class and unequal wealth is forgotten and power is shared willingly.

The suffragette, Teresa Billington-Greig, wrote earlier this century, "Liberty was never won by pleading, and cannot be purchased." The only time that power changes hands, she argued, is after a struggle: when those who have previously been considered non-existent establish their identity and their power.¹ David Korten, with his belief in "transformation" would presumably disagree.

Who are we to believe? Teresa Billington-Greig who supported a visible and unlawful struggle (the suffragettes' militant tactics were directed at property only) or David Korten who supports reform based on consciousness-raising and promoting mutual dependence and support. Strangely enough, I hope Korten is right. Not about "transformation" which shares some unfortunate characteristics with George Bush's "new world order" such as a global agenda for solutions to shared threats to global security, but that the transfer of power should be bloodless.

David Korten's book is a useful contribution to the environment and development debate and the recommendations for voluntary agencies, North and South, are worth reading. But when are we going to stop searching for global solutions and instead, work on opposing those who would prevent local, separate and very individual ways of life and living?

Pam Simmons

Pam Simmons works at *The Ecologist's* editorial office, liaising with environmental groups.

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1. Billington-Greig quoted in Spender, D. *Women of Ideas: And What Men Have Done to Them*, Pandora, London, 1988, p.575.

BOOKS DIGEST

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

- **TRANSPORT POLICY AND THE ENVIRONMENT: Six Case Studies**, edited by Jean-Phillipe Barde and Kenneth Button, Earthscan, 3 Endsleigh St., London (in association with the OECD), 1990, £9.95 (pb), 211pp. ISBN 1-85383-075-5.

Case studies written by economists on the environmental effects of transport policies in the USA, Germany, France, the Netherlands, Greece and Italy, with a general introduction relating the studies to the British context. The editors conclude that environmental and transport policies must be integrated so that transport decisions take account of social and environmental costs.

- **THE GREENING OF URBAN TRANSPORT: Planning for Walking and Cycling in Western Cities**, edited by Rodney Tolley, Belhaven Press, 25 Floral St., Covent Garden, London, 1990, £39.50 (hb), 309pp. ISBN 1-85293-092-6.

A comprehensive collection of 20 essays by planners and geographers showing that cities need to exclude or control strictly personal car use and encourage the "green transport modes" — walking and cycling. Includes case studies showing how pro-cycling and pedestrian policies have fared in Germany, the Netherlands, Denmark and the UK. All town planners should be made to read it and act on its recommendations.

- **THE ROUTE AHEAD: Proceedings of the WWF Conference on Road Transport and the Greenhouse Effect**, World Wide Fund for Nature UK, London, 1990, 223pp.

Participants at the conference covered many aspects of the subject including: "conventional" and "innovative" technological fixes to control vehicle emissions; trends in vehicle use and emissions worldwide; the Swedish experience with road pricing; the South California air quality management plan and the need for European cooperation on transport policy.

- **ENVIRONMENTAL POLICIES FOR CITIES IN THE 1990s**, OECD, Paris, 1990, FF 100 (pb), 91pp. ISBN 92-64-13435-2.

This report examines various urban environmental improvement policies and proposes ways and means to improve the coordination of policies which have an environmental impact on cities. The authors, in best OECD-speak, believe that "cities are not making their full potential contribution to achieving global sustainable development".

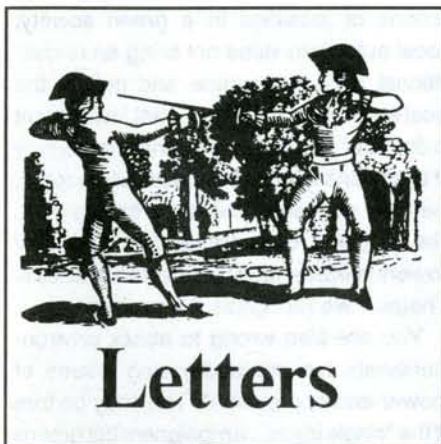
- **ALTERNATIVES TO THE AUTOMOBILE: Transport for Livable Cities**, by Marcia D. Lowe, Worldwatch Paper 98, Worldwatch Institute, Washington, DC, October 1990, \$4/£2.75, 49pp. ISBN 0-916468-99-2. Available in the UK from WEC Books, Worthyvale Manor, Camelford, Cornwall, PL32 9TT. Please add £0.50 postage.

"What would the future look like, if cities were not dominated by cars?" Lowe asks. "The heart of a city would be reserved for people on foot and passengers arriving by metro or trolley. Beyond the core, pedestrians, cyclists, trolleys and buses would share the streets equitably with slow car traffic . . . People would make most short trips by foot or bike, and longer trips by walking or biking to public transport stops. Cars would be reserved for trips for which the alternatives are inconvenient."

- **BEYOND THE PETROLEUM AGE: Designing a Solar Economy**, by Christopher Flavin and Nicholas Lenssen, Worldwatch Paper 100, December 1990, \$4/£2.75, 65pp. ISBN 1-878071-01-7. Available as above.

A thoroughly researched update of the case for renewable energy technologies. Renewables such as solar and wind power are rapidly becoming viable alternatives to fossil fuels, even on conventional economic terms. "The main danger is that new energy systems will evolve too slowly, overtaken not only by environmental problems but the social and economic upheavals that could accompany them."

Patrick McCully



The Need for Green Protectionism

Dear Sirs,
Congratulations on your GATT issue (Vol. 20, No. 6, November/December 1990). The articles provided an excellent analysis of some of the drawbacks of GATT for the Third World in particular and agriculture in general. However industry and sections of the more affluent part of the world will also be adversely affected, as we have spelt out in Earth Resources Research's latest publication, 'Green Protectionism: Halting the Four Horsemen of the Free Trade Apocalypse'.

GATT will make it more difficult for countries to maintain or implement tough environmental standards whilst protecting the competitiveness of their domestic industry. At present a government wishing to do this can establish import tariffs to offset pollution control costs, so that domestic producers will not be at a disadvantage when competing with imports from countries without similar environmental regulations. Alternatively, a country can subsidize the costs of environmental protection with general revenues by underwriting pollution control costs.

Neither of these options are likely to find favour under GATT principles which explicitly limit the right of governments to implement tariffs or use subsidies.

Perhaps the most worrying aspect of the proposed expansion of GATT's powers is the threats it could pose to international agreements for protecting the environment. The Montreal Protocol to reduce CFC emissions, for example, contains provisions for trade sanctions against states which do not comply with the Protocol. These measures have not yet been invoked, but they would conflict with GATT. Efforts to halt global warming could also be

threatened because any treaty to limit emissions of carbon dioxide could fall at the same free trade hurdle.

Yet governments, and virtually all political parties except the Greens, blindly accept that they have no choice but to bow the knee to the imperatives of international free trade. In Britain the parties and other players, such as the trades unions, seek to delude themselves that they can find adequate shelter from the chill winds of unfettered free trade. Well-thumbed straws are clutched at, such as pumping massive amounts of government money into education, training and R&D so that somehow we will miraculously "compete with" the likes of Japan, Germany, Taiwan and Korea. There will be an orgy of free market sales and consumption where every participating country fondly imagines that they will do well.

The growth of free trade has been, and will continue to be a disaster for most communities and the environment. Its mythical foundations have to be attacked and its appalling effects made apparent. Instead new policies of "green protectionism" must emerge, which favour local, national and regional approaches, which reduce free trade and which bolster regional self-reliance in food, services and industrial goods, to be produced with minimal environmental degradation.

Trade should be balanced as far as possible by limiting imports to a rough equality with expected exports. The basic aim would be to only import what materials are not available in the region, or whichever goods and services it is not possible to provide locally. Tariffs would be introduced to protect endangered industries from further erosion and allow them to begin to recover lost ground. They would also encourage new enterprise in areas where a country has become dependent on imports. With the assurance that these industries can have a secure future, provided they can compete successfully with local rivals and are hence profitable, local capital should flow to them.

At first these ideas might seem like some hopeless amalgam of old ecology party tracts fused with Labour's now discarded "Alternative Economic Strategy". Such a policy could gather a growing number of supporters however. These could include those businesses already seeking trade protection; the Labour Movement once it realizes that free trade will continue to destroy it; and lastly those individuals and organizations of all political persuasions who are concerned about the environment,

recognize the virtues of thrift and self-reliance and who want to keep power locally based.

At present many of these people are becoming increasingly uneasy about the effects of free trade, even if they have not yet identified it as the culprit. Their approach is often best summed up as "Lord give me free trade, but not yet." They need to be shown the way out.

Many will say that such a policy will lead to trade wars, followed by a 1930s style depression. But under a new self-sufficient, environmentally-led economic system, countries will not be beggaring each other because the only game in their mental town is more trade. They will have a self-reliant future to work towards.

Three things will make a more self-reliant future inevitable. Firstly, more and more people in Scotland, Wales, the North of England and the rest of the fringes of Western Europe, and in economically disadvantaged regions elsewhere, are aware that sufficient full-time, secure, adequately paid jobs are never going to return to their regions under the present system. Secondly, the kind of world production binge fantasized by the free marketeers, post-GATT and Europe 1992, is environmentally unsustainable in a world increasingly conscious of global warming and other major environmental problems.

However, the third and most critical factor is likely to result from the mounting chaos, misery and upheavals which will continue to emerge from Eastern Europe. The majority of the hapless populace will realize they have thrown off their communist yoke only to be subjected to the chill, unforgiving winds of a free trade system that impoverishes rather than enriches the majority. Their reaction will hopefully lead to a fundamental reappraisal of this unquestioning adherence to free trade.

Yours faithfully,

Colin Hines

Earth Resources Research
258 Pentonville Road
London N1 9JY

* Available from the above address for £5.

Power to the People?

Dear Sirs,

The 'Liberation Ecology' proclaimed in the editorial of your January/February issue (Vol. 21, No. 1, 1991) has an attractive ring to it yet the arguments put forward in its favour are suspect.

Your enthusiasm for what you call "the People" parallels that of the Russian radicals who, in the last century, placed their hopes of salvation in the simple goodness and revolutionary potential of the peasantry. They were rather disappointed. More recently, Regis Debray and other radicals in the 1960s thought that the poverty-stricken masses of the Third World could be the basis of a movement that would encircle the heartlands of Imperialism. Again, the People let them down.

The concept of the People is in fact no more use than that of the Proletariat as a tool for understanding society and devising strategies to change it. Indeed this kind of sociology which divides society into big homogeneous blocks has much in common with Newtonian physics, assuming

that there are direct and predictable links between existence, consciousness and behaviour. By contrast, all great changes in history have tended to split society, including individual families, down the middle. Perhaps the only predictable thing is that radical leaders have tended to come from outside the ranks of the most oppressed and exploited. *The Ecologist* editorial board is not exactly composed of horny-handed sons of toil (let alone any daughters). We should of course think carefully about who are potential allies as well as enemies of our cause. We should aim carefully tailored propaganda at specific audiences, a task not helped by sweeping generalizations.

This is not the only problem with your perspective. For all kinds of reasons, many ordinary people oppose our goals. Sometimes it is economic desperation, sometimes ignorance, sometimes greed. There are popular majorities for politicians whose actions (and inaction) have helped create environmental destruction.

There are also plenty of examples of how the empowerment of the People which you demand has, in isolation, led to detrimental changes in the environment. The mass trespasses of the 1930s in Britain and the subsequent gains in public access to the moorlands have led to serious environmental degradation in many places. The erosion on the Lyke Wake Walk in the North York Moors, for example, is such that it can be picked out on satellite photographs. The disastrous pollution of the Mediterranean and the encasement of much of its coastline in concrete hotels is in part the product of increased income and more leisure for the mass of the European People. Again, the point is not to regret the passing of the inequalities of yesterday, rather it is to spotlight the inadequacy of an analysis which blames everything purely on the "market" or on the machinations of hoteliers and travel agents. There are countless other examples.

There is indeed a case for a radical break-up of big political and economic power structures but on somewhat different grounds and dependent upon certain conditions. Perhaps the most important case for the devolution of decision-making downwards is that it may permit a greater fusion of costs and benefits in the same place and time. Today's system encourages irresponsibility precisely because the bill for bad decisions is picked up by people in other countries and other generations and by other species.

In any case, the wider community would always retain certain rights regarding the

actions of localities in a green society. Local autonomy does not bring an unconditional right to degrade and pollute the local environment if that is what locals want to do. Your position implies that if a majority of Brazilians want to burn down Amazonia, then we outsiders just have to accept it. The blending of supranational and local powers is easier said than done but at least it helps if we recognize the problem.

You are also wrong to attack environmentalists for not addressing issues of "power and oppression". This may be true of the "single issue" campaigners but greens of a darker hue have long realized their importance. Take, for example, Sir Frank Fraser Darling, whose famous Reith Lectures were attacked by conventional radicals as "elitist". His writings in the middle decades of the century addressed directly the land issue and the evils of absentee landlordism. In one of the first books of the environmental wave of the early 1970s, *How to be a Survivor*, Paul Ehrlich (another victim of the elitism tag) and Richard Harriman demanded that every human being have an equal right to self-fulfilment and called for a redistribution of resources from the rich to the poor. Finally, the roots of "disempowerment" have been analyzed by ecological thinkers, most notably by Nicholas Georgescu-Roegen. We too question your view not out of elitism but from a concern that social change will only take place if Greens start from a more sober and accurate assessment of reality.

The real danger is not that Greens ignore the social dimension but that social concerns are used to put the environment on the back burner. A truly ecological approach is one which starts outwards at the level of the ecosphere and specific ecosystems, taking their tolerances, rhythms and capacities (including the rightful claims of non-human life forms) as the guides to the right size and structure of human society. It is about devising social systems that maintain ecological integrity and productivity, not just the minimizing of certain side-effects of environmental abuse for the sake of yet greater human consumption in the future.

"Liberation Ecology" might make *The Ecologist* more popular in many quarters but it would be a victory won by avoiding not winning the arguments that really matter.

Best wishes,
Sandy Irvine and Alec Ponton
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ENVIRONMENTAL ASSESSMENT AND MANAGEMENT IN AGRICULTURAL DEVELOPMENT. 1-12/19 July 1991. Further details from University of London/Wye College, Agrarian Development Unit, Wye, Ashford, Kent, UK TN25 5AH. Tel: 0233 812401.

Second European NGO Network Meeting on GENETIC RESOURCES AND BIOTECHNOLOGY. 27-30 June 1991 at Barcelona. Information from Grain, Apartado 23398, E-08080 Barcelona, Spain. (Fax 34 3 302 21 18).

A SELF BUILDERS GUIDE TO LOW ENERGY AND ECOLOGICAL HOMES. Courses on 19 and 20 October 1991 in East London. Contact Simon Clark, 58a (Basement flat), Arbour Square, London E1 0PS. Tel: 071 790 8548.

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ENERGY MANAGEMENT. An advanced short course held from 2-3 July 1991 at Downing College, Cambridge, UK. Further information from Pam Whitfield, Dept of Engineering, University of Cambridge, Trumpington St, Cambridge CB2 1PZ, UK. Tel: 0223 332722. Fax 0223 332662.

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