The Ecologist

Journal of the Post Industrial Age Vol.13 No. 1983 £2

MAN AND NATURE
A Hindu View

including:

Brian Martin, **The Naked Experts.**

Vandana Shiva and others, **Social Forestry—No Solution within the Market.**

Jeanette Fitzsimons, **Beyond Logic—The Real Reasons for Synthetic Fuels.**

Rafal Serafin, **The Greening of Poland.**

including:

S. Epstein and J. Swartz, **Fallacies of Life-Style Cancer Theories.**

F. Terrasson and G. Tendron, **The Case for Hedgerows.**

Glenn Alcalay, **A Tale of Two Islands: Bikini and Enewetak.**

Edward Goldsmith, **Superscience: its mythology and legitimisation.**

including:

Val Plumwood and Richard Routley, **World Rainforest Destruction—The Social Factors**

Carl H. Moneyhon, **The Environmental Crisis and American Politics 1860-1920.**

Denys Trussell, **History in an Antipodean Garden.**

including:

Nicholas Hildyard, **Can We Trust Scientists.**

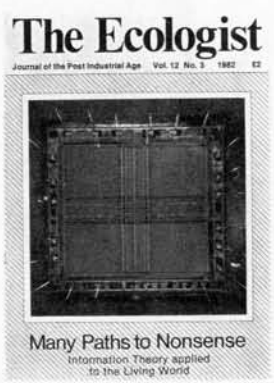
Robert Sinsheimer, **The Presumptions of Science.**

Donald H. Hughes, **Early Greek and Roman Environmentalists.**

Nigel Pollard, **The Gezira Scheme: A Study in Failure.**

Brian Martin, **The Scientific Straitjacket.**

Alan Grainger, **The Battle of Terania Creek.**



including:

Walter J. Lusigi, **New Approaches to Wildlife Conservation in Kenya.**

Edward Goldsmith, **Many Paths to Nonsense: Information Theory applied to the Living World.**

Des Wilson, **Lead—A Clear-cut Issue?**

Nigel Pollard, **The Kibbutz—An Ideal Society?**

including:

Nicholas Hildyard, **Expediency rules O.K.?**

J. Donald Hughes and J.V. Thirgood, **Deforestation in Ancient Greece and Rome: A Cause for Collapse?**

Edward Goldsmith, **Traditional Agriculture in Sri Lanka.**

Yann Brekilien, **The Real Regions of France.**

The Ecologist
Journal of the Post Industrial Age

Published by: Ecosystems Ltd., Edward Goldsmith

Editors: Edward Goldsmith, Nicholas Hildyard, Peter Bunyard. Managing Editor: Maria Parsons.
Associate Editors: Robert Prescott-Allen, Brian Johnson, Bernard Gilbert, Jimo Omo-Fadaka, Andrew Mackillop, Robert Waller, Lawrence Hills, John Papworth, Nicholas Gould, Raymond Dasmann, Richard Wilson, John Milton (USA), Henryk Skolimowski (USA), Manfred Siebker, Sigmund Kvaloy (Norway), Wouter Van Dieren (Holland).

Editorial Department: Whitehay, Withiel, Bodmin, Cornwall, UK. Tel: Lanivet (020883) 237.

Annual Subscriptions:

Ordinary Rate: £12.50 (US $28,00) (Students £11.50)
Institutional Rate (excluding schools): £18.00 (US $36.00)
Airmail Rate: £6.00 (US $12.00) extra
Special Rates for Members of the Ecology Party: £11.50

Subscriptions are payable to The Ecologist and sent to:
The Ecologist, Subscription Department, Worthyvale Manor Farm, Camelford, Cornwall PL32 9TT. UK. Tel: (0840) 212711

The Ecologist Bankers: National Westminster Bank Ltd.,
26 Molesworth Street,
Wadebridge, Cornwall. UK.

Advertisements:

Display Rates: Full page (261x185mm) £150.
Half page (131x185mm) £80
Third page (131x121mm or 261x58mm) £50
Quarter page (131x121mm) £40
Sixth page (131x58mm) £30

Inserts: Up to 261x185mm and not more than 10g £12 per thousand.

Enquiries to: The Ecologist, Advertisement Department, Worthyvale Manor Farm, Camelford, Cornwall PL32 9TT. UK. Tel: (0840) 212711.

Contributions:

The editor welcomes contributions, which should be typed, double spaced, on one side of the paper only, and with generous margins. Contributions should be accompanied by black and white photographs, line drawings, and tables where appropriate.

While every care is taken with manuscripts submitted for publication, the Editors cannot guarantee to return those not accepted. Articles published in the Ecologist do not necessarily express the views of the Editors.

The Ecologist's International Serial Number is ISSN 0261-3131.

Printed by: Penwell Ltd., Parkwood, Dupath, Callington, Cornwall. UK.

The
Ecologist

Vol. 13 No. 4 1983

Editorial

Feature Articles

Interview

Cover Layout: Steve Womersley

Cover Picture: Wooden Shield featuring Surya, the sun god. Horniman Museum.

Global 2000-Revisited

Detroit may hardly be first choice among American cities for a visit, but in May that is where we went for the Annual Meeting of the American Association for the Advancement of Science (AAAS). I have little idea what Detroit was like before the Black riots of the 1960s devastated the down-town area, but today the city centre still looks as if it had been blitzed. The wind whistles over empty, rubble strewn spaces where buildings had once stood, and many of those that still stand are semi-derelict with shattered windows and barred doors. Down-town Detroit is 90 per cent Black, unemployment is rife, and conditions are manifestly grim.

Detroit nonetheless has been striving hard to inject life back into the centre, and as has happened consistently elsewhere in the world has handed over the task to the developer and planners. Their solution, grandiloquently named the Renaissance Center, rises like a gigantic, glassplated citadel on the waterfront overlooking Canada. What such a building has to do with the city's problems and the Blacks is hard to imagine; indeed one has more than a suspicion that the millions of dollars sunk in that complex of towers is an opportunity purposefully blown, leaving the city essentially divided between the richer business community and the unemployed.

Why so much on the Renaissance Center? In fact we spent five long days there attending the AAAS Symposia, and still at the end of that time doubtful whether we had really mastered the layout of the place. Six towers, four of them 39 storeys high and two somewhat shorter, symmetrically surround the 73-storey tall Westin Hotel. Inside, the architect has let his futuristic ideas run riot. Walkways, stairs, interconnections, columns with streaming water, hanging shrubs, a rotating cafe, auditoria, shops, restaurants, together with the hotel rooms, set out to make a world of its own, aloof and seemingly disconnected from everything that goes on outside. In fact, Detroit's reputation for violence and the highest murder rate of all US cities, was enough to persuade some of the more timorous guests that they were safer inside the encased space of the Center than out, and as far as I could tell they never ventured forth from the building until safely in a cab on the way to the airport. As to finding the streets outside that was altogether another matter: the sheer, stultifying symmetry of the complex kept many of us going around in confused circles looking for a way out, or even for a toilet. I have never before seen a building which required such an army of people to direct the baffled visitor.

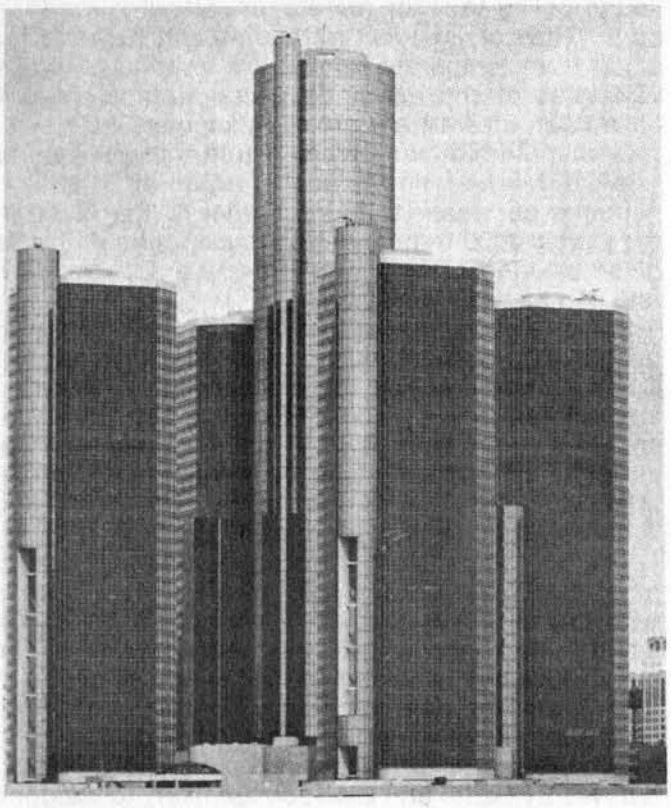
How apt that Hermann Kahn and his think-tank colleagues from the Hudson Institute and other institutions should have held their session on 'Global-2000 revised' in the environment of the Renaissance Center. For it is such a building, with all its spurious orderliness, that surely captures best the kind of world which Kahn believed would be the salvation of mankind; a world where nature was subjugated to man and to his purely materialistic notions. Kahn has since died, having failed to live out his hope that he would see his predictions for the year 2000 prove right, and with his death goes a man who more than anyone else spoke for the logic of technological development as a vital step in the creation of an artefact-laden, orderly world in which the major obstacle facing mankind would be no more than boredom and anomie, such problems a result not of failure, but of total success in man's conquest of the earth.

"The one way street of logic to the slum of Materialism"

In *The Next 200 Years,* Kahn argues that automation and materialistic affluence widespread throughout the world will lead to mankind indulging for much of his time in pleasure-seeking quaternary activities.

"The transition to a society principally engaged in quaternary activities—a transition likely to be well under way in the next century—will mark the third great watershed of human history," states Kahn. "Future ages will undoubtedly look back at what happened in these four centuries (the industrial revolution till two centuries hence) of economic development and technological advancement as mankind's most effective and pervasive transformation—from a world basically inhospitable to its few dwellers to one fully commanded by its expanded multitudes.

"Of course there will be problems. Some of them are likely to be: wishful thinking, illusion, decadence, educated incapacity and a kind of violence-prone boredom . . . we believe that at least for a time most people would generally enjoy this post-industrial society, but there would be many who would not. For them it would simply not be exciting and challenging enough; indeed it might be rather boring for many ambitious, advancement and achievement orientated people (though there will be fewer such people). We rather suspect that space will be a major focus for many of these people—as a locus of dynamism, initiative and entrepreneur-



The Renaissance Center

ship—and that the existence of such a frontier will be very healthy for the quaternary society that is developing on earth."

I must admit I wholeheartedly agree with Kahn's prognosis of the intellectual barrenness that would be the lot of human beings in a world in which they had no other role to play than to reap the bounties fed to them by self-perpetuating wholly automated machines. But the real question is whether we are really heading for Kahn's world of artefacts and of total self-indulgence, or whether that world is just a dangerous illusion, whose pursuit will ultimately destroy us by annihilating those biological systems that support our precarious hold on the planet.

Indeed Kahn's message strikes a false note of optimism by giving credence to the notion that technological innovation, combined with the capitalistic venture, is winning the battle against the environmental ills that assail mankind. His message is that governments must remain undeterred in their striving to develop their countries, despite seeming setbacks, and that they must ignore the Luddite cries of the environmentalists.

Not surprisingly, Kahn and his colleagues reacted bitterly to the publication of *The Global 2000 Report to the President,* coming as it did hard on the heels of *The Next 200 Years.* Furthermore, President Carter, unlike his successor Reagan, accepted the Report's findings and for the short time left to him in his presidential position, set in motion a series of high level diplomatic activity to get the message through to the rest of the world. For a report commissioned by a president it was remarkably forthright in its conclusion, stating that: "If present trends continue, the world in 2000 will be more crowded, more polluted, less stable ecologically, and more vulnerable to disruption than the world we live in now. Serious stresses involving population resources, and environment are clearly visible ahead. Despite greater material output, the world's people will be poorer in many ways than they are today."

The contributors to the Report analysed in detail the major elements behind man's impact on his environment: population growth and expectations with regard to standard of living and income; food resources; forests; water; non-fuel minerals and energy. The catalogue of disastrous trends is hardly new to *Ecologist* readers; indeed such trends are basically accepted as evidence that the anarchic drift of nation states away from traditional practices to industrialisation and development will have to cease if humanity is to have a future. Under the heading 'Entering the 21st Century', the Report states many unpalatable conclusions.

The following quotes may give a taste of them: "For every two persons on the earth in 1975 there will be three in 2000. The number of poor will have increased. Four fifths of the world's population will live in less developed countries. Furthermore in terms of persons per year added to the world, population growth will be 40 per cent *higher* in 2000 than in 1975 . . . There will be fewer resources to go round. While on a worldwide average there was about four-tenths of a hectare of arable land per person in 1975, there will be only about one-quarter hectare per person in 2000. By 2000 nearly 1000 billion barrels of the world's original petroleum resource of approximately 2,000 billion barrels will have been consumed . . . Over the same period (1975-2000) per capita water supplies will decline by 35 per cent because of greater population alone . . . The world's per capita growing stock of wood is projected to be 47 per cent lower in 2000 than in 1978."

The report also concludes that "The environment will have lost important life-supporting capabilities. By 2000, 40 per cent of the forests still remaining in the less developed countries will have been razed. The atmospheric concentration will be nearly one-third higher than pre-industrial levels. Soil erosion will have removed, on average, several inches from croplands all over the world. Desertification (including salinization) may have claimed a significant fraction of the world's rangeland and cropland. Over little more than two decades, 15 to 20 per cent of the earth's total species of plants and animals will have become extinct—a loss of at least 500,000 species."

Kahn's Counterblast

It is rare to hear such unequivocal statements coming from within the establishment, and actually getting into print—it would be inconceivable in Britain. In effect *Global-2000 Revised*, the title of the AAAS symposium, was Kahn's retaliation, in which he and his own experts attempted to refute every allegation of the original Global-2000 Report. For instance, Julian Simon, Kahn's right hand man from the University of Illinois, claimed that all the horrifying stories of environmental degradation in Global-2000 were little more than Grimm fairy tales conjured up by unscrupulous advisers for political gain.

The first part of the attack on the President's Report was to discredit those who had actually compiled it. They are accused by Steve Hanke of 'scientism', which according to him is none other than the "slavish imitation of the method and

language of the physical and biological sciences to the study of social phenomena which involve human action". Hence, in first stating that it is nigh impossible to make accurate forecasts on the future availability of fresh water for human use, the Global-2000 team has no right, according to Hanke, to make unequivocal statements about likely future shortages, and their implications. If we follow Hanke's logic through, it would have been more honest and abundantly more scientific of the Global-2000 team to have admitted their lack of precise facts and in the face of ignorance to have declared that inaction was the correct strategy.

Instead, Global-2000 were rash enough to provide a warning, based on present-day experience, that present policies of water use would be likely to lead to rates of discharge beyond the earth's capacity to replenish itself.

But what could be more scientistic than Hanke's notion that science and data-collecting must underlie any action? We have seen too many instances in the toxicological field in particular, where chemicals have been licensed for use as pharmacological agents and food additives after apparently exhaustive tests, only to have it discovered later that they are associated with teratogenic and carcinogenic effects. For a vivid account of the kind of deception that has gone on in the name of Science I recommend the new edition of Nicholas Hildyard's *Cover-Up* (New English Library 1983). Common sense tells us that we can never be sure that we know enough about the environment to come to an absolute judgement, nevertheless the perceptive person can tell whether a situation is deteriorating, and given certain trends is likely only to get worse. Whose opinion would one be more likely to trust? That of the man who has spent much of his working life in the fields and has seen deserts spread under his feet, as Richard St Barbe Baker described so graphically, who has seen boreholes dry up, who has seen water and soil become salinized and polluted with pesticides and nitrates, who has watched tropical forests being razed and seen the consequences of erosion and laterization? Or the likes of the armchair sociologist? Indeed all Hanke achieves with his erudite carping is a further demonstration that the scientific method is wholly inadequate as a method of appraisal when used to deal with the complexity of the planet's workings.

In reading through the various documents of the 'Revisited' team, I get the distinct impression that the world those experts see in front of them is an extrapolation of the United States and bears little reality with anything beyond. Despite the all-encompassing title 'Global Forests', Roger Sedjo and Marion Clawson of Resources for the Future discuss in detail the history of North American forests. Their claim, based I am sure on reasonably accurate data, is that North American forests are now more extensive than they were fifty years ago and that the annual average growth rate is three and a half times higher than it was in 1920. Anyone can see for himself the self-regeneration of forest that has taken place, for example, on the abandoned farms of New England.

The point Sedjo and his colleague are trying to make is that every country which is undergoing development will in all probability cut down large areas of forest, but once developed will establish a sound policy towards forestation, allowing regeneration. They claim too that supply and demand for wood from temperate forests are in balance, while estimates of the extent to which tropical forests have been cleared are grossly exaggerated. Hence they dispute Norman Myers' figure that the rate of tropical deforestation is in the region of 20 million hectares per year—a figure similar to that used in the Global-2000 Report—and instead uphold figures given by J.P. Lanley which indicate a deforestation rate of 11.3 million hectares.

Lanley's results are in the words of Sedjo 'empirically derived', while those more alarmist in character are referred to as 'anecdotal'. Unfortunately the anecdotal accounts, with supporting data, are voluminous enough to fill a library, and we have certainly carried our share of articles on deforestation, including an entire issue (*The Ecologist,* Jan/Feb 1980) on tropical forests. We know that Sri Lanka was 45 per cent forested in 1960 and has no more than 5 per cent of its land area forested now, with one officially preserved area of 20,000 acres; while India which was 60 per cent forested in the early 1900s has been almost entirely shorn of its forests. Moreover, governments, which are the source of official statistics on the forests in their land, and which are the main source of the empirical data so beloved by Sedjo and Clawson are likely to exaggerate the areas still forested. Indeed the Philippines government claimed that forests covered nearly 60 per cent of the land area, until a LANDSAT satellite indicated that a truer figure was closer to 38 per cent. Official government figures from India also indicate large areas of forest, on scrutiny however, such areas are often treeless. When criticised for its bogus trees, the official rejoinder is that such forests are temporarily unstocked.

According to Gloal-2000 Revisited each and every of the environmental threats delineated in the Global-2000 Report are either exaggerations or they can be easily circumvented. If acid rain is destroying lakes and forests in temperate countries the answer lies in nuclear power; if soil erosion is occurring in the United States—and according to Earl Swanson of the University of Illinois the rate of erosion is within acceptable limits—then its effects can be countered through the use of agrochemicals. Swanson also states that the costs to the farmer of soil conservation do not justify the returns—not unless one takes a long term view over the next 100 years.

As for food production in the world, D. Gale Johnson of the University of Chicago, sees no essential problems in meeting future demands and in the food getting to people. "In the past three decades," he states, "a world food system has been created. This system is now capable of making food available to almost every person in the world. This was impossible just a few years ago."

In essence Gale Johnson sees the future of food production and of supply as part of a gigantic world market system with food products being shipped from one part of the globe to another, like any other manufactured product. The notion is that everyone must somehow be incorporated into the market economy, with competition and technological innovations acting together to keep down prices. (That attitude is, moreover, the official one of Governments, and of International Agencies,

including FAO and the World Bank.)

Urbanisation is therefore a healthy trend, in Johnson's mind the supposition being that the logistics of feeding a captive population within the city is simpler than attempting to distribute food in a drought stricken area. The land, meanwhile, will be occupied by a bare minimum of productive farmers each of whom will be utilising modern labour-saving equipment and agrochemicals, to produce the world's food.

Gale Johnson is to a large extent correct. People are flooding into the cities; farmers are turning to cash crops and to the methods that go with such monoculture; food aid is keeping people alive in Africa. But what he does not describe is the degree of destruction that goes on universally as a consequence of such trends. Indeed, the growing poverty of the world's soils, the increasing degree of pollution, the misery brought about through malnutrition and disease, the horrific overcrowding in cities such as Mexico City, as well as the plethora of wars, are all the result of developmental processes.

In the end there is little or no meeting point between the two sides—the authors of *The Global-2000 Report* and those of *Global-2000 Revised.* In fact their world view points are diametrically opposed, the one seeing the trends as potentially disastrous and the other as potentially beneficial. The world of Kahn is one of economics, of marketability, of returns on investment; in his opinion the time having passed for any other kind of system.

Wealth to him is income that can be spent on material goods and pleasure-seeking activities, it has nothing to do with the richness of traditions and cultures that have developed slowly over generations. If people with traditional values have failed, like the nomads of Sahelia or of East Africa, the fault lies in them, and they are blamed for their greed in trying to build up herds of cattle beyond the carrying capacity of the land. There appears to be little appreciation that the forces that are destroying them and other traditional peoples, and are bringing upon them widespread misery and famine, have been unleashed through the process of development.

Kahn's logic for the future development of mankind is a ruthless, simplistic one, replete with technical fixes; furthermore his world of the future, as described in *The Next 200 Years*, is a wholly unappealing, barren place of human artefacts. Kahn would have us believe that current trends are taking us to that world, and his message and that of his associates is one of reassurance to those bent on industrialisation and development. *Global 2000 Revised* is therefore a pernicious piece of work in that it is a recipe for the present laissez-faire attitude towards the Global environment. One heartening aspect was to hear the ridicule poured upon it by scientists, agronomists and anthropologists attending other symposia at the Detroit meeting. But then, why listen to them: they had no other credentials than that they had been actually working in the field.

Peter Bunyard

The First Principle of Human Ecology

It is the general view of Britain's politicians that environmental conservation is the concern of the rich. Only the rich, they argue, can afford to worry about the beauty of the countryside and the preservation of our agricultural land and remaining woodlands. The poor, by contrast, have other more serious preoccupations—jobs for instance.

Lord Zuckerman, who was once chief scientist to the British Government, goes along with our politicians. He constantly talks of a trade-off between environmental conservation and the achievement of such social goals as full employment. It is astonishing that serious people can actually believe that such a trade-off exists—that people's welfare can in fact be promoted by systematically devastating the environment in which they must live and from which they must derive their livelihood.

On the contrary, it must be the first principle of Human Ecology that man's welfare must ultimately depend on the preservation of his natural environment.

I think this is clear if we look at the conditions of the poorest people in the world today—the inhabitants, for example, of the drought-prone areas of such tropical countries as India and Bangladesh. Thus, we find people in certain parts of Bihar who have an income that in many cases does not exceed £9 or £10 a year. They rarely, if ever, have enough to eat and are affected by all sorts of very unpleasant parasitic diseases. It is clear that such people are poor not so much because they are short of manufactured goods but because they suffer from malnutrition and chronic ill-health. It is also clear that this malnutrition and chronic ill-health are closely related to the state of their environment.

If one examines their environment, one finds to begin with that it is relatively treeless. The reason is that the trees have been removed—usually by Government contractors. Now, deforestation in the dry tropics has the most serious possible consequences. Once the trees have gone the rivers are transformed into torrents, the streams dry up and the soil blows away with the wind or is washed away with the annual monsoons. In some cases, where the soil is lateritic, the earth is transformed into hard, brick-like 'pan' on which nothing can grow. Once such a situation is allowed to arise, the impact of man's activities on what has now become a highly degraded environment can only lead to its further degradation. The inhabitants of such areas are thereby condemned to increasing poverty until they eventually die off from disease and malnutrition.

How deforestation has led to this horrible state of affairs was eloquently described by Washburn Hopkins eighty years ago:

> "All that great bare belt of country which now stretches south of the Ganges—that vast waste where drought seems to be perennial and famine is as much at home as is Civa in a graveyard—was once an almost impenetrable wood.

Luxuriant growth filled; self-irrigated, it kept the fruit of the summer's rain till winter, while the light winter rains were treasured there in turn till the June monsoon came again. Even as late as the epic period, it was a hero's derring-do to wander through that forest-world south of the Nerbudda, which at that time was a great inexhaustible river, its springs conserved by the forest. Now the forest is gone, the hills are bare, the valley is unprotected, and the Nerbudda dries up like a brook, while starved cattle lie down to die on the parched clay that should be a river's bed." (*India Old and New,* E. Washburn Hopkins).

People living in the industrial world have no idea of the extent of this degradation and of the poverty it gives rise to. In that magnificent book *The State of India's Environment,* published in 1982 by the Centre for Science and Environment, we are told how "India is rapidly becoming a vast wasteland"; how over half of the land in that country is now subject to "serious environmental degradation"; and how seventy per cent of the available water is polluted to the extent that 73 million working days are lost each year to water-related diseases. It is now generally accepted among those who study these issues in India—and I am told that it is accepted by the government too—that 20 per cent of the population, that is to say 140 million people, are condemned to die of starvation regardless of anything the government might do. Nor can the situation be much better in many other hot and arid countries such as Bangladesh and even Egypt.

That the poverty of the inhabitants of such areas is due to environmental disruption becomes clearer still if one compares their lot with that of the inhabitants of areas whose environment has not been so disrupted. The lifestyle of the Indians of the Northwest coast of North America has been described by Ruth Benedict and others. We read that when crossing a river they did not need a bridge. They could walk across it on the backs of the salmon, so great were their numbers. We are also told that on the sea coast, when the tide went out, the "table was laid" so numerous were the shell fish, while the forests abounded in fruit and berries, and teemed with wild game.

People living in such conditions, even if they do not have access to modern manufactured goods, must be regarded—especially in the context of the world situation today in which nearly a billion people suffer from serious malnutrition—as prosperous. If this is not evident to us, it is partly because we associate prosperity with the possession of largely superfluous manufactured goods rather than with the satisfaction of *real* biological, social, spiritual and aesthetic needs; partly, too, because—by virtue of the market system and the state welfare system—we have become *insulated* from reality to the extent at least *that we need no longer suffer the immediate consequences of environmental disruption.* Thus, we can transform our land into a desert and yet *continue to eat* because via the market, or alternatively with the aid of the state welfare system, we can at least temporarily buy our food from some other area where the environment has not been totally devastated and, hence, where it is still possible to produce food.

The inhabitants of the poorer areas of the Third World, however, are not insulated from reality the way we are. In India—even though this country is perhaps the eighth or ninth biggest industrial power in the world—only about 20 per cent of the population lives within the formal economy, and its welfare and prosperity—indeed the survival of 80 per cent of the population that lives outside it—*is entirely dependent on the state of its immediate environment.* If people there cut down their trees, then they have no firewood; if their rivers and streams dry up, then they have no water over and above what accumulates during the monsoons in the village pond; and if their soil blows away or is washed away, then they have no food.

What we must have the courage to face is that the insulation from reality which the world market system and the welfare state at present provide us, is *purely temporary.* Sometime during the next few decades, the world market system will collapse and the state will cease to have at its disposal the vast sums of money it requires to provide all those services that we have come to expect of it. As this occurs, so will we once more become dependent on the fertility of our land, the luxuriance of our woods and the clarity of our rivers and streams. We will then come to realise—for many of us, far too belatedly—that environmental preservation is not simply the concern of the rich. Ultimately it provides *the only strategy* for assuring human welfare, and indeed human survival.

Edward Goldsmith

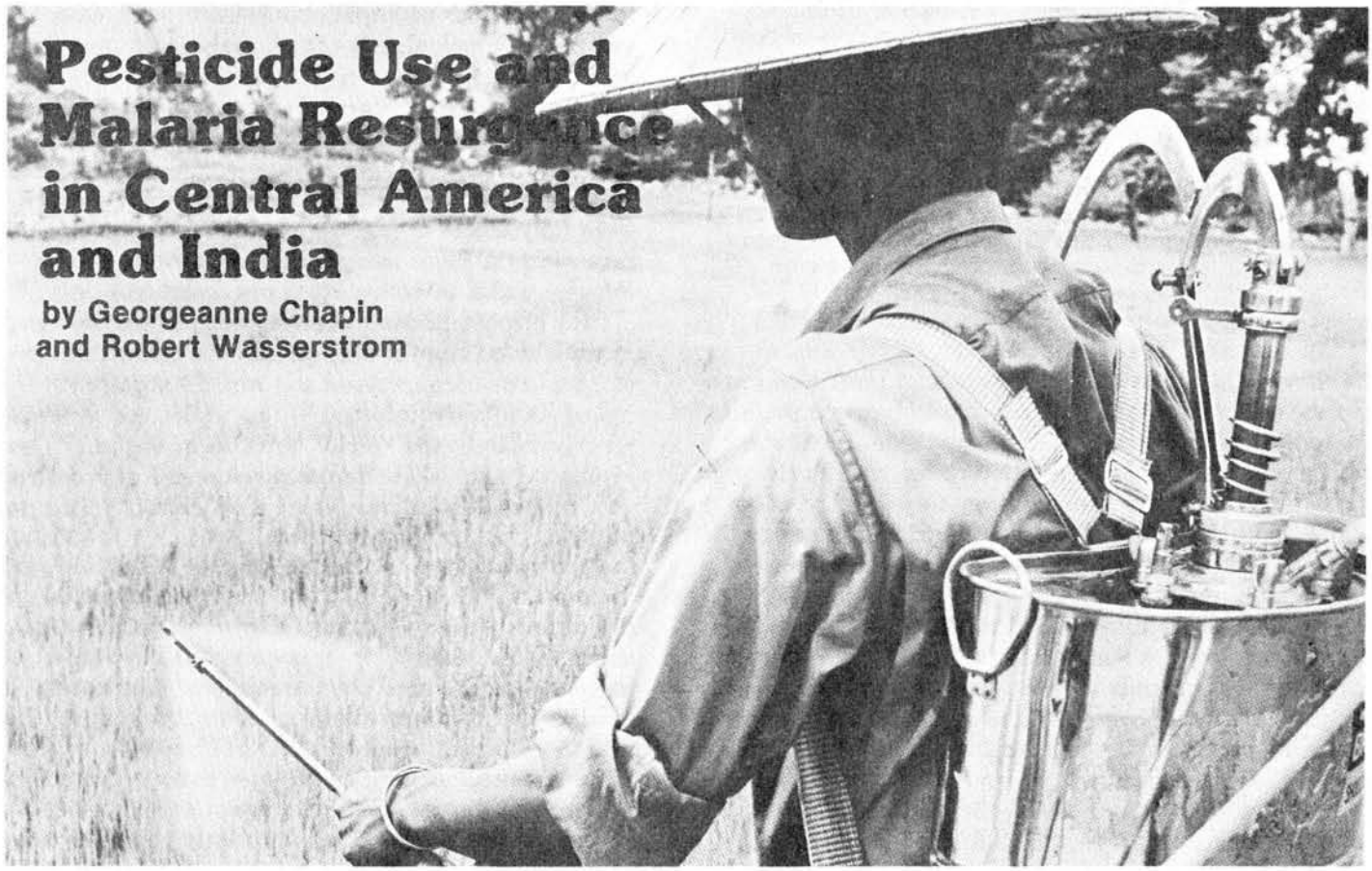
Notice to Readers

Anyone who would like to subscribe to the Ecologist but has difficulty meeting the subscription rates please write to us and we will do our best to help.

The Ecologist, Worthyvale Manor Farm, Camelford, Cornwall, U.K.

Pesticide Use and Malaria Resurgence in Central America and India

by Georgeanne Chapin
and Robert Wasserstrom



Among the inhabitants of Asia, Latin America and tropical Africa, malaria continues to represent a major cause for alarm.[1] Yet only a few years ago, health officials in a dozen developing countries pointed triumphantly at their efforts to eradicate this mosquito-borne scourge entirely.[1,25,81] Following World Health Organization guidelines, for example, Indian authorities instituted a programme of medical treatment and pesticide application in 1952 which within a single decade reduced the number of cases from over 100 million to 50,000.[30,98] Ten years later, using the same methods, health workers in Sri Lanka cut the annual incidence of malaria from 3 million cases to fewer than 25. But by 1970, it had become clear that malaria eradication had run into very severe difficulties. Rather than dwindle to insignificance, the number of infected individuals rose again to distressing proportions. In India, which had served as a showpiece for WHO policies, 5 million people soon caught the disease; in Sri Lanka, 2 million people became sick again almost overnight; and in Central America, infection rates grew to previously unknown levels.[30,98,203] Moreover, unlike earlier outbreaks, this new plague was often carried by mosquitoes which had become resistant to common pesticides like DDT and dieldrin and could not be controlled by conventional means.[2] Obviously, a major ecological disaster had occurred, a disaster whose origins must be sought as much in the politics of international organisations as in hapless nature.

In order to understand such events, it is necessary to bring into focus the motives and perceptions of those men and women who shaped the eradication campaign and set it on its course. By 1910, many public figures and medical authorities in the United States had become convinced that endemic diseases like malaria constituted a serious obstacle to development in tropical and semi-tropical areas. Most prominent among these authorities were officers of the Rockefeller Foundation, which in 1909 launched a programme to eliminate hookworm in the American South.[27,181] As Richard Brown has pointed out, such men were inspired by a combination of humanitarian and economic objectives, objectives which soon found expression in public health programmes abroad. According to Brown, these programmes . . .

> rested on four main propositions. First, U.S. control of the resources and markets, especially of non-industrialised countries, was considered essential to the prosperity of this country . . . Second, increased development of economically "backward" countries was seen as necessary to the successful exploitation of their resources, markets and investment opportunities . . . Third, tropical diseases—especially hookworm, malaria and yellow fever—were believed to be obstacles to peoples of underdeveloped countries (which prevented them from) contributing to the economic development of their countries. And fourth, the Foundation strategists believed the biomedical sciences and their application through public health programmes would increase the health and working capacity of these peoples *and* help induce them to accept western industrial culture.[26]

Like their counterparts in the Rockefeller Foundation, WHO officials took a similarly pragmatic approach toward tropical diseases. As recently as 1976, for example, they declared that

> the health objective (of eliminating parasitic infection) is perceived as a humanitarian rather

> than a materialistic one . . . However, it remains true that under some conditions a process of betterment in human well-being cannot be sustained over time unless the productivity and incomes of the poor rise to levels sufficient to support higher volumes of social consumption . . . In short, better health is desirable for humanitarian reasons, but its economic relationships must be considered if resources are to be employed for health improvement in ways that are supportive of—rather than detractive from—the economic productivity of the poor.[128]

And like the men at Rockefeller, WHO authorities believed that with the proper medical technology and organisational tools, disease control or eradication could become a powerful stimulus to development.

At this point, it is worth noting that early programmes to contain such diseases—primarily malaria and yellow fever—achieved remarkable degrees of success without recourse to sophisticated technologies.[98] Like their modern counterparts, for example, efforts to overcome malaria before World War II concentrated upon the ways in which mosquitoes of the *Anopheles* subfamily transmit *Plasmodia* parasites to human beings.[207] After reproducing in astronomical numbers, these parasites literally transform their human hosts into a reservoir of illness which may be spread to uninfected individuals. In 1907, Dr William Gorgas, an American Army surgeon in the Canal Zone, set out to break this cycle by draining swamps, emptying, covering or oiling pools of standing water and screening human habitations. Although he was unable to eradicate the disease completely, within two years such measures had cut the death rate from malaria among Canal company employees by 80 per cent to 8.86 per thousand. More or less simultaneously, an Italian physician, Dr Angelo Celli, noticed that in southern Europe the disease tended to attack people who were either poor or landless, particularly those who worked as seasonal labourers on large farms. In this case, he reasoned, transmission depended to a considerable degree upon the heavy flow of fresh human blood into malarious zones just as the *Anopheles* population began its yearly explosion. Not only sanitary engineering and medical treatment, then, but land reform and other social programmes might play a substantial role in conquering the disease.

By the end of World War II, however, it seemed that a technology had finally been devised which could eliminate malaria in much of the non-Western world: chemical pesticides. Unlike previous compounds, insecticides like DDT and dieldrin were not only cheap and easy to use, but they also remained active for several months after each application.[129,191] Thus they appeared to be ideally suited for the task of killing *Anopheles* mosquitoes, which characteristically rested for a short time on the inside walls of human houses after biting their victims. By spraying such walls with DDT, WHO officials reasoned, they could reduce the vector population to manageable levels. Simultaneously, they proposed to treat everyone affected by the disease with chloroquine or other anti-*Plasmodium* drugs and in this way to destroy the reservoir of disease upon which *Anopheles* mosquitoes drew*. If these conditions could be maintained for three or four years, they calculated, then malaria transmission might be broken forever.[25,30] And finally, projects of this sort might be carried out on a massive scale without altering patterns of land tenure or political institutions§.

Despite the simplicity of their plan, WHO officials were fully aware that a world-wide campaign to eradicate malaria faced nearly insurmountable obstacles. For one thing, previous attempts to control or eliminate the disease had been carried out piecemeal: except in the United States, Europe and the temperate areas of Latin America, most of the world's population still risked becoming infected.[83]ƒ In 1955, for example, shortly before the WHO campaign began, it was estimated that 200 million people caught malaria each year and that 2 million people died from it.[98] In many regions, control programmes were virtually non-existent, and even those programmes which did exist suffered from lack of funds, of technical expertise and of administrative efficiency. For another, in much of sub-Saharan Africa, an unhappy conjunction of climate, geography and politics rendered eradication unfeasible and confined efforts at control to major urban areas.[56,202] Then, too, without international collaboration, health authorities in one country could not prevent the disease from returning to areas which had already been cleared. It was precisely to rectify these problems that, beginning in 1956, officials at WHO chose to concentrate their efforts on providing technical assistance to interested governments and on fostering greater cooperation among affected states. As for the costs of such an enterprise, those governments which desired to participate were charged with the task of obtaining financial support from UNICEF, USAID or individual WHO members.

But there was another obstacle which experts at WHO were more reluctant to engage: as early as 1953, they obtained conclusive evidence that *Anopheles* mosquitoes, like many insect pests, sooner or later became resistant to DDT and dieldrin. Within a few years, in fact, such resistance had been recorded not only in Greece and Italy (where pesticides were employed both in public health and in agriculture), but also in Lebanon, Iran, Saudi Arabia and Nigeria. Moreover, as it turned out, in some cases a single application was sufficient to reduce mortality rates among mosquitoes by 80 per cent.[143] For this reason, WHO malariologists urged their local counterparts to conduct 'time-limited' spraying operations, that is, to conclude the 'attack' phase of their programmes as quickly as possible. To this end, anti-malaria teams were directed to treat the interior walls of all human habitations and shelters within the target zone on a

---

*For a further discussion of *Plasmodium* and its characteristics, see [45,134,140,207].

§Additional information about this strategy may be obtained in [91] and [109].

ƒWhat role eradication measures played in eliminating the disease in temperate regions is still a matter of dispute. According to Robert Garcia[83], for example, malaria transmission in such areas had already begun to decline in response to general improvements in sanitation and nutrition before the invention of chemical pesticides.

regular schedule—a gargantuan task under the best of circumstances. Meanwhile, by organising an elaborate system of regional laboratories and clinics, public health officials were supposed to administer chemotherapy and monitor the campaign's progress. In areas where these tactics proved to be successful, where the number of active cases diminished to zero, attack gave way to consolidation. And if no new illness occurred during the following three years, consolidation in turn was replaced by maintenance, the ever-lasting vigil against a recurrence of infection.[25] Whatever difficulties such a strategy might eventually encounter, then, it was nonetheless embraced in 1954 by the Pan American Health Organisation (whose director, Dr Fred Soper, was a senior member of the Rockefeller staff) and subsequently by the entire international community.

Initially, at least, it seemed that WHO's campaign enjoyed almost unmitigated success. In India, for example, after ten years of antimalaria efforts (1961) only 50,000 cases of the disease were uncovered by government officials and a number of states had passed from attack to consolidation or maintenance. Similar triumphs were registered in Pakistan, Sri Lanka, Paraguay, Venezuela, Mexico and Central America, which devoted considerable resources to this task. Moreover, in ten other countries, *Plasmodium* infection was completely overcome.[1,83] But within a short time the campaign began to falter. Between 1961 and 1966, disease rates in India increased three-fold; by 1970, half a million people caught malaria each year—many in areas where health authorities had recently scored impressive victories. Much the same course of events took place in Sri Lanka, which in 1968 experienced an epidemic that left 1.5 million people stricken.[1,37,98] Around the globe, in El Salvador, Nicaragua and Honduras (where anti-malaria measures began in the late 1960s), the incidence of disease in 1975 was three times higher than it had been a decade earlier, before the programme had started (Table 1). As a result, eradication projects which had reached consolidation frequently reverted to the attack phase—or even entered the newly-defined stage of "permanent attack".[162] Even so, it soon became clear that India and Central America were undergoing a major resurgence of malaria which existing administrative and technological methods could do little to prevent.[23] The question which malariologists in these areas then asked themselves was, "What had gone wrong?"

In fact, as early as 1962 a number of specialists had expressed their reservations about the WHO campaign and its chances for success.[38] Among other things, they pointed out that as infection rates dropped during the attack phase, hard-pressed governments often diverted critical resources from anti-malaria activities to other essential projects.[83,98,202] Thus, many infected people were not detected by surveillance systems, which themselves broke down under poor management and supervision. Even more ominously, however, resistance to DDT and dieldrin had reached alarming proportions among *Anopheles* mosquitoes—just as WHO officials had originally feared (Table 2).[50,122] Consider the case of El Salvador, where in 1958 a group of entomologists reported that the local vector, *A. albimanus,* had lost its susceptibility to all major organochlorine compounds and was proliferating rapidly along the Pacific coast.[154] Four years later, researchers in southern Mexico encountered the same problem, which forced them to foreswear eradication in several areas.[55] Simultaneously, in India, widespread tolerance to organochlorines was discovered among two important vectors, *A. culicifacies* and *A. fluviatilis,* particularly in regions which had recently shifted to high-yielding forms of agricultural production.[132] In such places, effective control might be regained only by using insecticides which cost four, five or even ten times as much as common toxins—a burden which few governments were willing to bear.[86] Then, too, many experts agreed that measures of this sort could serve at best as a temporary expedient: vectors which became resistant to one compound frequently enjoyed mysterious immunities to entirely unrelated poisons, and in any case it was only a matter of time before natural selection favoured those insects which could withstand a broad spectrum of chemical agents.[12] Faced with problems for which they had no solutions, therefore, in 1973 WHO officials reluctantly transformed the Malaria Eradication Division into the Division of Malaria and other Parasitic Diseases.[206]*

Given these facts, it is ironic that commercial agriculture—in which chemical pesticides were also used—often expanded in precisely those regions which had

*By the late 1960s, in fact, WHO experts recognised that eradication might eventually occur in a relatively few areas of the world. As for those countries which were not able to defeat the disease, they retreated to a more modest strategy of malaria *control*—a strategy similar to that which Gorgas has used in Panama. Thus they urged local officials to drain, cover or oil breeding pools, to use larvicides and to screen human habitations. For further discussion of this shift in policy, see [94,95,98,100,114,124,145,175,199,200,204,206,209]. Interestingly enough, WHO continued to place relatively little emphasis upon alternative means of reducing the disease [11,19,34,63,170,196]. On the contrary, research now focuses the search for further breakthroughs in medical technology [43,158]. Finally, for a description of non-ecological obstacles to malaria control, see [13].

Table 1. Prevalence of malaria in Central America, 1965–1977

Country	Number of cases (1000s)												
	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Costa Rica					0.6	0.3	0.3	0.2	0.2				0.2
El Salvador	34.2	68.6	83.0	35.8	25.3	45.4	46.8	38.3	35.1	67.0	83.1	83.3	32.2
Guatemala	14.3	22.0	21.2	11.0	10.6	10.9	8.3	9.3	1.0		1.0	9.6	
Honduras	6.9	17.1	16.1	15.7	29.6	34.5	48.4	18.6	8.8	7.5	30.3	48.8	39.4
Nicaragua	8.3	15.6		7.1	16.0	28.5	23.3	9.6	4.2	12.2	24.7	26.2	11.6

Source: WHO, *World Health Statistics Annual*, Geneva, 1966–1979.

Table 2. Insecticide resistance in anopheline mosquitoes, countries or areas

Species	DDT	Dieldrin/HCH	Organophosphorus	Carbamate
A. aconitus	Indonesia*	Indonesia		
A. albimanus	Haiti, El Salvador,* Nicaragua,* Guatemala,* Honduras,* Mexico, Cuba, Costa Rica, Panama, Dominican Republic, Colombia	Haiti, El Salvador, Guatemala, Belize, Honduras, Jamaica Mexico, Ecuador, Nicaragua, Cuba, Dominican Republic, Colombia	El Salvador Guatemala, Honduras, Honduras, Nicaragua	El Salvador, Guatemala, Nicaragua
A. albitarsis	Colombia, Brazil	Venezuela		
A. annularis	Nepal, India, Bangladesh	Indonesia, Nepal		
A. aquasalis		Trinidad, Venezuela, Brazil		
A. atroparrus		Romania, Bulgaria		
A. barbirostris		Indonesia		
A. coustani		Saudi Arabia		
A. crucians		USA, Dominican Republic		
A. culifacies	Afghanistan	Afghanistan	India	
	Iran, Pakistan, India,* Nepal, Sri Lanka	Pakistan, India, Nepal, Sri Lanka		
A. d'thali		Iran		
A. farauti Sp. No. 1		Solomon Islands		
A. filipinae		Philippines		
A. flavirostris		Philippines		
A. fluviatilis	India	Saudi Arabia		
A. funestus		Nigeria, Ghana, Kenya, Cameroon		
A. gambiae A.	Togo, Upper Volta, Central African Republic, Nigeria, Benin People's Republic, Cameroon, South Africa	Togo, Cameroon, Central African Republic, Upper Volta, Nigeria, Senegal, Guinea, Gambia Equatorial Guinea, Liberia, Sierra Leone, Kenya, Ivory Coast, Ghana, Benin People's Republic, Congo, Mali, Mauritania		
A. gambiae B.	Sudan, Senegal, Swaziland	Upper Volta, Sudan, Nigeria, Senegal, Swaziland, Ethiopia, Chad, Mozambique, Kenya, Zimbabwe, Mauritania		
A. hyrcanus	Pakistan, Turkey,* Afghanistan	Turkey	Turkey	
A. labranchiae	Algeria, Tunisia	Morocco, Algeria, Tunisia		
A. maculipennis	Iran, Turkey	Turkey		
A. messae	Bulgaria	Romania,* Bulgaria	Romania	
A. minimus		Indonesia		
A. multicolor	Saudi Arabia	Saudi Arabia		
A. neomaculipalpis		Trinidad, Colombia		
A. nili		Ghana		
A. pharaoensis	Egypt, Sudan, Ethiopia	Egypt, Sudan, Israel		
A. philippinensis	India	Malaysia		
A. pseudopunctipennis	Mexico, Peru	Mexico, Peru, Nicaragua, Ecuador. Venezuela		
A. pulcherrimus	Afghanistan, Iraq	Saudi Arabia, Syria		
A. quadrimaculatus	USA, Mexico	USA, Mexico		
A. rangeli		Venezuela		
A. rufipes		Mali		
A. sacharovi	Greece, Iran, Turkey,* Iraq, Syria, USSR, Azerbaijan	Greece, Turkey,	Turkey	Turkey
A. sergenti		Jordan		
A. sinensis	Japan*	Republic of Korea*	Republic of Korea, Japan	
A. spendidus		India		
A. stephensi	Afghanistan, Iran, Pakistan, India, Iraq, Saudi Arabia	Afghanistan, Iran, Iraq, Pakistan India, Saudi Arabia		India
A. strodei		Venezuela		
A. subpictus	Pakistan, India. Indonesia	Pakistan, India, Indonesia, Sri Lanka, Bangladesh		
A. sundaicus	Indonesia	Indonesia, Malaysia		
A. triannulatus		Venezuela, Colombia		
A. vagus	Bangladesh, South Vietnam	Indonesia, Malaysia, South Vietnam, Philippines		

WHO, *Resistance of Vectors and Reservoirs of Disease to Pesticides.* Geneva, 1976.
Roy R. G. *et al.* Susceptiblity status of adult *A. stephensi* to Propoxur in Tamil Nadu. *Indian J. med. Res.* **68**, 744, 1978.

recently been cleared of malaria.[46] As the danger of illness in such areas subsided, many landowners, stimulated by the high prices of such commodities as cotton, rice and tobacco, reduced their production of other crops and bought up more land.[46,193] The result of this decision, which was repeated in a wide variety of countries, was both to increase the number of poor and landless rural workers and to concentrate agricultural resources in progressively fewer hands.[5,6,32,85] In 1960, for example, the wealthiest five per cent of India's non-urban population owned 30 per cent of its croplands; ten years later, their holdings had risen to 33 per cent (Table 3).[173] Naturally, such proprietors also received lavish amounts of credit and other incentives, incentives which smaller operators did not enjoy. At the same time, they claimed a disproportionate share of the country's agricultural income: between 1960 and 1970, in fact, the richest 20 per cent of these men and women (like their counterparts in Pakistan and Bangladesh) appropriated nearly half of such revenues.[49,138,173] Similarly, in Central America, where cotton and cattle became king in the 1960s, both land and credit remained almost completely inaccessible to most small growers. Consider again the case of El Salvador, where one per cent of the rural population owned half of the country's land (including all properties over 50 ha) and earned 30 per cent of its income.[58,195] As in India, such prosperity was achieved only at the expense of considerable inequity: fully one-third of the area's peasants possessed less than one hectare and one-quarter of them owned no land at all. Clearly, the expansion of commercial agriculture in these regions exacerbated such difficulties and created an entirely new kind of agroecosystem.

Table 3. Land tenure in India, 1970

Size of holding (ha)	Number of holdings (1000s)	% Rural properties	Area (millions of ha)	% Total area
<0.5	23,178	32.9	5.4	3.4
0.5–1.0	12,504	17.7	9.1	5.6
1.0–1.9	13,432	19.1	19.3	11.9
2.0–2.9	6722	9.5	16.4	10.0
3.0–3.9	3959	5.6	13.6	8.4
4.0–4.9	2684	3.8	11.9	7.4
5.0–9.9	5248	7.4	36.3	22.4
10.0–19.9	2135	3.0	28.5	27.6
20.0–29.9	401	0.6	9.3	5.8
30.0–39.9	120	0.2	4.2	2.6
40.0–49.9	45	0.1	2.1	1.3
50+	65	0.1	6.0	3.1
Total	70,493	100.0	162.1	100.0

Source: Ministry of Planning, Government of India, *Statistical Abstract, India, 1977*, New Delhi, 1978.

Let us now examine in more detail the relationship between cotton and health in Central America. As Figs 1 and 2 suggest, the value of cotton exports from this area (principally to Japan) grew rapidly in the present decade; by 1979, cotton accounted for 14.5 per cent of the region's total foreign trade.[29] Nonetheless, as Paul Dorner and Rodolfo Quirós have pointed out, such events represented a mixed blessing for many rural families. They have written:

> The competition for land among the large producers of the different export commodities is

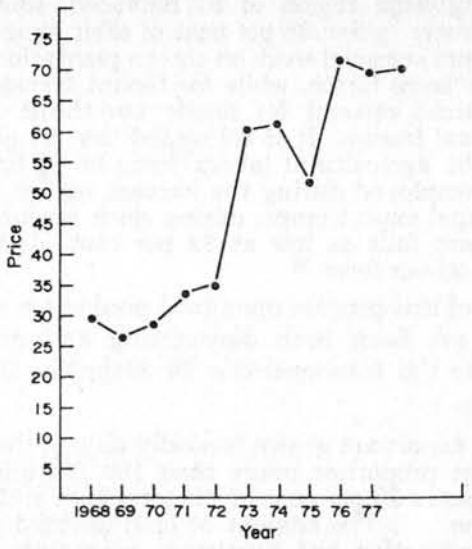


Fig. 1. Average spot price of Central American cotton in Northern Europe, 1968–1977 (U.S. cents per pound). Source: Commodities Research Bureau Inc., *1979 Commodities Yearbook*. New York, 1979.

quite limited. Coffee, cotton, bananas, sugar cane and livestock have quite distinct soil, climatic and other ecological requirements. The competition for land has always been, and continues to be, between the large export producers and the small farm sector producing mainly for domestic markets . . . In the major cotton producing departments of El Salvador, the number of farms 10 hectares or smaller increased by 72 per cent from 1959-60, but the average farm size in this category declined by 54 per cent. The major cotton producing departments of Nicaragua likewise showed an average decline of farm size of 38 and 20 per cent (1952-64) for holdings in the 1-9.9 and 10-49.9 manzana size classes.[58]

As a result, a growing number of small farmers have all but ceased to produce foodstuffs and have turned instead to seasonal labour on large plantations. Dorner and Quirós continue:

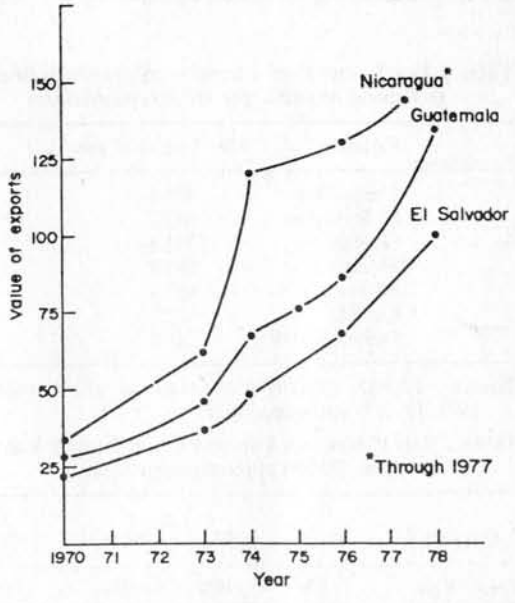


Fig. 2. Value of cotton exports from several countries in Central America, 1970–1978 (millions of U.S. dollars). Sources: United Nations Economic Commission on Latin America, *Economic Survey of Latin America*, New York, 1975; Business International Inc., *Business Latin America*, p. 67. Principal Latin American Export Commodities, 1980.

> In the Usulatán region of El Salvador, small farmer owners derive 38 per cent of their annual income from seasonal work on cotton plantations and other large farms, while for tenant farmers these sources account for nearly two-thirds of their annual income. It is estimated that 97 per cent of the agricultural labour force in El Salvador is employed during the harvest season of the principal export crops; during slack seasons, employment falls as low as 32 per cent of the available labour force.[58]

The effects of this process upon food production in El Salvador have been both devastating and direct. According to the Interamerican Development Bank, for example,

> crops for export are grown basically on less than 2000 large properties (more than 100 hectares) which possess 39 per cent of the total area under cultivation . . . The amount of land devoted to export production has fluctuated according to changes in the size of cotton plantings, but in general it has increased by 18.8 per cent during the period 1961-1974. The 95,804 hectares planted with cotton in 1974 substantially surpassed the level of 33,000 hectares during the decade of the 1950's, in comparison with an increase from 302,000 hectares to 397,000 hectares of croplands devoted to basic grains.[195]

Under these circumstances, it is not surprising that rural poverty has increased and the death rate from infectious and parasitic diseases in Central America—particularly among infants and young children—has remained extremely high (Table 4).[64,82,141,154] Nor is it surprising that the incidence of malaria has generally increased—despite an impressive diminution in the late 1960s and early 1970s (Table 5). The relationship between fibre production and the recrudescence of malaria in such areas has been clearly established in a study prepared recently by the United Nations Environmental Programme and the Instituto Centroamericano de Investigación y Tecnología Industrial (ICAITI). According to these agencies,

Table 4. Death rates from infectious and parasitic disease in Central America (per 100,000 population)

Country	Under 5 years of age
Costa Rica	405.3
El Salvador	605.2
Guatemala	1775.5
Honduras	591.9
Nicaragua	687.4
Canada	12.1
United States	15.0

Source: PAHO, *Health Conditions in the Americas, 1973–1976*, Washington, 1978.

Table 5. Rate of infection from malaria in Central America (per 100,000 population, all ages)

	Year			
Country	1973	1974	1975	1976
Costa Rica	8.6	8.9	14.7	24.0
El Salvador	930.9	1714.4	2073.9	2020.1
Guatemala	107.7	68.2	81.9	153.7
Honduras	340.8	280.0	1100.4	1723.9
Nicaragua	210.7	583.8	1145.8	1174.6

Source: PAHO, *Health Conditions in the Americas, 1973–1976*, Washington, 1978.

> resistance of *A. albimanus* to chemical control by DDT has been increased in the area. It is particularly high where cotton is grown. Average resistance in Guatemalan cotton areas went from 58 per cent to 86 per cent in those years. Malaria Control Agencies in the former country reacted by applying more expensive pesticides more frequently which resulted in a drop in malaria rates in cotton areas . . . Control in El Salvador has not been as effective and malaria rates have increased (from 39.2 cases/1000 to 65.7 cases/1000 between 1972 and 1974).[107]

Paradoxically, such difficulties have arisen not because toxins like DDT have become totally ineffective, but rather because most of what is sprayed never reaches its target. "The aerial application of pesticides under unstable weather conditions," the ICAITI document continues,

> is a key event in the movement of pesticides through the environment. It was estimated that with the ultra-low volume application system about 75 per cent of the amount applied falls outside the swathe of the airplane under conditions of temperature inversion and moderate winds. If a 20-hectare field is being treated one can expect about 56 per cent of the insecticide to fall outside the target area . . .[107]

And finally, the report concludes, by contaminating pasturelands and cattle fodder, pollution of this sort has cost local ranchers nearly two million pounds sterling in beef exports*.

Why do cotton planters pursue a policy which is apparently so wasteful and so inefficient? In large measure, the answer to this question may be found in the fact that cotton pests (primarily boll weevils and bollworms) have also shown heightened resistance to certain pesticides.[10] In order to combat these plagues and to raise their yields, planters in Guatemala, Nicaragua and El Salvador have not only expanded their acreage but since 1970 they have also applied heavier concentrations of poison. Whereas a decade ago such fields were sprayed only eight or nine times each season, at present they must be fumigated on as many as 50 occasions.[107] Consequently, the amount of poison which enters the local ecosystem has expanded at a burgeoning rate. In 1972 for example, farmers in El Salvador sprayed 58.4 kg on each hectare of cotton; three years later, such applications had reached 70.0 kg/ha. Nearby, in Guatemala, these figures rose from 45.6 to 79.9 kg/ha. As a result, DDT consumption in El Salvador increased three-fold between 1970 and 1977—from 555,200 to 1.6 million kg. Similar circumstances prevailed in Nicaragua, where DDT imports rose from 29,000 kg in 1974 to 521,600 kg in 1976. Naturally, the importation of pesticides on this scale could be accomplished only as long as cotton revenues offset the rising costs of poisons. Fearful that unstable prices and skyrocketing expenses might soon cut their earn-

*Naturally, U.N. agencies were well aware that increased use of pesticides in agriculture also increased the risk of contaminating human food. But the relationship between pesticides and other public health problems has continued in large measure to elude them or to be treated as a secondary issue.[3,52,67,77,78,142,188,197,198,205] In this respect, they reflect the attitudes of their counterparts in the United States, where chemical residues in food or direct human intoxification—not parasitic disease—contitute a major focus of concern.[e.g. 8,31,54,103,111,127,151,176,192]

ings, then, and anxious to ensure the greatest returns on their investments, many growers attempted to achieve total control of insect parasites—an obsession which only increased their reliance upon expensive chemicals. In fact, it is this obsession which has created the conditions for a revival of *Anopheles albimanus,* the local malaria vector.

Ironically, vector resistance in India has developed even in areas where cotton is grown on relatively small plots of land or where food grains—primarily rice—still dominate local agriculture. In Tamil Nadu and Gujarat, for example, most farmers own between two and five hectares; few possess more than 50.[14,106,147,179] Even so, these men produce nearly one-third of the country's cotton and an impressive share of its rice. By 1968, too, the incidence of malaria in this region had decreased to insignificance—indeed, in Tamil Nadu, the disease was largely confined to urban areas like Madras.[48,59,60,87,157,168] Within a few years, however, public health officials throughout southern India reported that mosquitoes of the *Anopheles* and *Aedes* subfamilies (which transmit yellow fever) had become resistant to a wide variety of chemicals including DDT, BHC, Malathion (an organophosphate) and Propoxur (a carbamate).[113,132,156,166,167] Although indisputable evidence is not yet available, it appears that such resistance began to occur with the introduction of green revolution technology—particularly of high-yielding varities of rice—throughout the region (Fig 3). According to entomologists at the Vector Control Research Centre in Pondicherry,

> the major changes that have been taking place in the area are in the tremendous increase of acreage under cultivation, the near total replacement of organic manure by chemical fertilizers and the extensive use of chemical insecticides for paddy and other crops. Many fallow lands have also been brought under an extension of the irrigation system.[157]

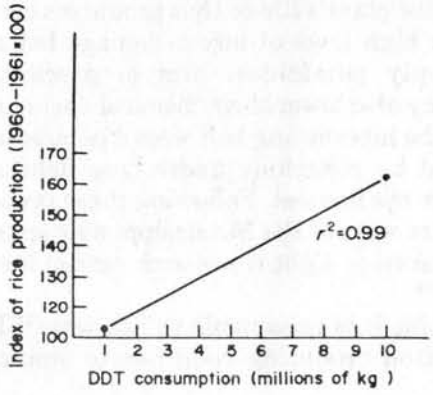


Fig. 3. Effect of DDT use upon rice production in India, 1970–1977*. Sources: Ministry of Planning, Government of India, *Statistical Abstract, India 1977.* New Delhi, 1978. Tate Services Ltd, *Statistical Outline of* India. Bombay, 1978; Food and Agricultural Organization, *1977 FAO Production* Yearbook. Rome, 1978. *$y = 5.45x + 107.7$.

It should be noted as well that the new strains of rice cultivated by many Indian growers have proved to be especially susceptible to insect infestation.[10,96,115,116] As Figs 4 and 5 suggest, farmers have responded to this problem by applying heavy doses of DDT, BHC and dieldrin—a procedure which may well be related to the recent explosion of malaria in the region. Moreover, as these growers have switched from DDT to more sophisticated chemicals, traditional disease vectors have been replaced by rarer species which show a diminished sensitivity to such poisons.[48,157] Little wonder, therefore, that as early as 1972 the *Indian Journal of Public Health* declared that "the most serious threat to public health . . . is the uncontrolled use of pesticides for agronomic practice".[62*]

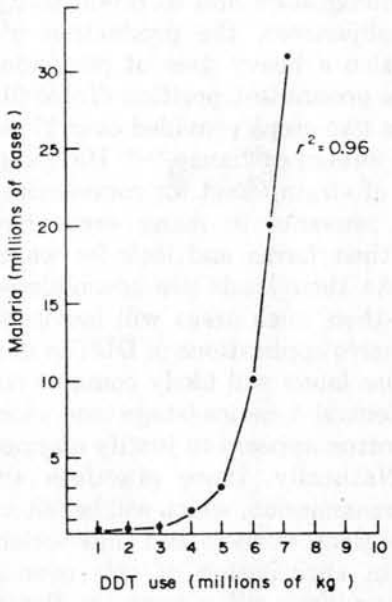
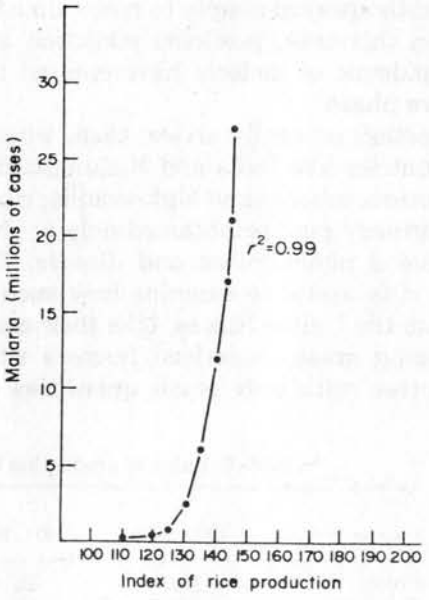


Fig. 4. Relationship between DDT use and malaria incidence on India. 1969–1977*. Sources: *1977 FAO Production Yearbook.* Rome, 1978; Harrison G., *Mosquitoes, Malaria and Man.* New York, 1978. *$y = 0.033e^{1.05}$.



*Given the country's current agricultural plans and production policies, this problem is likely to become much more serious over the next 5 years. For a description of these policies, see [18,33,93,110,144,160,185,186,187]. Additional information about malaria in India may be found in [16,17,105,123,165]. Finally, a number of authorities have reported that *Plasmodium* parasites themselves are becoming resistant to chemotherapy in India.[161,164,171,172]

Under these circumstances, it is possible to discern a three-stage relationship between the evolution of cotton agroecosystems and the spread of malaria. During the first stage, eradication programmes proceed more or less effectively to combat the disease and often permit farmers to exploit previously infected areas. In eastern Paraguay, for example, landless peasants from so-called over-populated regions have been encouraged to clear and colonize 'uninhabited' jungle where malaria is endemic.[4,194] For its part, the Paraguayan government has undertaken great efforts to eliminate the *Plasmodium* parasite—as a stimulus both to immigration and to productivity. Among its primary objectives, the production of cotton and tobacco (also a heavy user of pesticides) for export occupies a preeminent position (Table 6). By 1978, in fact, these two crops provided over 27 per cent of the country's foreign exchange.[29,194] Having prepared vast expanses of virgin forest for commercial exploitation, however, peasants in many areas have begun to abandon their farms and look for wage labour elsewhere.[44] As their lands are consolidated into larger holdings, then, such areas will inevitably be treated with intensive applications of DDT or dieldrin. At this point, these lands will likely come to resemble many parts of Central America (stage two), in which the high price of cotton appears to justify augmented doses of poison. Naturally, these practices also stimulate malaria transmission, which will be felt most intensely among migrant workers and impoverished peasants. Perhaps in anticipation of this event, PAHO has already commissioned a study in Paraguay entitled "The Impact of Malaria on Economic Development".[44] According to this report, seasonal increases in *Plasmodium* infection do not interfere with cotton or tobacco cultivation—although they may wreak havoc upon food production. Finally, in places like India, Pakistan and Bangladesh (stage three), more and more DDT must be sprayed simply to maintain a fixed yield (Fig 6). In this case, pesticide addiction and a full-fledged epidemic of malaria have entered their most destructive phase.

The question naturally arises, then, whether Third World countries like India and Nicaragua must cease to grow cotton, tobacco and high-yielding rice, whether foreign currency may be obtained only at the expense of widespread malnutrition and disease. By way of response, it is useful to examine how such crops are produced in the United States. Like their counterparts in developing areas, American farmers who started raising cotton with only small quantities of insecti-

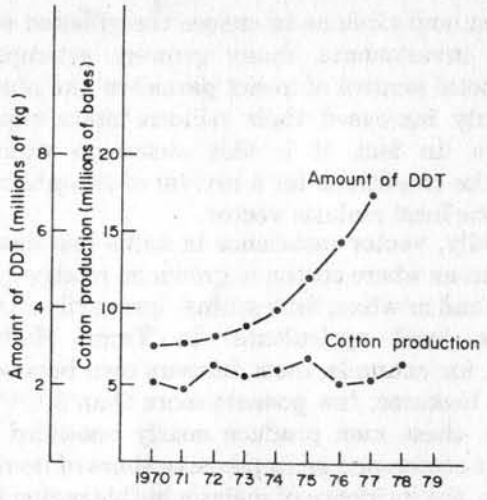


Fig. 6. Cotton production and DDT use in India, 1970–1978. Sources: FAO, *1977 FAO Production Yearbook*. Rome, 1978; Commodities Research Bureau, *1978 and 1979 Commodities Yearbook*. New York, 1978, 1979.

cides found that insect pests reappeared in their fields almost as soon as the fumigators departed.[21,47,88,108,148] Most often, they responded to this situation by applying stronger poisons with greater frequency until they were spraying every two or three days for five months.[90,99,210] By then, the side effects of such addiction has become clearly visible: cattle fodder had to be destroyed because it contained pesticide residues too high to be fed to animals and crops that had never suffered severe infestations were suddenly devastated by previously innocuous insects.[8] In response to this state of affairs, entomologists developed what they called integrated pest control (or integrated pest management) systems.[21,66,89,152,169,189] The key to these systems lies in timing insecticide applications so that the crop is protected from predators only at the most vulnerable stages of its growth cycle.[21,178] As it turns out, cotton buds destroyed by pests regrow throughout the plant's life so that producers can afford to sustain a high level of insect damage before they need to apply pesticides. Simple precautionary measures may also lower their chemical costs: up to 75 per cent of the hibernating boll weevil population may be destroyed by ploughing under crop debris which remains after the harvest. Following these procedures, many growers west of the Mississippi now spray their fields only seven or eight times each season instead of 25 or 30.[21,178*]

At this point it is reasonable to ask why WHO did not urge cotton producing countries to employ inte-

Table 6. Index of production for selected crops in Eastern Paraguay, 1970-1975 (by volume)

Crop	1970–1971	1971–1972	1972–1973	1973–1974	1974–1975	Average annual growth rate (%)
Cotton	100.0	267.4	478.6	494.8	549.3	52.0
Tobacco	100.0	140.6	123.4	175.7	163.0	13.0
Soybeans	100.0	112.7	151.7	219.5	271.4	28.7
Corn	100.0	70.7	87.2	106.3	111.9	2.9
Manioc	100.0	102.3	84.0	131.1	126.3	6.0
Rice	100.0	150.5	170.8	215.9	230.9	23.3
Beans	100.0	171.9	153.5	242.0	267.7	27.9

Source: World Bank, *Regional Development in Eastern Paraguay*. Washington, 1978.

grated management systems which would not interfere with malaria eradication programmes. A tentative answer may perhaps be found in the activities of another international agency, the Food and Agricultural Organisation (FAO). Like WHO, FAO was established to provide technical advice and assistance to U.N. members.[118] In the case of pesticides, which are manufactured and distributed by a few multinational corporations like Shell, Dupont, Ciba-Geigy and Bayer, FAO's advice might have played a critical role in reducing environmental contamination.§ Normally, both farmers and extension agents in developing nations must rely upon pesticide company salesmen for information about how to use agricultural chemicals—much like physicians in this country rely upon pharmaceutical companies for information about new drugs.[85,120] Beginning in 1967, therefore, FAO put together a small working group of experts on integrated control which published technical manuals and desseminated other information.[68,72,73,76-79] Three years later, it commissioned an American entomologist, Dr Louis Falcon, to develop an integrated system in Nicaragua, a system which achieved remarkable success within a few seasons.[65] Subsequently, similar programmes were undertaken in Mexico, Peru and Pakistan.[22,118] Then, in 1975, FAO delegates met in Rome to consider the question of pesticides in agriculture and public health.[71] Although they recognised that insecticide abuse was intimately linked to many health problems, they decided that integrated control was an idea whose time had not quite come.** Instead, they recommended that FAO launch a full-scale programme to teach growers in developing nations how to make more 'safe and efficient' use of pesticides.[71,78]

Why did FAO apparently abrogate its responsibilty to provide poor countries with the best advice about these highly toxic and dangerous substances? In answer to this question, it is important to examine how pesticide manufacturers have shaped the policies of international agencies. As public concern about the effects of toxins like DDT began to grow in the 1960s, these corporations formed a lobbying organisation called GIFAP (Groupement International des Associations Nationales de Pesticides) which in turn worked directly with U.N. technicians through a FAO bureau known as the Industry Cooperative Programme (ICP). By the early 1970s, joint FAO-ICP regional seminars had been organised in many parts of the world to promote new and better ways of distributing agricultural poisons.[71,72,85] More important, high-level officials in WHO and FAO, who share the industry's views on most major issues, invited GIFAP to play an active role in agency 'consultations' and other internal meetings.[71,72,77,78,85] In this way, for example, the roster of corporate representatives who attended the meeting in Rome on pesticides in agriculture and public health reads like a *Who's Who* of the chemical trade: no fewer than 25 lobbyists lent their experience and expertise to the proceedings.[71] Moreover, these lobbyists openly dominated several of the sub-committees which were responsible for formulating U.N. policy on essential matters. Not surprisingly, then, these sub-committees stressed the need to apply more pesticides in a more effective manner rather than to limit their use or replace them with alternate forms of pest control. And what is more disconcerting, neither FAO nor WHO felt compelled to include representatives from other international constituencies such as environmental groups, labour unions or farmers' organisations.

In fact, this incident reflects a much broader pattern of corporate activity within the U.N. specialised agencies, a pattern which has recently become the object of considerable debate and controversy.[7,20,85,180] Originally created in 1966, ICP has permitted member companies (which number around 100) to enjoy a sort of semi-official status in FAO. Among its principal projects, for example, in 1975 the Programme took a leading role in organising the World Food Conference; at the same time, it functioned as a brokerage service which allowed "government planners to meet top executives who would not otherwise be considering investment in this or that country".[85] The advantage of such contact, according to researchers at the Harvard Business School, was that it enabled corporate leaders to concentrate on

> working with multilateral institutions . . . in effecting the transfer of resources for agricultural development . . . (and) of effectively managing the delivery of capital and technology to developing countries, so that they themselves can marshall the necessary resources to increase their own food production.[7]

A less charitable view of this relationship was suggested by Brian Bolton, a member of the Institute for Development Studies at Sussex. Instead of channelling resources into developing areas, Bolton claimed, ICP help business executives to utilise

> the U.N. agencies (to) assist them in financing adaptation of technologies, to 'spread risk', and for the provision of infrastructure. Most of the ICP Mission reports call for government assistance in providing . . . the ubiquitous 'safe investment climate.[20]

More important, however, neither ICP nor FAO in general attempted to insure that corporate investments negotiated under their auspices reflected either

*Nonetheless, it must be noted that investment in agricultural technology (particularly chemical technology) remains an extremely attractive proposition for many corporations. According to Robert Just and his collaborators at the University of California at Berkeley, for example, "the rates of return on these investments are much above the average for the economy as a whole 15 to 50 per cent".[12] As a result, such corporations exert considerable pressure both upon farmers here and upon regulatory agencies to attack pests and weeds with poisons rather than by other means. And given the difficulty of obtaining independent information about these poisons, legislators and administrators alike often find such pressure difficult to resist.[101] Finally, even when regulations are applied, many corporations simply market prohibited substances abroad—substances which often return to the United States as residues in food or fibre.[103,190]

§For a discussion of international agencies and their participation in scientific research, see [39,119,137,159,208]. A particularly striking case of mismanagement by such agencies is described in [115].

**Paradoxically, by this time integrated programmes of pest management had been employed successfully with a variety of crops including corn[36] and rice[116,131]. The feasibility of adapting such programmes at the national level has recently been demonstrated in Hungary, which has developed a key pest forecasting system for all major insect predators.[104]

U.N policy or the production requirements of underdeveloped countries. And when in 1975 FAO officials broached the subject of consultation between the Programme and labour organisations, Bolton reported, "the ICP representative said that they would be prepared to discuss matters which they thought were of interest to trade unions".[20] Perhaps for these reasons, therefore, in June 1978 the current director general of FAO, Edouard Saouma, finally expelled ICP from his agency.[180]

Conclusions

In 1976, WHO published a technical report entitled "Resistance of vectors and reservoirs of disease to pesticides". In this report, WHO's Expert Committee on Insecticides declared that

> It is finally becoming acknowledged that resistance is probably the biggest single obstacle in the struggle against vector-borne diseases and is mainly responsible for preventing successful malaria eradication in many countries . . . Evidence has also accumulated to show conclusively that resistance in many vectors has been caused as a side-effect of agricultural pesticide usage. Thus, control of selection pressure is largely out of the hands of those who use insecticides for the control of disease vectors.[201]

Accepting this unhappy fate, the report concluded that

> Despite the harmful effects of resistance, the Committee emphasised that all the evidence showed that vector control was likely to depend on substantial, continued use of pesticides for at least a decade. Therefore, it was important to encourage commercial firms to continue the search for pest control, especially compounds with a novel mode of action.[201]

And yet, as many specialists have pointed out, such compounds are unlikely to resolve this dilemma or to undo the damage which in-bred tolerance has already caused: detoxification appears to rely upon physiological processes which are both irreversible and difficult to disrupt. In effect, throughout southern India, the recrudesence of malaria now represents a social cost of growing high-yielding rice—just as elsewhere in India and Central America it represents a social cost of producing cotton. Naturally, such costs are more easily accepted when they can be passed along to the rural poor, who in any case are more susceptible to infection. Not new technology, then, but rather proper attention to the social and environmental conditions which make a resurgence of malaria inevitable would seem to demand our most urgent consideration. And while more equitable solutions are found to the problems of inequality and poverty, surely it makes sense to employ integrated systems of pest management on such crops as rice and cotton.

References

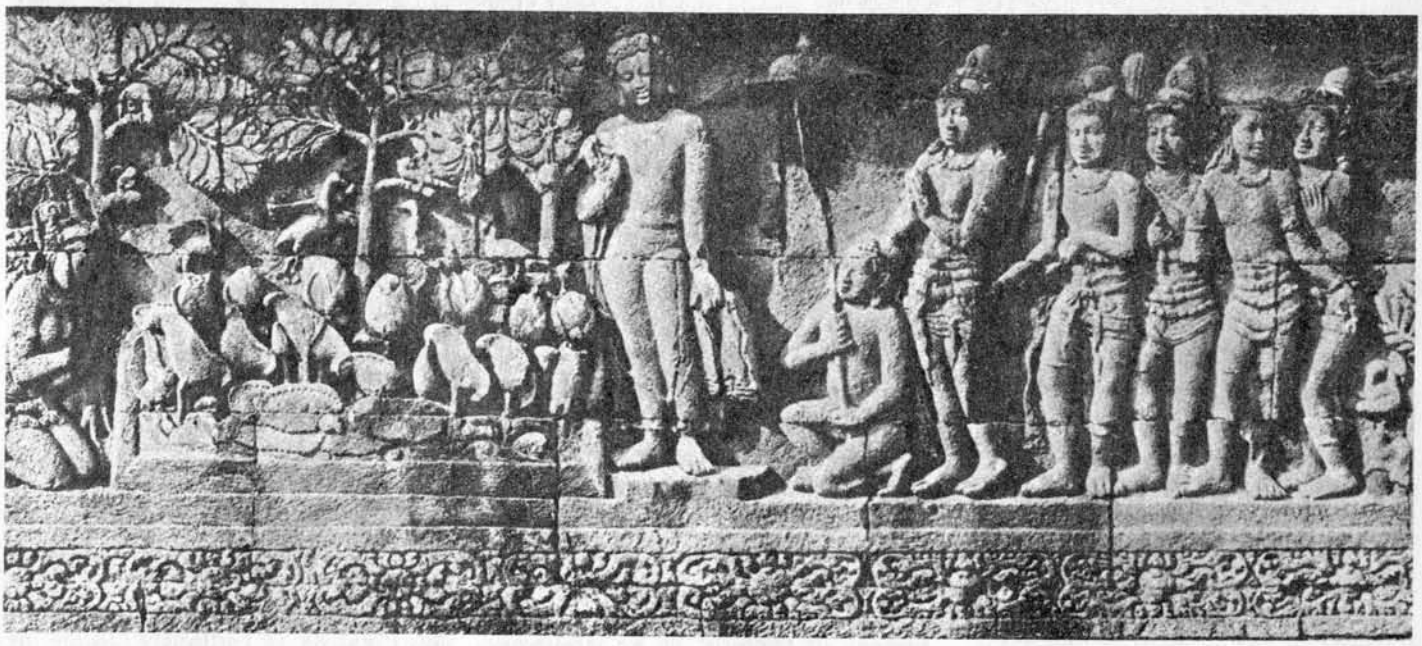
1. Agarwal A. Malaria makes a comeback. *New Scient.* 2 February, 274-277, 1978. See also Refs 25, 37, 43, 59, 80, 83, 98, 117, 124, 125, 143, 177, 183, 199, 202.
2. Agarwal A. Pesticide resistance on the increase, says UNEP, *Nature* **279**, 280, 1979. See also Refs 12, 22, 24, 28, 30, 50, 80, 82, 83, 92, 97, 107, 113, 122, 132, 133, 143, 167, 201.
3. Agarwal H.C. *et al.* Residues of DDT and its metabolites in human blood samples in Delhi, India. *Bull. Wld Hlth Org.* **54**, 349-351, 1976.
4. Agarwal M. and Hugo Z.-B. *Paraguay: Economic Memorandum.* World Bank, Washington, DC, 1979.
5. Ahluwalia M.S. Rural poverty and agricultural performance in India. *J. Dev. Stud.* 298-323, 1977.
6. Ahluwalia M.S. Rural poverty in India: 1956/57 to 1973/74. In *India: Occasional Papers,* World Bank Staff Working Paper No. 279, pp. 1-42. World Bank, Washington, DC, 1978.
7. Albright K., McClelland J.F. III and Young W.H. Cooperation between agroindustry and the UN. *Food Policy* **2**, 44-59, 1977.
8. Aldrich S.A. Some effects of crop-production technology on environmental quality. *BioScience* **22**, 90-95, 1972. See also Refs 35, 57, 121, 136, 146, 149, 150, 188.
9. Ansari N. and Junker J. The economic aspects of parasitic diseases. *Biotechnol. Bioengng Symp.* 235-252, 1969.
10. Apple J.L. Intensified pest management needs of developing nations. *BioScience* **22**, 461-463, 1972. See also Refs 21, 53, 65, 68, 69, 72, 86, 88, 121.
11. Arata A.A. *Biological Control of Vectors.* Special Programme for Research and Training in Tropical Diseases (TDR/WD/76.22). World Health Organisation, Geneva, 1976.
12. Ariaratnam V. and Georghiou G.P. Carbamate resistance in *Anopheles albimanus:* cross resistance spectrum and stability of resistance. *Bull. Wld Hlth Org.* **51**, 655-659, 1974. See also Refs 2, 15, 84, 143, 153, 201.
13. Audy J.R. Aspects of human behaviour interfering with vector control. In *Vector Control and the Recrudescence of Vector-Borne Diseases,* pp. 67-82. Pan American Health Organisation, Washington, DC, 1972.
14. Batra C.P., Reuben R. and Das P.K. Studies of day-time resting places of *Anopheles stephensi* Liston in Salem (Tamil Nadu). *Indian J. med. Res.* **69**, 583-588, 1979.
15. Benson R.L. On the necessity of controlling the level of insecticide resistance in insect populations. *Bio-Science* **21**, 1160-1165, 1971.
16. Bhat H.R. A survey of haematophagous arthropods in Western Himalayas, Sikkim and Hill districts of West Bengal: records of mosquitoes collected from Himalayan region of Uttar Pradesh with ecological notes. *Indian J. med. Res.* **63**, 1583-1608, 1975.
17. Bhat H.R. A survey of haematophagous arthropods in Western Himalayas, Sikkim and Hill districts of West Bengal: records of mosquitoes collected from Himalayan region of West Bengal and Sikkim with ecological notes. *Indian J. med. Res.* **63**, 232-241, 1975.
18. Bhatt V.V. A decade of industrial development Bank of India. *Commerce* (Bombay) Annual Number, 9, 1974.
19. Biocontrol kills larvae of malaria-carrying mosquitoes. *BioScience* **28**, 607, 1978.
20. Bolton B. Agribuisiness and FAO. A critical view. *Food Policy* **2**, 240-244, 1977.
21. Bottrell D.G. and Adkisson P.L. Cotton insect pest management. *A. Rev. Ent.* **22**, 451-481, 1977.
22. Brader L. Integrated pest control in the developing world. *A. Rev. Ent.* **24**, 225-254, 1979.
23. Breeland S.G. *et al.* Observations on malathion-resistant adults of Anopheles albimanus Wiedermann in costal El Salvador. *Bull. Wld Hlth Org.* **43**, 627-631, 1970. See also Refs 30, 80, 83, 125, 126, 135, 139, 154, 155, 163, 168.
24. Brown A.W.A. Alternative methods of vector control. In *Vector Control and the Recrudescence of Vector-Borne Diseases,* pp. 59-66. Pan American Health Organization, Washington, DC, 1972.
25. Brown A.W.A., Haworth J. and Zahar A.R. Review article: Malaria eradication and control from a global standpoint. *J. med. Ent.* **13**, 1-25, 1976.
26. Brown E.R. Public health in imperialism: early Rockefeller programs at home and abroad. *Am. J. publ. Hlth* **66**, 897-903, 1976.
27. Brown E.R. *Rockefeller Medicine Men: Medicine and Capitalism in America.* University of California Press, Berkeley, 1979.
28. Bruce-Chwatt L.J. Resurgence of malaria and its control. *J. trop. Med. Hyg.* **77**, Suppl. 62-66, 1974.
29. Business International Corporation. Principal Latin American export commodities. *Busin. Latin Am. 27* February, 67, 1980.
30. Busvine J.R. Current problems in the control of mosquitoes. *Nature* **273**, 604-607, 1978.
31. Cairns J. Estimating hazard. *BioScience* **30**, 101-107, 1980.
32. Cassen R. India's human resources. In *India: Occasional Papers,* World Bank Staff Working Paper No. 279, pp. 124-228. World Bank, Washington, DC, 1978.
33. Chakravarti A.K. Foodgrain sufficiency patterns in India. *Geogrl Rev.* **60**, 208-228, 1970.
34. Chapman H.C. Biological control of mosquito larvae. *A. Rev. Ent.* **19**, 33-59, 1978.
35. Chasan D.J. How ya gonna keep bugs down (on the farm)? *Smithsonian* **9**, 78-85, 1978.
36. Chiang H.C. Pest management in corn. *A. Rev. Ent.* **23**, 101-123, 1978.
37. Cleaver H. Malaria and the political economy of public health. *Int. J. Hlth Serv.* **7**, 557-579, 1977.
38. Colbourne M.J. Prospects for malaria eradication with special reference to the Western Pacific. *Trans. R. Soc. trop. Med. Hyg.* **56**, 179-201, 1962.
39. Collins P. Science at the UN: coordination or chaos? *Nature* **275**, 84-85, 1978.
40. *1970 Commodities Year Book.* Commodities Research Bureau, New York, 1970.
41. *1978 Commodities Year Book.* Commodities Research Bureau, New York, 1978.
42. *1979 Commodities Year Book.* Commodities Research Bureau, New York, 1979.
43. Cohen J.E. Malaria, a moving target. *The New York Times* July, 1979.
44. Conly G.N. *The Impact of Malaria on Economic Development: A Case Study,* PAHO Scientific Publication No. 297. Pan American Health Organization, Washington, DC, 1975.
45. Cox F.E.G. Immunology of malaria. *Nature* **277**, 1979.
46. Croat T.B. The role of overpopulation and agricultural methods in the destruction of tropical eco-systems. *BioScience* **22**, 465-467, 1972.
47. Cross W.H. Biology, control and eradication of the boll weevil. *A. Rev. Ent.* **18**, 17-46, 1973.
48. Das P.K., Reuben R. and Batra C.P. Urban malaria and its vectors in Salem (Tamil Nadu): natural and induced infection with human *plasmodia* in mosquitoes. *Indian J. med. Res.* **69**, 403-411, 1979.
49. Datey C.D. *The Financial Cost of Agricultural Credit: A Case Study of Indian Experience,* World Bank Staff Working Paper No. 296. World Bank, Washington, DC, 1978.
50. Davidson G. and Zahar A.R. The practical implications of resistance of malaria vectors to insecticides. *Bull. Wld Hlth Org.* **49**, 475-483, 1973.
51. Davies J.E., Smith R.F. and Freed V. Agromedical approach to pesticide management. *A. Rev. Ent.* **23**, 353-366, 1978.
52. Davies J.E. Pesticide management problems of public health concern in Central America. In *Animal Disease Control in the Americas, 1977. Proceedings of the X Inter-American Meeting, at the Ministerial Level, on Foot-and-Mouth Diseases and Zoonoses Control, PAHO Scientific Publication No. 358.* Pan American Health Organization, Washington, DC, 1978.
53. Day P.R. (Ed.) *The Genetic Basis of Epidemics in Agriculture.* New York Academy of Sciences, New York, 1977.

54. Deck E. Federal and state pesticide regulations and legislation. *A. Rev. Ent.* **20**, 119-131, 1975.
55. de Zulueta J. and Garrett-Jones C. An investigation of the persistence of malaria transmission in Mexico. *Am. J. trop. Med. Hyg.* **14**, 63-77, 1965.
56. Desowitz R.S. How the wise men brought malaria to Africa. *Nat. Hist.* **85**, 36-44, 1976.
57. Dhanji F. *El Salvador: Cuestiones y perspectivas demográficas.* World Bank, Washington DC, 1979.
58. Dorner P. and Quirós R. Institutional dualism in Central America's agricultural development. *J. Latin Am. Stud.* **5**, 217-232, 1973.
59. Dutta H.M. and Ashok K. Malaria ecology: a global perspective. *Soc. Sci. Med.* **12**, 69-84, 1978.
60. Dutta H.M., Ashok K. and Vishnukumari G. The resurgence of malaria in Tamilnadu. *Soc. Sci. Med.* **13**, 191-194, 1979.
61. Economics Intelligence Unit. *Q. Econ. Rep. A. Suppl.* India, Nepal. 8-12, 1972.
62. Editorial. Pesticides and public health. *Indian J. publ. Hlth* **16**, 105-106, 1972.
63. Ejercito A. Agricultural control of malaria. *J. Philipp. Med. Ass.* **27**, 591-607, 1951.
64. Faich G. and Mason J. The prevalence and relationships of malaria, anemia, and malnutrition in a coastal area of El Salvador. *Am. J. trop. Med. Hyg.* **24**, 161-167, 1975.
65. Falcon L.A. and Smith R.F. *Guidelines for Integrated Control of Cotton Insect Pests,* FAO/AGPP: MISC/8. Food and Agricultural Organisation, 1973.
66. Falcon L.A. Problems associated with the use of arthropod viruses in pest control. *A. Rev. Ent.* **21**, 305-324, 1976.
67. Food and Agricultural Organization. *Evaluation of the Toxicity of Pesticide Residues in Food,* PL/1965/10 Rome, 1965.
68. Food and Agricultural Organization. *Integrated Pest Control.* Report of the Seventh Sessions of the FAO Panel of Experts, Rome, 1977.
69. Food and Agricultural Organization. *Pest Resistance to Pesticides and Crop Loss Assessment—1.* Report of the 1st session of the FAO Panel of Experts, AGP: 1976/M/10, Rome, 1977.
70. Food and Agricultural Organization. *FAO Production Yearbook, 1977,* Vol. 31. Rome, 1977.
71. Food and Agricultural Organization. *Report of the Ad Hoc Government Consultation on Pesticides in Agriculture and Public Health,* AGP: 1975/M/3. Rome, 1975.
72. Food and Agricultural Organization. *Report on FAO Expert Consultation on Pesticides and the Environment,* AGP: 1977/M/7. Rome, 1977.
73. Food and Agricultural Organization. *Report of the Fifth Session of the FAO Panel of Experts on Integrated Pest Control,* AGP/M/2, Rome, 1975.
74. Food and Agricultural Organization. *The State of Food and Agriculture, 1977.* Rome, 1978.
75. Food and Agricultural Organization. *FAO Trade Yearbook, 1977.* Vol. 31 Rome, 1977.
76. Food and Agricultural Organization (FAO)/United Nations Environmental Programme (UNEP). *The Development and Application of Integrated Pest Control in Agriculture: Formulation of a Cooperative Global Programme.* Report on an *ad hoc* session of the FAO panel of experts on integrated pest control, AGP: 1974/M/8. Rome, 1975.
77. Food and Agricultural Organization (FAO)/United National Environmental Programme (UNEP). *Impact Monitoring of Agricultural Pesticides. Proceedings of the FAO/UNEP Expert Consultation on Impact Monitoring of Residues from the Use of Agricultural Pesticides in Developing Countries.* AGP: 1976/M/4. Rome, 1976.
78. Food and Agricultural Organization (FAO)/United Nations Environmental Programme (UNEP). *Impact Monitoring of Residues from the Use of Agricultural Pesticides in Developing Countries.* Report of the FAO/UNEP expert consultation, AGPP: MISC/22. Rome, 1975.
79. Food and Agricultural Organization (FAO)/United Nations Environmental Programme (UNEP). *Integrated Pest Control.* Report of the eighth session of the FAO panel of experts, AGP: 1979/M/1. Rome, 1978.
80. Gabaldón A. Recrudescence of malaria. In *Vector Control and the Recrudescence of Vector-Borne Diseases,* pp. 23-40. Pan American Health Organization, Washington, DC, 1972.
81. Gabaldón A. What can and cannot be achieved with conventional anti-malaria measures. *Am. J. trop. Med. Hyg.* **27**, 653-658, 1978.
82. García M., Nájero-Morondo G. and Nájero-Morondo J. The interrelationships of malaria, agriculture, and the use of pesticides in malaria control. *Boln Of. Sanit. pan-am.* **6**, 15-25, 1972 (English edition).
83. García R. The control of malaria. *Environment* **14**, No. 5, 2-9, 1972.
84. Georghiou G.P. The evolution of resistance to pesticides. *A. Rev. Ecol. Syst.* **3**, 133-168, 1972.
85. George S. *How the Other Half Dies,* Allanheld, New York, 1977.
86. Ghatak S. and Turner R.K. Pesticide use in less developed countries. *Food Policy* **3**, 136-146, 1978.
87. Ghosh R.N. and Ghosh Ray. B. An observation on the study of resistance of *Culex pipiens fatigans* (Wied) collected from Calcutta against DDT. *Indian J. publ. Hlth* **18**, 189-191, 1974.
88. Glass E.H. and Thurston H.D. Traditional and modern crop protection in perspective. *BioScience* **28**, 109-115, 1978.
89. Godfrey D.G. Identification of economically important parasites. *Nature* **273**, 600-604, 1978.
90. Graham F. Jr. A tale of technology gone sour. *Nat. Hist.* **87**, No. 8, 124-128, 1978.
91. Grothaus R.H. and Weidhaas D.E. Control of arthropods of medical importance. In *Tropical Medicine.* *(Edited by Hunter G.W. III et al.)* pp. 783-802. W.B. Saunders, Philadelphia, 1976.
92. Hadjinicolaou J. and Betzois B. Resurgence of *Anopheles sacharovi* following malaria eradication. *Bull. Wld Hlth Org.* **48**, 699-703, 1973.
93. Halverson C. Indian grain crop hits record, exports to continue. *For. Agric.* 2 October, 7-8, 1978.
94. Hamon J. *et al.* Development, testing and introduction of envionmentally sound methods of malaria control. World Health Organisation Ms. MAL/WP/75,12, 1975.
95. Hamon J. *et al.* Environmental implications of the present malaria control practices. World Health Organisation Ms. MAL/WP/75,11, 1975.
96. Hargrove T.R. and Cabanilla V.L. The impact of semidwarf varieties on Asian rice-breeding programs. *BioScience* **29**, 731-735, 1979.
97. Haridi M. Inheritance of DDT resistance in species A and B of the *Anopheles gambiae* complex. *Bull. Wld Hlth Org.* **47**, 619-626.
98. Harrison G. *Mosquitoes, Malaria and Man: A History of the Hostilities since 1880.* Dutton, New York, 1978.
99. Headley J.C. Economics of agricultural pest control. *A. Rev. Ent.* **17**, 273-286, 1972.
100. Hedman P. *et al.* A pocket of controlled malaria in a holoendemic region of West Africa. *Ann. trop. Med. Parasit.* **73**, 317-325, 1979.
101. Henig R.N. Agriculture's strange bedfellows: CAST-industry tie raises credibility concerns. *BioScience* **29**, 9-12, 1979.
102. Hobbs J. and Mason J. Evaluation of propoxur spraying in houses as a malaria control measure in El Salvador. *Mosquito News* **34**, 156-159, 1974.
103. Holden C. Environmental assessment sought for federal actions abroad. *Science* **201**, 598-600, 1978.
104. Hungary's careful use of pesticides for plant protection. *Nature* **278**, 498, 1979.
105. Husainy Z.H. 1978. Some observations on *Anopheles* (Cellia) *varina* Iyengar, 1924 in Bastar District. Madhya Pradesh (Diptera: Culicidae). *Indian J. med. Res.* **68**, 264-267, 1978.
106. Government of India, Ministry of Planning. *Statistical Abstract, India, 1977.* New Delhi, 1978.
107. Instituto Centroamericano de Investigación y Tecnología Industrial (ICAITI). *An Environmental and Economic Study of the Consequences of Pesticide Use in Central American Cotton Production,* ICAITI Project No. 1412. Guatemala, 1977.
108. Irving G.W. Jr. Agricultural pest control and the environment. *Science* **168**, 1419-1424, 1970.
109. Jeffery G.M. Malaria control in the twentieth century. *Am. J. trop. Med. Hyg.* **25**, 361-371, 1976.
110. Johnson I.E. India's economy again benefits from good farm output. *For. Agric.* May, 16-18, 1979.
111. Johnson J.E. The public health implications of widespread use of the phenoxy herbicides and picloram. *BioScience 21,* 899-905, 1971.
112. Just R.E. Schmitz A. and Zilberman D. Technological change in agriculture *Science* **206**, 1277-1280, 1979.
113. Kaul H.N. *et al.* Insecticide susceptibility studies in populations of *Aedes aegypti* from Maharashtra State, India. *Indian J. med. Res.* **64**, 1760-1768, 1976.
114. Kerr J. A. Lessons to be learned from failures to eradicate. *Am. J. publ. Hlth* **53**, 27-30, 1963.
115. Kidwai A. Pakistan reorganises agricultural research after harvest disaster. *Nature* **277**, 169, 1979.
116. Kiritani K. Pest management in rice. *A. Rev. Ent.* **24**, 279-312, 1979.
117. Lepes T. Present status of the global malaria eradication programme and prospects for the future. *J. trop. Med. Hyg.* **77**, Suppl. 47-53, 1974.
118. Ling L.L. Plant pest control on the international front. *A. Rev. Ent.* **19**, 177-196, 1974.
119. Linking science to technology: harder than it seems for the Third World. *Nature* **275**, 467, 1978.
120. Lappé F.M. and Collins J. *Food First.* Ballantine, New York, 1978.
121. Luck R.F., van den Bosch R. and García R. Chemical insect control—a troubled pest management strategy, *BioScience* **27**, 606-611, 1977.
122. Macdonald W.W. The response of vectors and of nature to current eradication and control measures. In *Vector Control and the Recrudescence of Vector-Borne Diseases,* pp. 41-58. Pan American Health Organization, Washington, D.C., 1972.
123. Mahadev P.V.M. *et al.* Studies on the mosquitoes of Bankura district. West Bengal: adult populations. *Indian J. Med. Res.* **68**, 248-263, 1978.
124. Malaria control—a reoriented strategy. *WHO Chron.* **32**, 226-230, 1978.
125. The malaria situation in 1976. *WHO Chron.* **32**, 9-17, 1978.
126. Mason J. Patterns of *Plasmodium vivax* recurrences in a high-incidence coastal area of El Salvador, C.A. *Am. J. trop. Med. Hyg.* **24**, 581-585, 1975.
127. Matthews W.H. Environmental analysis and policy planning *BioScience* **29**, 23-25, 1979.
128. McEvers N.C. Socio-economic considerations of the Special Programme. Unpublished Working Paper TDR/WP/76.31. World Health Organization, Geneva, 1976.
129. McIntire G. Spoiled by success. *Environment* **14**, No. 6, 14-29, 1972.
130. Menzie C.M. Fate of pesticides in the environment. *A. Rev. Ent.* **17**, 199-222, 1972.
131. Metcalf R.L. China unleashes its ducks. *Environment* **18**, No. 9, 14-17, 1976.
132. Mojamdar V.G. Response of malaria vectors to insecticides in South Gujarat. *Indian J. publ. Hlth* **29**, 107-114, 1975.
133. Molineaux L, *et al.* The impact of propoxur on *Anopheles gambiae* s.l. and some other anopheline populations, and its relationship with some pre-spraying variables. *Bull. Wld Hlth Org.* **54**, 379-389, 1976.
134. Nature. Parasitology Supplement. **273**, 595ff., 1978.
135. Nave Rebollo O., Parada E.S. and Guerra A.S. El paludismo en El Salvador: análisis de las campanas de control y erradicación. *Revta Inst. Invest. Med.* **2**, 3-30, 1973.
136. Norgaard R.B. The economics of improving pesticide use. *A. Rev. Ent.* **21**, 45-60, 1976.
137. Norman C. Global research: who spends what. *New Scient.* 20 July, 279-280, 1979.
138. Ojha P.D. and Bhatt V.V. Pattern of income distribution in India: 1953-55 to 1963-65. *Sankhyá* **36**, 163-166, 1974.
139. Palacios Fraire S. Problemas que dificultan el desarrollo normal de los programas de erradicación de la malaria. *Bol. Of. sanit. pan-am.* **79**, 375-387, 1975.
140. Pan American Health Organization. *Guide to the Chemotherapy of Human Malaria,* Scientific Publication No. 373. Washington, D.C., 1970.
141. Pan American Health Organization. *Health Conditions in the Americas, 1973-1976,* Scientific Publication No. 364, Washington, D.C., 1978.
142. Pan American Health Organization. *Ten-Year Health Plan for the Americas.* Final Report of the III Special Meeting of Ministers of Health of the Americas. Official Document No. 118, Washington, D.C., 1973.
143. Pan American *Vector Control and the Recrudescence of Vector-Borne Diseases.* Proceedings of a Symposium held during the Tenth Meeting of the Pan American Health Organization Advisory Committee on Medical Research. Scientific Publication No. 238, Washington, D.C., 1972.
144. Parker J.B. Jr. India has near-record foodgrain harvests. *For. Agric.* 2 January, 5, 1978.
145. Payne D. *et al.* Impact of control measures on malaria transmission and general mortality. *Bull. Wld Hlth Org.* **54**, 369-379, 1976.
146. Perkins J.H. Boll weevil eradication. *Science* **207**, 1044-1049, 1980.
147. Petges R. Personal communication. Tobacco and Cotton Division, FAS, USDA, 1980.
148. Philogene G.J.R. Physiological studies and pest control. *BioScience* **22**, 715-717, 1972.
149. Pimentel D. *et al.* Benefits and costs of pesticide use in U.S. food production. *BioScience* **28**, 772-784, 1978.
150. Pimentel D. *et al.* Pesticides, insects in foods and cosmetic standards. *BioScience* **27**, 178-185, 1977.
151. Pimentel D. Realities of a pesticide ban. *Environment* **18**, No. 2, 18-29, 1973.
152. Pimentel D. and Pimentel M. The risks of pesticides. *Nat. Hist.* **88**, 24-33, 1978.
153. Plapp F.W. Biochemical genetics of insecticide resistance. *A. Rev. Ent.* **21**, 179-197, 1976.
154. Rachou R.G., Schinazi L.A. and Lima M.M. An intensive epidemiological study

of the causes for the failure of residual DDT-spraying to interrupt the transmission of malaria in Atalaya and Falla, two villages of the coastal plain of El Salvador, Central America. *Revta bras. Malar. Doenc. trop.* **25**, 1-293, 1973.
155. Rachou R.G. *et al.* Synoptic epidemiological studies of malaria in El Salvador. *Am. J. trop. Med. Hyg.* **14**, 1-62, 1965.
156. Rajagopal R. Malathion resistance in *Anopheles culicifacies* in Gujarat, *India J. med. Res.* **66**, 27-28, 1977.
157. Rajagopalan P.K., Chandrahas R.K. and Paniker K.N. Mosquito collections in Pattukottai and adjacent localities in Thanjavvur district (Tamil Naju), with particular reference to *Anopheles culicifacies* Giles. *India J. med. Res.* **69**, 589-597, 1979.
158. Reaching toward a malaria vaccine. *BioScience* **28**, 144, 1978.
159. Redfearn J. International research could ease world food problem. *Nature* **274**, 7, 1978.
160. Reutlinger S. The level of stability of India's foodgrain consumption. In *India: Occasional Papers*, World Bank Staff Working Paper No. 279, pp. 92-123. World Bank, Washington, D.C., 1978.
161. Roy R.G. Presumptive treatment of *P. vivax* and *P. falciparum* cases with 600mg chloroquine base in Tamil Nadu. *Indian J. med. Res.* **68**, 741-743, 1978.
162. Roy R.G. and Ghosh R.B. Relationship of the annual parasite incidence with the child spleen and parasite rates in resurgent malaria in Karnataka State. *Indian J. med. Res.* **69**, 739-745, 1979.
163. Roy R.G. *et al.* Distribution of human *plasmodia* in Karnataka and Tamil Nadu states in the reappearing phase of malaria in 1970 and 1975. *Indian J. med Res.* **69**, 53-59, 1979.
164. Roy R.G. *et al.* Response of *P. falciparum* infection to chloroquine therapy in some parts of Tamil Nadu and Karnataka states. *Indian J. med. Res.* **63**, 1464-1471, 1975.
165. Roy R.G. *et al.* Malaria in Lakshadweep islands. *Indian J. med. Res.* **67**, 924-925, 1978.
166. Roy R.G. *et al.* Susceptibility of *A. stephensi* from some urban areas in Tamil Nadu and Karnataka to some commonly used insecticides. *Indian J. med. Res.* **67**, 947-952, 1978.
167. Roy R.G. *et al.* Susceptibility status of adult *A. stephensi* to Propoxur in Tamil Nadu. *Indian J. med. Res.* **68**, 744-746, 1978.
168. Roy R.G. *et al.* The urban malaria problem in Tamil Nadu state. *Indian J. med. Res.* **64**, 313, 316, 1976.
169. Ruesink W.G. Status of the systems approach to pest management. *A. Rev. Ent.* **21**, 27-44, 1978.
170. Schad G.A. and Rozeboom L.E. Integrated control of helminths in human populations. *A. Rev. Ecol. Syst.* **7**, 393-420, 1976.
171. Sharmugham C.A.K. *et al.* Results of treatment of *Plasmodium* infection with chloroquine in some parts of Tamil Nadu. *Indian J. med. Res.* **67**, 926-928, 1978.
172. Sharmugham C.A.K. *et al.* Treatment of *P. falciparum* infection with chloroquine and primaquine in Salem and Sathyamangalam towns of Tamil Nadu. *Indian J. med. Res.* **64**, 1314-1317, 1976.
173. Singh I. *Small Farmers and the Landless in South Asia.* World Bank Staff Working Paper No. 320. World Bank, Washington, 1979.
174. Sitaraman N.L. *et al. Anopheles varuna* Iyengar, 1924 in Rameswaram Island, Tamil Nadu state—a short communication. *Indian J. med. Res.* **67**, 581-582, 1978.
175. Smith A., Hansford C.F. and Thomson J.F. Malaria along the southernmost fringe of its distribution in Africa: epidemiology and control. *Bull. Wld Hlth Org.* **55**, 95-103, 1977.
176. Smith R.J. U.S. beginning to act on banned pesticides. *Science* **204**, 1391-1394, 1979.
177. Sotiroff-Junker J.A. Bibliography on the Behavioural, Social and Economic Aspects of Malaria and its Control. World Health Organisation, Geneva, 1978.
178. Stern V.M. Economic thresholds. *A. Rev. Ent.* **18**, 259-280, 1973.
179. Tata Services Ltd. *Statistical Outline of India 1978.* Bombay 1978.
180. Taylor W. The U.N.'s corporate cronies. *Multrinatn. Monit.* **2/80**, 24-26, 1980.
181. Tullos A. The great hookworm crusade. *S. Exp.* **6**, 40-49, 1976.
182. United Nations Economic Commission on Latin America. *Economic Survey of Latin America.* New York, 1975.
183. United Nations Development Programme/World Bank/World Health Organisation Special Programme, 1978. *Action Against Tropical Diseases, Second Annual Report.* Geneva: World Health Organisation, Geneva, 1978.
184. United States Department of Agriculture, Foreign Agriculture Service. Central American cotton crops larger; 1977/78 exports up. *For. Agric.* 23 January, 10-11, 1978.
185. United States Department of Agriculture, Foreign Agriculture Service. India's big cotton crop ends ban on exports. *For. Agric.* 2 February, 8, 1979.
186. United States Department of Agriculture, Foreign Agriculture Service. India's farm output seen increasing in 1978. *For. Agric.* 27 February, 10-11, 1978.
187. United States Department of Agriculture, Foreign Agriculture Service. Indian plan targets sharp crop gains. *For. Agric.* 18 December, 8-10, 1978.
188. van den Bosch R. The cost of poisons. *Environment* **14**, No. 7, 18-31, 1972.
189. Webster B. New approaches sought in war on pests. *New York Times* 5 June, C1, C4, 1979.
190. Weir D., Shapiro M. and Jacobs T. The boomerang crime. *Mother Jones* November, 1979.
191. West T.F. and Campbell G.A. *DDT: The Synthetic Insecticide.* Chapman & Hall, London, 1946.
192. Wittwer S.H. Future technological advances in agriculture and their impact on the regulatory environment *BioScience* **29**, No. 10, 603-610, 1979.
193. World Bank. *Agricultural Land Settlement.* Washington, D.C., 1978.
194. World Bank. *Paraquay: Regional Development in Eastern Paraquay.* Washington, D.C., 1978.
195. World Bank/Interamerican Development Bank. *Informe general sobre el desarrollo agropecuario y rural de El Salvador.* Washington, D.C., 1976.
196. World Health Organisation. Biological control of insect vectors of disease. *Bull. Wld Hlth Org.* **56**, 377-378, 1978.
197. World Health Organisation. *Chemistry and Specifications of Pesticides.* Second Report of the WHO Expert Committee on Vector Biology and Control, Technical Report Series No. 620. Geneva, 1978.
198. World Health Organisation. Classification of pesticides by hazard. *Bull. Wld Org.* **56**, 872, 1978.
199. World Health Organisation. *Ecology and Control of Vectors in Public Health.* Twenty-first Report of the WHO Expert Committee on Insecticides, Technical Report Series No. 561, Geneva, 1975.
200. World Health Organisation. *Engineering Aspects of Vector Control Operations.* First Report of the WHO Expert Committee on Vector Biology and Control, Technical Report Series No. 603. Geneva, 1977.
201. World Health Organisation. *Resistance of Vectors and Reservoirs of Disease to Pesticides.* Twenty-second Report of the WHO Expert Committee on Insecticides, Technical Report Series No. 585. Geneva, 1976.
202. World Health Organisation. *Malaria Control in Countries Where Time-Limited Eradication is Impracticable at Present.* Report of a WHO Interregional Conference, Technical Report Series No. 537. Geneva, 1974.
203. World Health Organisation. *World Health Statistics Annual. Geneva,* Yearly Updates.
204. World Health Organisation Expert Committee on Malaria. *Seventeenth Report,* Technical Report Series No. 640. Geneva, 1979.
205. World Health Organisation/Food and Agricultural Organisation. *Pesticide Residues in Food.* Report of the 1975 Joint Meeting of the FAO Working Party of Experts on Pesticide Residues and the WHO Expert Committee on Pesticide Residues, WHO Technical Report Series No. 592; FAO Plant Production and Protection Series No. 1. Geneva, 1976.
206. Wright H.W., Fritz R.F. and Haworth J. Changing concepts of vector control in malaria eradication. *A. Rev. Ent.* 17, 75-102, 1972.
207. Young M.D. Malaria. In *Tropical Medicine* (Edited by Hunter G.W. III *et al.*), pp. 353-396. W.B. Saunders, Philadelphia, 1976.
208. Yuthavong Y. Science and technology in Southeast Asia. *Nature* **274**, 634-636, 1978.
209. Zahar A.R. Review of the ecology of malaria vectors in the WHO Eastern Mediterranean Region. *Bull. Wld Hlth Org.* **50**, 427-440, 1974.
210. Zwerdling D. The pesticides plague. *Washington Post* 5 March, 1978.

By kind permission of the authors reprinted from the Journal of Medicine, Vol 17, No. 5, 1983.

Georgeanne Chapin and Robert Wasserstrom are from the Center for Social Sciences, Columbia University N.Y. and from the World Resources Institute. Washington D.C.



A PROFOUNDER ECOLOGY

The Hindu View of Man and Nature

by Krishna Chaitanya

Now that the consequences of the seriously wrong assumptions man made about himself and, consequently, about the way in which he should relate to the world, are surfacing in one catastrophe after another, and each greater than the preceding, one does not need to be exceptionally perceptive to sketch the main features of the world-view that has brought us to the brink of a vast cesspool of pollution or the crater of a nuclear bomb.

Building up this view with obdurate obtuseness, we started with a physics of the dead particle which had no power of self-movement but moved only when pushed or pulled by a force wholly external to it. On this base we erected a biology of merely reflex reaction which made organisms mere marionettes, of random genetic mutations which made them fortuitous and undesigned products of chance and the deterministic necessity of the laws of dead matter, and of bitter survival struggle which endorsed murderous competition among themselves. Then we proceeded to create a psychology of no psyche or an irrational and unconscious psyche which made all reasoning a crafty rationalisation by a self-centred ego. The economics of deified self-interest and the politics of pressure groups and power blocs emerged with logical inevitability from such presumptions. The end result has not been quite happy, to say the least. The number of people who have started wondering if man will be around when the year of our Lord 2000 comes along is rapidly increasing.

The Faustian man of the technological age has endless faith in his capacity to fix any problem, or had; because smug talk about the clean bomb and the harmless fallout and brave talk about the feasibility of building bomb shelters for millions, meant to reassure the population, have begun to sound grotesquely unfunny even to the manipulators of the people who sell the line. But such noises will continue to be heard. However, more serious minds are by now convinced that redemption is possible only through a radical change in outlook. The voices have as yet to build up into a grand, totally assuring polyphonic chorus; but each theme seems to have winged its way from the heights man had once rapport with but had lost sight of.

Benthall[1] feels that "the balanced use of material resources will be hard to achieve for a society that lacks belief in non-material ends". Leo Marx[2] is convinced that the balance of nature "is related to the balance of *human* nature". Daly,[3] who coined 'growthmania' and other astringent diagnostic terms for our society and has written a fine book on steady-state economics, rejects "the mechanistic, reductionistic, positivistic mode of thought that came to be identified with a certain phase of the evolution of science", and feels convinced that redemption is not possible till we recover "teleology and purpose, the dominant concepts of an earlier age" and recognise and correct "the error of omission in our past treatment of ultimate means and of the Ultimate End". Lifton,[4] who wrote a great book on Hiroshima, has stressed that the ecology movement will succeed only if the new relationship to nature becomes "part of a more

general psychic renewal", and the conviction is gaining that this renewal will have to be religious in temper. Roszak[5] traces all the maladies of the modern world to man's loss of "a sure purchase on the vertical dimension" that linked earth and sky, and Aldo Leopold[6] is pessimistic about the conservation movement because "no important change in ethics was ever accomplished without an internal change in our intellectual emphasis, loyalties, affections and convictions" while "today's religion and philosophy have not yet heard" of the ecological movement. And we have Ophuls[7] who tried gamely to extend Adam Smith's philosophy of individual self-interest to include and strengthen the conservation movement, failed, and came to this conclusion. "If human society is reordered, it will almost certainly have a religious basis—whether it is Aristotelian political and civic excellence, Christian virtue, Confucian rectitude, Buddhist compassion, Amerindian love of land, or something similar, old or new". More briefly, what is required is "restoring the category of the sacred, the category most thoroughly destroyed by the scientific enlightenment", as Hans Jonas[8] has put it.

This prologue should hopefully be a plausible apology (one feels apologetic when having to talk about the religious and the sacred, about values, these days) for presenting a brief account of the old Hindu worldview which had many perceptions that can help us in our predicament. I cannot help adding the wry comment that the material will be as new to the modern Indian as to many readers in the west.

As the centuries-old lines of evolution of the major concepts cannot be traced in detail in a short paper, we may keep in mind this important feature: in the initial phases—generally represented by Vedic poetry which Max Müller called the earliest utterance of Indo-European man—the sensing was pre-reflective, poetic, mythopoeic, analogic rather than syllogistic, convictional rather than merely propositional. Incidentally, the values of these modalities are gaining increasing recognition today. But this sensing did need to be firmed up by integrative, coherent, systemic thinking, and this was achieved in the later phase, primarily by the *Gita* which is a great inset dialogue in the *Mahabharata*, the longest epic poem of the world.

Both scientific exploration and mythopoeic sensing seek to reach the invisible reality behind the visible manifestation. Galileo said that "the book of the universe is written in the mathematical language". Burtt,[9] who quotes this, sums up the result to which a quest based on this assumption necessarily drifted. "Quite naturally enough, along with this exaltation of the external world as more primary and more real, went an attribution to it of greater dignity and value . .. Man begins to appear for the first time in the history of thought as an irrelevant spectator and insignificant effect of the great mathematical system which is the substance of reality." When, with Galileo, this mathematical grid failed to accommodate even the colours, sounds and fragrances of the earth, its forthright rejection eventually of a subjective centre in created beings and a subjective intentionality behind creation had quite an illogical logic. The logic is illogical because the denial of consciousness, means and purpose by say a behaviourist still presupposes a consciousness purposefully arguing its idea of the meaning of reality.

Gods in Space

The mythopoeic sensibility also moves from the visible to the invisible. But it first appraises the visible, and notes that all things about the world generally cooperate to a benign end: fostering the emerging of life, sustaining its growth and varied development. The geometrodynamism of people like Wheeler and Tilson,[10] for instance, develops Einsteinian concepts about gravitation and the curvature of space-time and derives matter from the mere geometry of pure, empty space. But what the Vedic poet derived from empty space was gods, or beings of the finest kind. Aditi was pure space. But this visible emptiness pointed to an invisible presence. "Aditi is the intermediary space. Aditi is the celestial sphere. Aditi is the mother, the father, the son. Aditi is all gods, the five classes of being, the created and the cause of creation."[11] The wind too is invisible, but is a real, benign deity. In the Atharva Veda, we find a prayer to the winds to send clouds bearing rain which will fill the rivers and make the corn grow in the fields. Even more subtle is the action of the winds on the waters. "When you breathe on them, the waters all become tasteful and medicinal herbs attain potency."[12] The metaphysical principle of a changeless being abiding behind the changing phenomena was derived by poetic sensing, not mathematical reductionism. Dawn is as old as time, but the goddess is radiantly young at every appearance. "Immortal, she moves on in her own strength, undecaying."[13] Agni, or fire, is also an old yet ever young deity, for he flames forth in undiminished brightness when he is lit every day. Further, though a god, he has taken up his abode among mortals in their domestic hearth. He is termed the guest, the lord of the house. This poetic perception will later lead to the philosophical realisation that the transcendent can also be the immanent. The energy of fire manifests itself in numerous forms, which suggests that behind the plurality of the world is a unity. Finally, Agni mediates between man and all the gods, for it is he who carries the clarified butter and the crushed juice of Soma leaves, symbols of the life-supporting productivity of the earth, offered in the simple early ritual, to the ambient space which is thus nourished and invigorated. This strengthening of the ambience is needed, for the continued well-being not only of the race of man, but of the entire family of created things. For they all are part of the grand design and their well-being too is the concern of deity. To each order of creation, deity has assigned a realm. "It is you who have fixed their realm in water for aquatic life. The wild beasts have spread over the steppes. The woods belong to the birds. None of them transgresses the laws of Savita."[14] None of them except man, we should correct today, with the bitter wisdom of our hindsight.

Aldo Leopold has indicated how

man can discover the right way of living that can renew, sustain and strengthen the grand ecological harmony of the cosmos. "A thing is right when it tends to preserve the integrity, stability and beauty of the biotic community. It is wrong when it tends otherwise." But the right way is discovered through many modalities. Intuition can be pre-reflective or post-reflective. In the pre-reflective early phase, associations build up and interdictions of wrong acts emerge in ways which may be alien to our predominantly intellectual approach; but we shall be the losers if we failed to note that the resultants were salutary and that our own conclusions should converge towards them whatever be our mental procedure.

The Sin of Greed

The strange sounds that emanate from the heart of the woods, especially at the hour of twilight, the dim shapes that the eye seems to discern in the depth of the forest, generated that numinous awe which Rudolf Otto[15] saw as the originating base of the idea of the holy. This, as well as the perception of the surging life of nature, that attains to a lush growth without the help of a tiller or the plough, can be seen in a Vedic hymn to Aranyani, the goddess of the forest. "The forest creaks like a cart at eventide. Who tarries in the forest-glade, thinks to himself, 'I heard a cry'. Sweet-scented, redolent of balm, replete with food, yet tilting not, mother of beasts, the Forest Deity, her have I magnified with praise."[16] The wanton destruction of forests is not just something merely inexpedient, it is a sacrilege.

In the Santi Parvan (Book of Peace) of the *Mahabharata* which, it must be mentioned here, is an extended discourse on right living in all its facets, Bhishma, the preceptor, narrates a legend. When Indra slays Vritra, Brahmahatya, a terrible retributive apparition like the Erinyes or Furies of Greek myth, pursues him. Indra seeks refuge with the god Brahma, who tries to contain the apparition by allotting her specific dwelling places. One of these is the flora of the earth—the trees, shrubs and herbs. But they plead that this is too terrible a burden and they should be allowed to pass it on to somebody else. Then Brahma decrees that whenever men cut down trees out of season and out of greed, the sin will automatically transfer to them.[17]

In the same epic, there is a discourse by the sage Markandeya on the four Yugas or epochs of mankind. This is a remarkable anticipation of the systematisation of history by Pitirim Sorokin[18] as a recurring cycle of ideational, idealistic and sensate cultures. One feature of the Kali epoch, when man's nature will sink to the nadir of grossness, will be that he will indulge in the wanton destruction of the flora of the earth.[19] Incidentally, according to this scheme, we are in the Kali epoch now. Probably it was obvious to the readers without needing my mention. Finally, the Vedic poet realised that the peace he yearned for man was indivisible, it had to be shared with the world. "Peace of sky, peace of earth, peace of waters, peace of plants; peace of trees, peace of the universe, peace of peace, may that peace come to me:"[20]

In the state of Kerala in the old days, every sizeable homestead had a sacred wood in a corner of the grounds where the chthonic deities were worshipped. But rampant urbanisation destroyed them as well as the great tropical forests of the mountainous hinterland. In a poem entitled *Kerala stripped naked* (1961) Kunjiraman Nair made a terrible indictment of this destruction. But Nair is a traditionalist and his emphasis on the aspect of sacrilege seemed rather obscurantist to many who were rather proud of their emancipation from outmoded traditional beliefs. Nevertheless, I should think that it is because tradition is still strong in that part of India that the project for the deforestation of the Silent Valley—30,000 hectares of virgin forest rich in rare flora and fauna—led to widespread protest and has been stayed. The Himalayan region, where the tradition is not so strong, is being denuded of forests at appalling speed.

The mention of the Himalayas brings to mind another instance of tradition seeking benign ends through poetic legend. Siva is the deity of the Himalayas. When the Ganges, which was a river of heaven, was prayed to for coming to the earth, she said it could not be done because the force of her descent would shatter the earth. But the matted locks of the great Siva broke the fall and the impetus of the waters did not destroy the earth. The locks stand for the Himalayan forests that break the fury of tropical rain and conserve both the water and the top soil of the slopes in ways beneficial to man. There is also a further and profounder perception deep-hidden in the legend. Bhagiratha is the legendary king whose devotion made the Ganges consent to come to the earth. But he brought the river, not primarily for supporting the material life of the people, but for leaving the ashes of his ancestors with her sacred waters and absolving them of a sacrilege they had committed. Now, this kind of perspective seems rather difficult to assimilate for us. But perhaps we can begin to sense its deep validity if we recall the lines from Keats:

The moving waters at their priest-like task
Of pure ablution round earth's human shores.

This may probably help us to make the transition from pre-reflective to post-reflective perception. For a poetic attitude towards life can conserve all that is valid in antique sensings, reconciling reason too, whose first critique of old modalities of thought is often hostile, sterile, destructive.

It is time our age started having second thoughts about the intellectuality of which it is inordinately proud. Weisskopf[21] points out that economicism and sensatism have combined to create a restrictive intellectuality that employs instrumental rationality which can use means but can say nothing about ends. And Kahler[22] contrasts rationality, which is a functionalisation of the mere procedure of reason and has therefore become anti-human, with reason which is a human faculty, inherent in the human being as such. But when the evolving Indian psyche recognised the importance of the intellect in probing the hidden reality of the cosmos, it kept in mind that affective responses to the world were also cognitive modalities and therefore sense and sensibility should work together. "Searching in their heart with intellect"—a beautiful expression for the combined enquiry by feeling and thought—"the sages found the source of being in non-being."[23] The desire of the One was to become the Many and to indwell all of them, "undivided, though seemingly divided."

This unity of origin, prolonged as active presence in all the proliferating forms created by evolution, is the grander ecological design which is the ontological basis of the ecology which is becoming an increasing concern with us today though we are yet to sense its deeper reach. But an intuition of the profounder meaning of the old Hindu concept of the 'earth-family' *(vasudhaiva kutumbakam)* is occasionally seen in contemporary writing as, for instance, when William Irwin Thompson says in *At the Edge of History*, "Meditating between *Nous* and Cosmos is Logos." Lynn White[24] too has made an important point. The scientific

Nagini. Detail of the descent of the Ganges.

movement that developed ever since "Galileo rolled balls down inclined planes" was isolationist, proliferating into specialised disciplines that soon lost touch with one another. "Ecological science is, on principle, anti-isolationist. It is the science of totalities. As such it is anti-scientific, as science at present is usually conceived and practised." The Indian psyche was able to gain an insight into the totality because it probed with all the powers of the human person, both cognitive and affective. It saw the world-system as a *Vangmaya* or a great semantic, meaningful, utterance, as *Rita* or order which latter term corresponds to the Logos or Tao of other cultures.

The sure purchase on the vertical dimension, the loss of which was stressed by Roszak, was gained by Indian thought through its analysis of reality as an evolving verity. The word *Sat* is reality in the metaphysical sense. Reality is not brute, disparate, isolated fact. Deity, the ultimate reality, reveals himself as *Rita*, eternal order.[25] In nature, this order establishes the directed, teleological rhythm of processes. It is this rhythm that makes organic life, and finally the social life of man, possible. Thus, in the sphere of human life, *Sat*, the real, becomes *Satya*, truth, or moral integrity. Like Plato, the Vedic poet saw Reality as the embodiment and source of the three ultimate values: truth, goodness and beauty. "Firm-seated are the foundations of *Rita*. In its lovely forms are many splendid beauties. By Eternal law they give us long-lasting nurture. By Eternal Law have the worlds entered the universal order."[26] *Satya* or integrity of living in accordance with a trans-human scenario was continuously strengthened by remembering the total design and man's own role in further progressing it; and the deep faith in the grander ecology was expressed with the help of an image of surrealistic power—a tree with roots above and branches growing downward. "In the limitless region, Varuna, of hallowed power, holds erect the tree's stem. The root is high above and the branches stream downward. May they sink within the secret recesses of our own being!"[27]

The same thought, aspiration and

commitment can be seen in the great Vedic Hymn to Earth.[28] The poet begins by expressing his ardent faith that what upholds the earth is the working of the eternal order, and man's consecrated living. He contemplates the achievement of that order which has bound "rock, soil, stone and dust" so that "trees, lords of forests, stand ever firm", which keeps in "unfailing flow, day and night, the waters that are common to all", and has brought up "corn fields that nourish quadrupeds and bipeds". His plea is as much a prayer as a commitment. "Whatever I dig from thee, Earth, may it have quick growth again! O purifier, may we not injure thy vitals or thy heart!" And he concludes: "Earth, my Mother, set me securely with bliss in full accord with Heaven!"

After a bitterly disappointing experience with a science that decayed into scientism and a philosophy that took to discussing utter trivialities with enormous seriousness, we have begun to realise that poetry may possibly provide redemption. Gaia is the Earth Mother of ancient Greek myth and worship; and in advancing his 'Gaia hypothesis', Lovelock[29] stresses the need to go beyond the mind-set of mere expediency to a sense of the sacramental. The composition of the earth in all its richness, and the processes of the earth in all their variety, form a cybernetic system that maintains conditions in the earth optimum for the flourishing of life. Endorsing this suggestion for deep change in attitudes, Roszak[30] writes: "The system seems to exhibit the behaviour of a single organism, even of a living creature. But if the hypothesis is convenient, why not yield to its poetry as well? For the earth is in no way more beautifully known to us than in the ancient imagery of goddess and mother. And then recall what James Watson said of the double helix of the DNA molecule: 'In science there can be ideas that are too beautiful not to be true'."

Schumacher[31] said that the whole of human life is a dialogue between man and his environment, a sequence of questions and responses. We pose questions to the universe by what we do and the universe, by its response, informs us whether our actions harmonise with its laws or violate them. If we persist in our violations in spite of repeated signals of warning, there will be a hardening of consequences that will become Karmically inescapable. Ellul[32] has clarified this in relation to the repeated transgressions of our technological society. The Vedic poet meant the same thing when he said that *Rita*, though benign, can be 'stern and fierce', in respect of transgressions. Brihaspati rides the fearsome chariot of *Rita* for destroying the wicked.[33] But the wicked perish here because they are—to borrow the idiom of Aeschylus which has the same deep ontological resonance as the Vedic—shattered against the throne of Eternal Law. The systemic unity of the great design that is the world makes the Vedic poet realise that ideal conduct is expected of him if he is to benefit by the bounties of nature. He prays for nature's benediction. "May sweet to us be the night and sweet the dawns; sweet the dust of the earth! Sweet be our father the sky to us!" But he prefaces the prayer with an acknowledgement of his own obligation. "For one who lives according to Eternal Law, the winds are full of sweetness, the rivers pour sweets. So may the plants be full of sweetness for us!"[34]

Krishna and Responsible Man

While pre-reflective, mythopoeic sensing generally characterises the phase of the Vedas, we can see from the above that on many occasions they embody rational assessments and integrate them in a poetic reading of the world. Nevertheless, it would be generally correct to say that systemic and comprehensively integrative thinking was perfected in the *Gita* where the author of the *Mahabharata* presents his world-view through Krishna, the august character he creates. The concepts were further developed in the *Harivamsa* and the *Bhagavata* which elaborated the Krishna story. It is impossible to give a critically annotated account of this world-view in its entirety and complexity in a short paper; that will have to await the completion of a major project on which the writer is now working. But an account of the concepts directly bearing on the profounder ecology that is the theme of this paper is attempted here.

Sturt[35] has shown how the image of responsible yet responsive man relating himself to the world in ways which can make it better and his own being finer is threatened alike by philosophical views which otherwise seem the opposites of each other. "One adversary tells each of us: 'You are a transitory resultant of physical processes'; and the other: 'You are an unreal appearance of the Absolute.' Naturalism and Absolutism, antagonistic as they seem to be, combine in assuring us that personality is an illusion." What Sturt calls absolutism is the view which accepts only transcendental Being as real and rejects Becoming, world, life as unreal—in the manner of the Eleatics of Greece and the rigorous monists of India. But the *Bhagavata* affirms that this earth, this river, this Vraja (Krishna's pastoral village on the Yamuna) is higher than any transcendental realm; even the gods yearn to be born on the earth, for *Moksha* is possible only through life on the earth. *Moksha* (Liberation) is the most important and most misunderstood concept in the Indian tradition. But it really means the liberation of the human person from the ego-centred and utilitarian attitude towards the world, which transforms everything as an 'It' and not as a 'Thou', in the profound Buberian sense, and the euphoric expansion of ego-boundaries which comes from this new type of relatedness, a relatedness in communion, with everything in the world.[36]

What Sturt calls naturalism is science or rather the scientism of the type which made Monod[37] explain away evolution as the fortuitous result of chance and necessity and made Simpson[38] affirm that "the mechanism of evolutionary adaptation is basically materialistic, with no sign of purpose as a working variable" and add: "Man is the result of a purposeless and materialistic process that did not have him in mind. He was not planned." As against this, Krishna, the Supreme Person, the intentionality behind creation, affirms "Great nature is My womb. I seed it with the germ and from it are born all things."[39] The theory of

special, direct creation by deity of all species is rejected. Krishna states what may seem to be a paradox: that all the visible world is the work of his Nature, not his own. But though deity does not function directly as the impressario of the great production, he does preside over the unfolding of the pageant of nature. "Under My presiding Nature generates all things, animate and inanimate, and by this instrumentation the world functions."[40]

In rejecting special creation and affirming the role of nature in evolution, the *Gita* shows the same approach as science. Why, then, has science arrived at a world picture which has no room for teleology while the *Gita* presents the 'exemplary and soteriological model' of a deity ever active in sustaining the world processes and directing them so that evolution becomes the unfolding of an 'exemplary scenario' (to use the idiom of Mircea Eliade[41])? The reason seems to be that science did not realise the importance of the distinction, fundamental in the *Gita*, between two aspects of nature or two levels in her operations: atomistic and holistic; segmental and integral; mechanistically causal and overarchingly teleological. The *Gita* distinguishes nature at the lower level as *Apara* from nature at the higher level as *Para* and calls the latter the creator and sustainer of life.[42]

Denying teleology dogmatically and hugging fortuitousness, science relied upon the immensity of evolutionary time for explaining the seeming orthogeny of evolution. But of late we have run into serious difficulties here. Given time, it was said, a batch of monkeys, strumming on typewriters, could eventually reproduce all the sonnets of Shakespeare. But Elsasser[43] has shown that even if the possibility of reproducing only the first lines of the sonnets was considered, their syllables can be combined in 10^{143} ways, while the total number of seconds that have elapsed during the existence of our galaxy is at the most 10^{18}. Lecomte du Noüy[44] has shown that a sphere of matter, in which even the simplest protein molecule (only of two thousand atoms and only of two kinds of atoms) can be formed by the fortuitous coming together of the constituents, would have to have a radius of 10^{82} light years which far exceeds that of the universe. Bertalanffy,[45] likewise, points out that even if nucleic acids and enzymes come together fortuitously in the 'famous primeval soup', they would never form an open system, remaining sustained in a state of high improbability; "what they would do instead would be breaking down into nucleic acids again."

Kascer[46] has suggested that what has led science astray is dogmatic adherence to linear, single-tracked, unidirectional causal lines. And serious difficulties encountered in (reductionist) analyses are now suggesting that we have to incorporate immediate causes into final causes which latter are really overarching directionalities. As Wright[47] points out, "the range of possible control mechanisms and their interdependence are so complex that it is difficult to distinguish cause from effect". In homeostasis, in the operation of the endocrine system, regulation of quantity, control of quality and timing of programme are managed by the direction of many separate lines of chemism from a plane above them. With feedback, says Urquhart,[48] "causality flows round a circle making ambiguous the distinction between cause and effect . . . Multiple interaction poses a problem not really different from that posed by feedback, since the ambiguity inherent in tracing and quantifying a circular line of causality also exists with patterns which are otherwise tortuous and may include extensive divergent or convergent lines of causality". And finally we have a fine summing up by Weiss.[49] He rejects reductionism because, while there is no phenomenon in a living system that is *not* molecular, there is none that is *only* molecular. The molecules of the cell, while functioning as parts of the cell, behave in ways which cannot be explained except in terms of the cell as a living system. The 'more', in holistic systems, "does not at all refer to any measurable quantity in the systems themselves; it refers solely to the necessity for the observer to supplement the sum of statements that can be made about the separate parts by any such additional statements that will be needed to describe the *collective behaviour* of the parts, when in an organised group. In carrying out this upgrading process, he is in effect doing no more than *restoring information content* that has been lost in the progressive analysis of the unitary universe into abstracted elements." In its triune scheme of a prior intentionality, a *Para Prakrti* or Nature as total design and an *Apara* or short-term and immediate causality, the *Gita* was presenting a unitary universe.

As Jonas[50] has clarified, scientism brought our thinking "under the ontological dominance of death" because it made the dead, inert Galilean particle the brick of the universe and consequently, deadness became the natural thing, life and consciousness became problems to be explained. But the discovery of the quantum reality of matter can help us to get out of this predicament created by a wrong, mechanistic view of matter. As Young[51] has now picked up the courage to say, "it is implicit in present findings that *action* (Planck's quantum of action) rather than matter is basic, action being understood as analogous to human decision." And Lillie[52] was able to exorcise the ontological dominance of death and insentience by affirming: "The living organism is psychological because it is a development from a nature which is psychophysical". In the *Bhagavata*, Krishna says that the stuff of the world is psychophysical *(chid-achidanmaya)*, that the smallest particle is ensouled, and adds, "Nobody will be able to establish the world as different from spirit."[53]

Lorentz[54] has given a long list of phenomena to show the ubiquity of the quantum of action and its role in holding matter together as system identities; and Bachelard[55] has clarified that there is implicit in the reality of the quantum a structuring tendency, for example a tendency for macromolecules to combine to arrange themselves to form more complex forms of ordering. Now we need no longer conceptualise any organised material system as a plaything of external, mechanistic forces; with Dobzhansky and Sellars[56] we can use the terms 'internal teleology' or 'immanent causality' for that superordinate

reality in any system which maintains its self-identity and directs its own evolutionary growth through the focal organisation of all its resources. And Sommerfeld[57] links up the particle, the smallest and simplest unit of the old atomistic-mechanistic view, with the psyche of man, at the other end of evolutionary continuity—than mere analogy. "If we treat the human body physiologically, we must speak of a corpuscular local event. To the psychic principle we can assign no localisation, but must treat it—and this is also the opinion of psychophysiologists—as if it were present more or less throughout the body, just as the wave is connected with the particle in an unspecifiable way." There are further fascinating extensions of this trend of thought. In what is called the tunnel effect, particles with low energy are often found to have transited high energy barriers because of the elusive reality of the wave field which is associated with the particle and which is not localised like the particle. In some such elusive way, the psyche of an individual can transcend the physiological system limits and 'indwell' other things and persons. Michael Polanyi[58] has convincingly argued the reality of this 'indwelling' or 'tacit knowing'. The knower here is inspired to an intuitive whole-seeking, or to a quest of the holistic meaning, and the intuitive nature of the processes makes him a participant-knower.

These insights that are only faintly and belatedly dawning now have been very clearly stated in the *Gita*. "Whatever has been evolved, inanimate or animate, know that to be from the union of the field and the knower of the field."[59] Any constellated system is a unified field and what establishes the unity is the fact that there is an immanent superordinate principle which directs the energy and action of the field. The whole world too forms a unified world. "This entire universe is pervaded by My subtle presence[60] . . . Know Me as the knower of the field in all the fields[61] . . ." In the case of man, "the body is the field"[62] and the knower of the field, the individual psyche, is really "a fragment of My self that, having become life, attracts to itself the senses and the mind that inhere in nature."[63] That is, the material stuff of the world has potentiality for sensation and thought and evolving life refines matter into instrumentalities for these functions. But just as deity gave autonomy to nature in working out his design, he has given freedom to man. Man can deny deity and the grand design; but he will be able to fulfil himself only if he follows the soteriological model of deity. For *Moksha* or the ultimate goal, according to the *Gita*, is man attaining to the state of "like functional nature with deity".[64] The nature of this high functioning is very clearly indicated. Krishna says, "There is not for Me, in the three worlds anything unobtained to be obtained. And yet I continue in action. For if I did not do my work, these worlds would fall into ruin, I would become the creator of chaos and would destroy these people."[65]

Since Krishna here is indicating a motivation for man that can ensure the weal of the world and enrich his being and since the directly opposite type of motivation man has been following is now threatening to wreck the ecological system and wipe the human race off the earth, we should pay more attention to it. When Krishna says that "the light of lights that is to be known" is his reality as "the supporter of existence, remaining undivided and yet divided in all things",[66] he means something more than the ontological unity of the world-system resting on its origin in the intentionality that created it. He means that the "fragment of his splendour" indwelling everything makes them

work together in concert for the weal of the whole system, just as he himself is working to that end. He adds that this deeper aspiration or motivation is in the hearts of everything, every being. And he rapidly sketches the grand ecological linkages of the world and their convergence to benign ends. The animal world and man are sustained by food grains which are helped to sprout by rain which is created by *Yajna*, other-regarding, altruistic action (of the sun).[67] If This sounds naive to us, we might recall what Henderson[68] wrote, unheeded, in the early years of this century, listing all the important entities and processes of nature and showing how they were "uniquely favourable" to life and in a way that clearly pointed to an intentionality; the serious attention now being given to Lovelock's Gaia hypothesis which in one sense derives from Henderson; and what Tennant[69] wrote about "the conspiration of innumerable causes" in the order of nature for creating "the fitness of the inorganic to minister to life".

Tennant mentioned another important feature: "the world's instrumentality in the realisation of moral ends". This too is a distant echo from the *Gita*. For, in the same context, Krishna says that the man who, by his conduct, does not help along this design of the work of the world, leads a vicious life. Krishna makes clear how man should sustain himself on earth. "They eat evil who cook only for themselves. But the good people are they who live on the leavings of the sacrifice." That is, altruistic action, mindful of the other entities and beings of the world, will yield enough for all; self-centred action that lacks this concern will lead to evil, disaster.

But this seems to be all wrong from the present world-philosophy. Aligning the aligned and the non-aligned, developed and developing, capitalist and socialist peoples of the world, reigns today the philosophy of Adam Smith. Of late, however, we have begun to notice, with Weisskopf[70] and others, that Smith smuggled unargued philosophical concepts into his treatise on economics; and the concepts, though universally embraced, are today threatening to bring universal ruin. Smith asserted that men can be motivated only by self-interest and he was thoroughly happy about it. "We address ourselves not to their humanity but to their self-love, and never talk to them of our own necessities, but of their advantages". He took this extraordinary line because he too believed in a Providence, of a sort. The individual "neither intends to promote the public interest, nor knows how much he is promoting it . . . He is led by an invisible hand to promote an end which was no part of his intention . . . By pursuing his own interest he frequently promotes that of society."[71]

But it is to the rim of a bomb crater or the brink of a vast cesspool of pollution that the invisible hand has led self-centred man. The market place was the temple with which Smith sought to replace the temples of old. With the hardening of repeated transgressions into an Ellulian or Karmic nemesis, we may as well inscribe on the facade of this temple what was written at the portals of Dante's Inferno. "Abandon hope, all ye who enter here". For, as Nicholas Hildyard has shown in a sombre yet thoroughly realistic analysis,[72] our society is enmeshed in the market economy and such is its nature that we cannot now escape wondering in alarm "whether there is a single ecological problem that can be solved so long as we remain with it". And if we still believe—or persist in wanting to believe—that Smith is right about human nature and that it is impossible for man to be other-regarding, everything is quite simple; sit back and wait for a little bang to finish off the messy handling of a scenario which began with a big bang in the dark backyard and abysm of time and which had august possibilities.

Meanwhile, we have to conclude this paper. One very attractive feature of the Indian tradition is that the same truths are communicated in various ways, as poetic vision, philosophical analysis, transparent symbolism, enchanting story.

The Rig Veda had affirmed that in the lovely forms created by *Rita* are many splendid beauties. In a breathlessly excited narration in the *Gita*,[73] Krishna enumerates as reflections of his splendour the lovely forms of nature: mountain, lightning, elephant, horse. The Rig Veda had also affirmed that the animal forms, and not only man, were the concern of deity. "The woods belong to the birds". During their exile in the forests, the Pandava princes of the *Mahabharata* dwell too long in one wood and decimate the animal species. In a dream Yudhishtira, the eldest, had the few surviving animals come to him to lament that if they too are destroyed their various species will become extinct. Since these beautiful forms too have a right to exist, Yudhishtira decides to move from the wood.[74]

Beauty of animal forms has till recently been regarded as the fortuitous result of random genetic mutations that got stabilised because it came in handy for sexual selection. But the very detailed researches of Adolf Portmann[75] have shown that nature makes a tremendous investment of biological resources, undertakes the most intricate biochemical processes, to create the beauty of animal forms. And Cohen[76] has brought out the unbelievable precision in the timing of many lines of chemism needed to create a beautiful bird feather with its intricate pattern. The *Bhagavata*[77] explains the symbolism of every detail of Krishna's iconic form. The ultimate realisation possible for man, where all existential dread arising from the feeling that life has no meaning will evaporate away, is symbolised by Krishna's coronet. And what crowns that coronet is a peacock feather. We can now move to the story of the pastoral community of Krishna. In the *Harivamsa*, Krishna is unhappy about the thoughtless destruction of the woods in their settlement. The woods no longer exhale breezes of pure air, are no longer resonant with bird-song, for the trees have been cut down and the bare sky is visible where there was once a green canopy. He asks his people to move to the virgin land at the foot of the Govardhan hill, and bids them pay homage to the hill and its forests as their guardian deities. It is they that protect them against torrential rain, conserve water and soil. And far more significantly, Krishna affirms that the simple yet ecologically balanced life that conserves—and that

in turn is conserved by—the hills, forests and streams, is an aesthetically rich life too. "The stalls of the herds at their feet are decorations for the hills. For the mangers, the forests are ornaments. For the forests, the herds are a lovely embellishment."[78]

The Krishna story is dear to the masses of India primarily because of its links with a lost pastoralism. From the heart of the technological—industrial west, I hear a response—from Leo Marx.[79] Today, instead of conveying "Wordsworthian impulses from the vernal wood", ecological studies report "the rate at which monoxide poisoning is killing the trees." The philosophic source of this predicament is "an arrogant conception of man, and above all of human consciousness, as wholly unique—as an entity distinct from, and potentially independent of, the rest of nature". Pastoralism is a saner creed than this self-defeating self-aggrandizement. "In economic terms, then, pastoralism entails a distinction between a commitment to unending growth and the concept of material sufficiency. The aim of the pastoral economy is enough—enough production and consumption to ensure a decent quality of life."

References

1. Jonathan Benthall: Discussion of Ecology and Art. *Studio International*, December 1969
2. Leo Marx: *Science* November 27, 1970
3. Herman Daly: *Steady-State Economics*, Freeman, 1977
4. Robert Jay Lifton: *Harper's Magazine*, April 1973
5. Theodore Roszak: Review of EF Schumacher's "A Guide for the Perplexed". *Los Angeles Times*, September 11, 1977
6. Aldo Leopold: *A Sand County Almanac*, Oxford University Press, 1949
7. William Ophuls: *Ecology and the Politics of Scarcity*, Freeman, 1977
8. Hans Jonas: "Technology and Responsibility". *Social Research*, Spring 1974
9. E.A. Burtt: *The Metaphysical Foundations of Modern Science*, Doubleday, 1965, pp.89-90
10. John A. Wheeler & Seymour Tilson: "The Dynamics of Space-Time". *International Science and Technology*, December, 1963
11. *Rig Veda*, I 89.10
12. *Rig Veda*, X 168
13. *Rig Veda*, I 113.13
14. *Rig Veda*, II 38
15. Rudolf Otto: *The Idea of the Holy*, Oxford University Press, 1950
16. *Rig Veda*, X 146
17. *Mahabharata*, Santi Parvan, ch.282
18. Pitirim Sorokin, *Social and Cultural Dynamics*, Allen & Unwin, 1937
19. *Mahabharata*, Vana Parvan, ch.190
20. *Yajur Veda*, 36.17
21. Walter A. Weisskopf: "Equality". *Annals of the American Academy of Political and Social Science*, September 1973
22. Erich Kahler: *The Meaning of History*, Braziller, 1964
23. *Rig Veda*, X 129
24. Lynn White Jr: *Science 80*, January 1980
25. *Rig Veda*, VIII 100.4
26. *Rig Veda*, IV 23.9
27. *Rig Veda*, I 24.7
28. *Atharva Veda*, XII 1
29. James E. Lovelock: *Gaia: A New Look at Life on Earth*, Oxford University Press 1977
30. Theodore Roszak: *Ecology Center Newsletter*, October 1978
31. E.F. Schumacher: "Modern Pressures and Environment". *Manas*, February 28, 1973
32. Jacques Ellul: *The Technological Society*, Knopf, 1965
33. *Rig Veda*, II 23.3
34. *Rig Veda*, I 90.6-7
35. Henry Sturt: *Personal Idealism*, Preface, London, 1902
36. Krishna Chaitanya: *Freedom and Transcendence*, Manohar, 1982 pp.488-521
37. Jacques Monod: *Chance and Necessity*, Knopf, 1971
38. George Gaylord Simpson: *The Meaning of Evolution*, Mentor, 1953 p.101
39. *Gita*, XIV 3
40. *Gita*, IX 10
41. Mircea Eliade: *Yoga, Immortality and Freedom*, Pantheon, 1958
42. *Gita*, VII 5
43. Elsasser, cited, W.H. Thorpe: *Science, Man and Morals*, Methuen, 1965 p.36
44. Pierre Lecomte du Nouy: *Human Destiny*, Signet, 1949 pp.35-39
45. A. Koestler and J.R. Smythies (eds): *Beyond Reductionism*, Hutchinson, 1972 p.45
46. R.J.C. Harris (ed): *Biological Organisation at the Cellular and Supracellular Level*, Academic Press, 1963
47. Barbara C. Wright: "The use of Kinetic Models to analyse differentiation". *Behavioural Science*, Vol.15, 1970 p.44
48. John Urquhart: "Endocrinology and the System Paradigm". *Behavioural Science*, Ibid, pp.57-58
49. Paul Weiss: "The Living System". A. Koestler and J.R. Smythies: op.cit., p.11
50. Hans Jonas: *The Phenomenon of Life*, Harper & Row, 1966
51. Arthur M. Young: *The Reflexive Universe*, Delacorte, 1976
52. R.S. Lillie: *General Physiology and Philosophy of Organism*, Chicago University Press, 1945 p.76
53. *Bhagavata*, XII 4.25-30
54. H.A. Lorentz: *Naturwiss.* Vol.35, 1925 p.1008
55. Gaston Bachelard: *Le Materialisme Rationel*, Paris, 1953 p.146
56. Roy Wood Sellars: "Causality and Substance". *Philosophical Review*, Vol.52, 1943 pp.1-27
57. A. Sommerfeld: *Scientia*, Berlin, 1936
58. Michael Polanyi: *The Tacit Dimension*, Anchor, 1967
59. *Gita*, XIII 26
60. *Gita*, IX 4
61. *Gita*, XIII 2
62. *Gita*, XIII 1
63. *Gita*, XV 7
64. *Gita*, XIV 2
65. *Gita*, III 22-24
66. *Gita*, XIII 16
67. *Gita*, III 14-16
68. Lawrence J. Henderson: *The Fitness of the Environment*, New York, 1913
69. F.R. Tennant: *Philosophical Theology*, Cambridge University Press, 1928 pp.79-81
70. Walter A. Weisskopf: *Alienation and Economics*, Dutton, 1971
71. Adam Smith (ed. by Edwin Cannan): *An Inquiry into the Nature and Cause of the Wealth of Nations*, London, 1904 Bk I, p.421
72. *The Ecologist*, January-February, 1982
73. *Gita*, X 21-38
74. *Mahabharata*, Vana Parvan, ch.258
75. Adolf Portmann: *Animal Forms and Patterns*, Schocken, 1967
76. Jack Cohen: "Feathers and Patterns". M. Abercrombre and J. Brachet (eds): *Advances in Morphogenesis*, Vol. 5, 1966 p.34
77. *Bhagavata*, XII 11.10-20
78. *Hari Vamsa*, Vishnu Parvan, chs.16-18
79. Leo Marx: *Science*, November 27, 1970

Krishna Chaitanya, born 1918 in Karala, India, is the author of more than 30 books, including the classic "Philosophy of Freedom" and "Freedom in Transcendence."

The Ecological, Energetic and Agronomic Systems of Ancient and Modern Sri Lanka

by Ranil Senanayake

The agricultural system of Sri Lanka has an old, well-recorded history. The chronicle Mahawamsa[1] which covers the period from 543 BC to 1758 AD indicates that the island had no agricultural traditions until the introduction of farming in 543 BC. The construction of tank (reservoirs) for agricultural water storage began in 504 BC but no great advances are recorded until the advent of Buddhism in 307 BC. Buddhism with its philosophy of reverence for life changed the eating habits of the people. Meat and fish were excluded from the diet of the people.[2] Thus by 200 BC there are many references to the growing of leguminous crops, fruit trees and nut trees.[1] The tank system became central to agricultural development and the construction of irrigation works became the idea of the Kings.

Although invasions from the mainland of India disrupted the civilization from time to time, a consistent growth was recorded in the building of irrigation works. Presently over 10,000 of these tanks have been recorded.[3] The population in the 11th to 12th century has been estimated from 10 to 17 million people.[4] Innumerable records indicate the construction of schools, universities, libraries, music halls, etc., and the maintenance of a large monastic population, these works being made possible by the surplus generated from rice production.[5] The agricultural surplus was also used to construct tanks, extend agricultural channels and to maintain armies.[6] The agricultural systems remained inviolate despite changes in dynasty since the peasants would disperse at the times of strife and "returned after each temporary dispersion, to resume possession of the lands and their village tank."[2] The collapse of the civilization began in the 14th century due to the military strategies of the Malabar invaders who began disrupting the tanks. The collapse being accelerated by the plague of malaria that followed.[7] Although much of the tank system had decayed by the 16th century, the agricultural skills persisted and had evolved into hill country farming on terraced fields or lowland farming on relatively flat fields. Farming villages in many areas were reported to have "extraordinary agricultural skills, often yielding double the crops elsewhere."[8]

An early attempt at the 'development' of agriculture was the introduction of plantation agriculture in about 1830. The coffee plantations became a success and when the renovation of the native agricultural system was conceived in 1867 it was based on the model of commercial plantation agriculture.[9] This placed all traditional agriculture on a development course towards modern agriculture which 'envisions' food cultivation as a business enterprise to be operated strictly for the purpose of generating a profit from the market economy.'[10] The forces that fuelled the traditional system were different from those of the market economy. Many processes not answering to the needs of the market economy were viewed as time consuming or superstition. What could not be dismissed had to be developed in the manner of the economically successful western model. The initial moves to renovate Sri Lankan agriculture consisted of revamping defunct irrigation works and the revival of many aspects of the traditional management system[11] but the goal was crop maximization. As a consequence the traditional agricultural system itself became modified, with various elements being introduced to 'modernize' it. For example, the replacement of the buffalo with the tractor.

The historical information would suggest that agriculture was practiced by the inhabitants of this country for over two thousand four hundred years. During all this time it would have been subject to a process akin to natural selection. For instance, given two methods of farming, the method that yields best and is most stable is the method that will persist. As the peasants were largely unlettered we would expect to find this information transmitted verbally until it was incorporated into cultural symbols. A good example is seen in 'waiting for the Pitta bird'. The farmers of many communities scattered through the country would not begin to prepare their fields until they heard the cry of the Pitta bird. The superstition seems to have no base until the life history of the Pitta bird is studied. The Indian Pitta, *Pitta brachyura*, is a migratory bird and arrives in Sri Lanka during the month of September. However, it is a weak flier and takes advantage of the northeast monsoon winds.[12] The northeast monsoon which blows the moisture laden air from the Indian peninsula to Sri Lanka carries the rain used for the Maha or major rice cropping season.[13,14] The information contained in the

superstition of the Pitta bird is now evident. The birds being weak fliers cannot migrate until the northeast monsoon begins to blow. The arrival of the birds is a signal to the farmer that the rains are soon to come and the field may be prepared. Information may be stored in many other modes. If the agricultural field with its village is looked at as an ecosystem and if such an ecosystem has existed over a long period of time, we would expect to find sets of information in the sense of ecological relationships that confer some degree of stability on the ecosystem. Further, as all factors which constitute an ecosystem are related or are sensitive to each other, the study of any one of the factors should demonstrate its relationship to the others.

The motive power used in the traditional ploughing, tilling, and threshing operations has been subject to a major change with the advent of modern agriculture. The source of traditional motive power, the buffalo, is being replaced by the tractor. The rationale used to justify this action is questionable. The initial premise that the promotion of the use of the tractor will draw unemployed, educated youth into agriculture has been demonstrated to be false.[15] The concept that a tractor reduces human labour is actual but generates other problems. The labour saving being 9 man days per acre when a four-wheeled tractor replaces the buffalo and 8 man days per acre when a two-wheeled tractor replaces the buffalo.[16] However, this process depresses the labour market in the village and penalizes the landless peasants who obtained employment as agricultural labour. Presently tractorization has spread beyond economically justifiable levels, a process made possible by hidden subsidies and political patronage.[17] The current energy crisis has tended to escalate tractor operation costs, until tractor ploughing costs have risen to four times the cost of ploughing with buffaloes; yet the present farming population preferred tractor ploughing even though it incurred extra costs.[18] Therefore the present attraction of the tractor over the buffalo would seem to be due to 'cosmetic values' of no utility to the farm economy except to provide speed.

Physically too, the operation of the tractor seems to be more disadvantageous than using buffaloes. The rice fields over which buffaloes have continually trod attains a 'hard pan' or tamped layer on the bottom of the field, the presence of this hard pan being beneficial to water retention in the field. The use of a tractor tends to disrupt and lower this 'hard pan'[19] and in dry fields creates large clods that have been shown to reduce the yield.[20] Moreover, the subsidization of tractor purchase has encouraged the slaughter of buffalo through the effect of the subsidy and by the release of the consumers resources for the purchase of buffalo meat.[21]

The loss of the buffalo means the loss of nutrients to the farmer and his family, as the buffalo is a major source of milk and curd. It also means a loss of organic fertilizer in the form of urine and dung. Further, it leads to the loss of job opportunities for the village youth who were employed as herdsmen. The buffalo had been a part of the Sri Lankan rice agroecosystem

for over 1400 years;[2] thus, in addition to the economic, physical and social factors discussed, other biological, ecological relationships with the environment should be observable.

The buffalo is adapted to living in marsh conditions and is obliged to spend much of its time immersed in water or mud;[22] to fulfil this need the lowest point of a series of rice fields is dug out and made into a pool. The pool may be an extension or deepening of the swamp that naturally occurs at such declivities or it may be excavated for the express purpose of serving as a buffalo wallow. These buffalo wallows are a very common feature of rice fields that are situated at some distance from a river or other perennial source of water capable of being utilized by buffaloes.

As the rice fields dry out completely during the harvest season the majority of its aquatic fauna die out. The recolonization of the fields is usually achieved during flood times by organisms that have maintained their populations in 'drought refugia', habitats which contained water through the dry period, such refugia usually being rivers or lakes. The greater the distance from a drought refugia to a given field, the smaller the likelihood of it being recolonized.[23] The buffalo wallows also function as very efficient drought refugia for aquatic organisms and ensures the recolonization of the set of fields associated with it after the dry season.[24]

The village gains a manifold benefit from the drought refugia, one benefit being the crop of fishes that grow in the warm, productive water of the rice field and the associated streams. At the onset of the rains the fishes in the drought refugia migrate up the newly formed streams to breed. The juvenile fish quickly colonize all the waterways and grow to adulthood during the rice growing season. When the water begins to recede at the onset of the harvest all the fishes in the streams get trapped in the pools, the fishery being conducted by bailing the water out of the pools and collecting the fish in baskets.[25] The catches of four drought refugia and their associated stream pools is given in Table 1. The stream pools are fished twice a year at harvest time, while the drought refugia supports a constant rod and line fishery. The drought refugia studied provides a fish protein input worth between Rs.1660,00 and Rs.1198,00 annually.[25]

Another significant benefit obtained from the drought refugia is the large number of insectivorous

TABLE 1

Area	Size of refugia (surface area)	Annual catch	Number of associated stream pools	Catch per season	
				Mean	Range
Gampaha	2.0 acs.	800 lbs.	11	5 lbs.	2-6 lbs.
Nittawbuwa	1.5 acs.	580 lbs.	14	3 lbs.	1-6 lbs.
Dambulla	1.5 acs.	680 lbs.	6	2 lbs.	1-5 lbs.
Matale	2.0 acs.	700 lbs.	16	3 lbs.	1-8 lbs.

Source: Senanayake 1980 data

fishes it supports. These fishes are among the first aquatic organisms that travel upstream with the new rains to colonize the rice fields and wet areas. It has been demonstrated that waterbodies incapable of being colonized by such insectivorous fishes become the ideal breeding habitat for the malaria vector *Anopheles culicifaices.*[23] The lack of drought refugia will reduce the potential of the rice fields to be colonized, as the colonizing fishes will have to migrate over a greater distance. This process increases the number of habitats suitable for large populations of the malaria vector to arise from. As the level of insecticide spraying for malaria vector control is determined by the level of the vector population,[26] any increase in the vector population will cause a corresponding increase in the level of spraying. Even if the ecological ramifications of intensive insecticide spraying was discounted, each spraying round represented a cost of Rs.100,00 per household in 1980.[27]

Mature drought refugia with good vegetative cover act as an island of stable habitat for many species of plants and animals, much of the surrounding area being subject to constant perturbation and change by man. Two examples will be drawn to demonstrate the supportive links that extend from the drought refugia to the farmers' agroecosystem. The first is the snake *Ptyas mucosus.* This snake commonly known as the Rat snake is non-venomous and left unharmed by the villagers. In fact, the farmers welcome the snake as it comes into the fields at grain ripening time to feed on the rats and mice. It has been estimated that a single Rat snake can consume over twenty rodents per month.[28] This snake has been deemed as one of the most important biological control agents of the small mammalian pests of rice farmers and an international programme has been recently launched to promote its use in rodent control.[29] The Rat snake is incapable of breeding or maintaining a population in rice fields and open areas. It requires a wooded habitat or dense thicket to serve as a safe nursery area for the juveniles. Such a habitat is found only around drought refugia in rice field areas. It also demonstrates a strong partiality for the vicinity of water,[30] again a condition met with in the drought refugia.

The lizard *Varanus salvator* has been respected by the farmers as a part of their tradition. It was assumed that this tradition arose due to its habit of eating poisonous snakes.[31] Later work demonstrated that the farmer received another important benefit from this lizard; this was the removal of the crabs that weaken and destroy the bunds of the rice fields.[32] The fresh water crabs of the genus *Paradelphusa* inhabit most lowland rice fields and habitually make their burrows in the bund. These burrows create leaks in the upper field which may lose its water retention ability or may weaken the bund and cause it to collapse. A heavy infestation of these crabs can require the farmer to devote three to four man days to bund maintenance work in each cropping season. The Varanus lizard, like the rat snake, requires a moist thicket or similar set of conditions as a nesting and nursery area. It too is incapable of maintaining populations in dry areas devoid of drought refugia.

Now a more real assessment of the impact of the introduction of the tractor as a tool of development can be attempted. Table 2 lists the opportunity cost of introducing a 4-wheeled tractor to 20 acres of rice fields with a 2-acre buffalo wallow, but it becomes evident that many more links have to be examined and measured before the final cost of the impact can be attempted. For instance, crop losses due to a reduction of beneficial insect predators have been shown to be substantial in various agroecosystems.[33] The links may also extend to other human activity; the last item in Table 2 (Roofing thatch) demonstrates another set of linked relationships.

Roofing thatch refers to woven coconut leaves, and is produced by weaving the coconut leaves to form a mat. The coconut leaf is pliable and easily worked only at the green stage. When they mature and dry they become brittle and difficult to work with. However, no green branches are cut for the purpose of weaving as the removal of branches effects the yield of nuts negatively. The dry branches are made pliable by soaking in water for about two to three weeks. In many rural areas in Sri Lanka the buffalo wallow is the resource used for this work. The weaving of roofing thatch may be done as a casual or a regular mode of employment within the village community. The loss of the buffaloes

TABLE 2

Opportunity Cost of Tractorization of the Traditional Sri Lankan Rice Agriculture (Per Household)

Item	Cost (per 6 months)
Milk and Curd	2160.00[1]
Dung	180.00[1]
Herdsman (salaries) @ Rs.15,00 per day	1620.00
Malathion spray for malaria @ Rs.100,00 per 3 months	200.00
Bund repair	200.00
Fisheries input Rs.2,00 lb.	200.00
Grain loss to rodents	?
Losses due to reduction of predators	?
Employment in coconut thatch weaving	600.00

[1]Computed at the rate of 1 pair of animals per household

is usually followed by the development of the wallow for agriculture or industry as the village thatch weavers do not possess the economic strength to preserve their resource. The village now loses its ability to supply roofing needs and has to resort to importing alternative roofing material such as asbestos or tiles, the cheapest alternative material being tile. Each tile costs approximately Rs.2.00 and it requires four tiles to give the cover afforded by a unit of roofing thatch. At the current cost of .20 cts for a unit of roofing thatch, the alternative ends up costing the village 80 times what the traditional material would have. Further the burning of the tiles requires energy (firewood), and the major source of firewood is the forests. With the area under utilizable forest dwindling from a cover of 44 per cent in 1956 to 22 per cent in 1976,[34] and to 6 per cent in 1980,[35] any extra pressure on the forest resources would tend to hasten complete deforestation.

The goal of agricultural 'development' can become a potentially dangerous objective if only a set of narrow perspectives determines the criteria of acceptance or rejection of an innovation. The complexity of the interactions observable in the traditional agricultural system of Sri Lanka suggests that some forms of modern agricultural innovation can have a disruptive effect due to their insensitivity to this complex nature. As agroecosystems evolve with time, the strength or the pressure that any agricultural practice exerts on a given ecosystem is dependent on the history of both the practice and the ecosystem. When there has been a long history of co-evolution it is suggested that the practices that reinforce stability should be conserved and the transmission of this information be achieved by being embodied into the cultural practices.

The impact of modern agriculture on the rice agroecosystem of Sri Lanka can be summarized by the farmers' description of it. They claim to get a higher yield than through traditional methods but say that through these practices the field 'gets burnt'. A formal explanation of this description has to include such factors as differential settling of the soil and the breaking up of the hard pan by tractors,[16] reduction of soil quality through the application of pesticides,[36] changes in the carbon nitrogen ratio as a lack of organic matter,[37] the destruction of the aquatic fauna by the application of fertilizer,[38] and the addiction of the agricultural system to high energy inputs. The farmers questioned suggested that it can take between two to three years to build up the quality of the field so that it could be farmed again in the traditional manner. As most farmers cannot afford to rebuild the biological productivity of the fields or to keep them fallow for two to three years, the 'modernization' process continues as a positive feedback loop, building an increasing degree of instability into the agroecosystem.

Energetically, the 'modern' method of farming has been shown to be very expensive.[39] In Sri Lanka the 'modern' method requires a 5- to 10-fold energy increase over the traditional methods, similar increases being recorded for other parts of the world.[40,41] An important consideration is the fact that the increase is wholly in units of 'external energy' where 'external energy' is defined as energy derived from a source outside the geopolitical boundaries of a nation. The modern method of farming was promoted in Sri Lanka due to its potential for increasing the yield. The use of high yield varieties was adopted and by 1960 the government began to subsidize the cost of fertilizer.[42] On first perusal the introduction of modern farming seems economically sound. Even if a 50 per cent increase in yield is achieved, the cost of production will be lowered. However, the energy cost of accomplishing this feat is a 5- to 10-fold increase in input energy, an increase not particularly salient during times of cheap energy but of great importance when energy prices escalate. In Sri Lanka where all the fossil fuel based energy has to be imported, it means the transference of global energy linked inflation to the agricultural production base. Subsidies become a temporary control of such inflation but at tremendous national cost. The Sri Lankan government paid Rs.1,000 million in fertilizer subsidy in 1981.[42] A further problem with this method of agricultural development is the creation of vast monovarietal regions; Table 3 illustrates the spread of the high yield H4 during one decade, the area under this variety amounting to 67 per cent of the total rice sown in the main growing season of 1970.[43]

The value of the traditional system of rice agriculture and the problems associated with developing it to simulate the high energy model would seem to be evident. What reasons then can we attribute to the persistence of the promoters of such a destructive model? During the colonial experience a premium was placed on western education and "this inevitably led to the neglect of the traditional education systems of the colony."[11] This process continues to influence society up to the present times. A native Sri Lankan has a much greater opportunity to achieve recognition or enter the decision making process if he or she has received training in the West. Unfortunately, the West had only the western model of agriculture to teach. This model was learnt and implemented. Agricultural development became synonymous with 'modern agriculture'. Further, Western aid to help the 'less privileged' was distributed by people who were exponents of 'modern agriculture' either by being trained in it or by assuming that the western model was superior in all learning. Lastly, the destruction has been accelerated by unscrupulous businessmen seeking to create new markets for their goods.

The insensitivity of 'modern' agriculture to the complexity of natural systems may stem from the model of reality it is based upon. An earlier paper[44] hypothesized two models of reality; the mechanical model where a thing in itself is independent of its relations to other things and the ecological model where a thing in itself is a product of its relations to other things. If we were to accept the mechanical model, then the buffalo wallow would be a pool of water, redundant if the buffalo is removed. The loss of fish, lizards, snakes or thatch will have to be described only in relation to themselves. If we were to accept the ecological model, the buffalo wallow ceases to be a thing in itself and becomes a product of its relations to other things. It

TABLE 3

Introduction of high yield variety H4

Season	Extent
1959/60 Maha	1,000 acs.
1964/65 Maha	455,100 acs.
1969/70 Maha	800,000 acs.

Source: Izumi & Ratatunga, 1974

will be seen that the ecological model is capable of addressing a much wider set of relationships than the mechanical model. However, the history of modern agriculture suggests that the ecological model has been seldom used. This neglect of the ecological perspective may have stemmed from the lack of a synthetic perspective: another contributing reason may have been the insensitivity to a set of information that will be hypothesized as 'ecological information'. Ecological information consists of the interactions between the parts of an ecosystem, the information existing only as long as a dynamic relationship between the parts exists. The retention of this information is presently possible only by maintaining that the ecosystem is a physical entity.

If the present trends continue, the traditional agricultural system of Sri Lanka will soon disappear and with it all the information that could be utilized in the design of a low energy, sustainable method of agriculture. It is also pertinent to note that much of this information is continued in the vast network of ecological relationships that have evolved with the agroecosystem, and will be lost when the ecosystem is changed. Can humanity afford such losses?

> "We are the product of the strength and the weakness of our forebears. I do believe it is not too late to attempt to eliminate the weakness and conserve the strength."[45]

References

1. *Mahavamsa* translated by Wilhelm Geiger, Pali text Soc. London.
2. Tennent, J.E. 1859 *Ceylon,* Longman, Green, Longman & Roberts, London
3. Fernando, C.H. 1965 "Development of Ceylon's Fisheries XI, The role of inland waters in relation to the development of Ceylon's fisheries, and a note on the pearl oyster fishery."*Bull. Fish Res.* Stn. Ceylon 17.
4. Brohier, R.L. 1934 *Ancient Irrigation Works in Ceylon.* Govt. Publ. Bureau, Colombo.
5. Ellawela, H. 1969 *Social History of Early Ceylon,* Colombo.
6. Nicholas, C.W. and Paranavitana, S. 1961 *A Concise History of Ceylon,* Colombo.
7. Senanayake, F.R. *An Ecological Perspective of Malaria Resurgence in Sri Lanka.* Unpub. M.S. Thesis, U.C. Davis, California, USA
8. Guyard, J.L. 1763 "Journals of a Journey" *in* Raven—Hart 1963 *Travels in Ceylon 1700-1800,* Colombo
9. Herring, R.J. 1977 *Policy and ecology in the origins of the discontinuities in the land tenure system of the Hambantota district,* ARTI, Colombo.
10. Bookchin, M. 1976 *Radical Agriculture ed.* Richard Merrill Harper Colophon, New York.
11. De Silva, K.M. 1973 *History of Ceylon, Vol. III,* University of Ceylon, Peradeniya.
12. Wait, W.E. 1925 "Manual of the Birds of Ceylon", *Ceylon Journ. Sci.,* Colombo.
13. Gaussen, H., Legris, P., Viart, M. and Labroue, L. 1968 *Explanatory notes on the vegetation map of Ceylon,* Govt. Press, Colombo.
14. Macmillan, H.F. 1954 *Tropical planting and gardening,* Macmillan & Co., London.
15. Farrington, J. and Abeysekera, W.A.T. 1979 *Issues in Farm Power and Water Use in Sri Lanka.* Ag. Res. Train. Inst. occ. publ. 17, Colombo.
16. Carr, M.N. 1975 *Patterns of tractorization in the major rice growing areas of Sri Lanka.* D.Phil Thesis (unpub.) IDS University of Sussex.
17. Wickramanayake, V.E.A. 1964 "The Mechanization of Rice Culture in Ceylon." *Journ. Nat. Agr. Soc. Ceylon* Vol (1).
18. Abdul Hameed, N.D. 1977 *Rice revolution in Sri Lanka.* U.N. Res. Inst. for Social Development. Report 76.7 Geneva.
19. Carr, M.N. 1975 *Tractors in Sri Lanka, a case of inappropriate technology.* Sem. Paper I.D.S. University of Sussex.
20. Harriss, B. 1974 "Tractors, Profits and Debts in Hambantota District" in Farmer, B (ed.) *Green Revolution,* London.
21. Burch, D. 1979 *Overseas aid and the transfer of technology.* A Case Study of Agricultural Mechanization in Sri Lanka. Ph. D. thesis (unpub.) University of Sussex.
22. Phillips, W.W.A. 1935 "Manual of the Mammals of Ceylon,"*Ceyl. Journ. Sci.,* Colombo.
23. Senanayake, F.R. 1980 *Biogeography and Ecology of the Inland Fishes of Sri Lanka.* Ph.D thesis (unpub.) Univ. of Calif. Davis.
24. Wiley, A. 1910 "Notes on the Freshwater Fisheries of Ceylon."*Spolia Zeyl.* Vol. VII (XXVI).
25. Senanyake, F.R. (in prep.) *Small Scale Inland Fisheries of Sri Lanka.*
26. Abeyesundare, A.N.A. 1979 Administrative Report of the Anti-Malaria Campaign, Colombo.
27. Abeyesundare, A.N.A. 1980 Administrative Report of the Anti-Malaria Campaign, Colombo.
28. Anon 1980 Madras Snake Park Records, Madras.
29. Whittaker, R. 1980 *in* Hamadryad' Bull Madras Snake Park, Madras.
30. Wall, F. 1921 *Snakes of Ceylon,* Govt. Printer, Colombo.
31. Tennent, J.E. 1861 *Natural History of Ceylon,* Longman, Green, Longman and Roberts, London.
32. Deraniyagala, P.E.P. 1965 *A Coloured Atlas of Some Vertebrates of Ceylon.* Vol II, Ceyl. Nat. Mus. Publ., Colombo.
33. Huffaker, C.B. (ed.) 1971 *Biological Control,* Plenum Press, New York.
34. U.S. AID 1980 *Sri Lanka reforestation and watershed management program.* Doc. 383 -0053, Washington, DC.
35. NEDECO 1981 *Mahaveli Ganga Development Program Implementation Strategy Study,* Vol. 5, Ministry of Foreign Affairs, Kingdom of Netherlands, The Hague.
36. Malone, C.R., Winnett, A.G., and Helrich. 1967 "Insecticide induced responses in an old field ecosystem." *Bull. Environ. Contam. Toxicol.* 2, No. 2.
37. Panabokke, C.R. 1967 "Soils of Ceylon and Fertilizer Use."*Ceyl. Assn. Adv. Sci. Publ.,* Colombo.
38. Merrill, R. 1976 "Towards a Self-Sustaining Agriculture" *in Radical Agriculture,* ed. R. Merrill, Harper Colophon, New York.
39. Odum, H.T. 1971 *Environment, Power and Society,* Wiley Inter-Science, New York.
40. Odum. E.P. 1963 *Ecology,* Holt, Rinehart and Winston, New York.
41. Pimentel, D. and Pimentel, M. 1979 *Food, Energy and Society,* Edward Arnold, London.
42. Kuruppu 1981 *Fertilizer use in Paddy Cultivation.* National Fertilizer Secretariat, Ministry of Plan Implementation, Colombo.
43. Izumi, K. and Ratnatunge, A.S. 1974 *Environmental and social constraints on paddy production under existing conditions.* Occ. publ. 4 Ag. Res. Training Inst., Colombo.
44. Cobb, J. 1982 *Theology, Perception and Sustainability of Agriculture,* Conference on Agricultural Sustainability in a Changing World Order, Pomona College, Claremont, California, March 31, April 1,2.
45. Senanayake, D.S. 1934 Foreward *in* R.L. Brohier, *Ancient Irrigation Works in Ceylon,* Government Publ. Bureau, Colombo.

Ranil Senanayake has a Ph.D. in Ecology from the University of California. He is the great nephew of Sri Lanka's First Prime Minister after Independence. He is an author of books on the Ecology of Sri Lanka and a director of the Institute of Sustainability.

Beyond Industrial Society: Towards Balance and Harmony

by Alwyn Jones

Many sociological writers have tried to identify those characteristics by which industrial societies can be distinguished from non-industrial societies; such distinguishing characteristics have been well documented by Frankenberg[1] through the use of his 'rural' and 'urban' (less rural) notion of continuum. It is not the intention to go into this in detail here, but what must be emphasised is the extent to which Frankenberg's notion of 'urban' (less rural) at one polar extreme of the continuum, implies a clear association between 'urban' and the process of industrialisation, a process which has meant the erosion of life styles and values expressive of integrated community living. That this fragmentation of modern life is an issue that has been at the basis of much sociological criticism of industrialisation is acknowledged by Frankenberg in his implicit and explicit references to, among others, such writers as Tönnies, Durkheim and Marx, whose respective concepts of 'Association', 'Organic Solidarity' and 'Alienation' are subsumed within his notion of the urban.

For the purpose of this paper Tönnies'[2] distinction between 'natural will' *(Wesenwille)* and 'rational will' (*Kurwille*) as an exemplification of the breakdown of community (*Gemeinschaft*) living is very important. For Tönnies, natural will is that which embraces the whole of an individual's being; that is, it places being before thought, and springs from the unity between individuals in *Gemeinschaft* relationships. Julien Freund in his comment on Tönnies has put it well:

> "Organic (natural) will is the profound will of all being, the one that expresses the spontaneity and the movement of life itself. As such, it is the source of all creation and all individual reality. It is immanent and consubstantial with being and, at bottom, as complex as life itself. Having its origin in the past, it is a motivated and surging will, which manifests itself in pleasure, habit and memory".[3]

In contradistinction to natural will, rational will puts calculative thought before being, is future-oriented and emphasises means over ends. It comes into prominence with the breakdown of *Gemeinshaft* and the emergence of society based on association (*Gesellschaft*) wherein human relationships are fragmented, self-motivated and egocentric. No longer do people treat each other as ends or whole persons as in *Gemeinschaft* relationships, but as means by which to achieve their objectives or purposes. *Gesellschaft* society is composed of a mosaic of not necessarily interconnected associations organised for the achievement of such purposes. The fragmentary nature of such a society is made clear by Pappenheim:

> "Individuals who enter a *Gesellschaft* do so with only a fraction of their being, that is, with that part of their existence which corresponds to the specific purpose of the organisation. Members of a taxpayer's association, or individuals who own stock in a company, are related to each other, not as whole persons, but with only that part of themselves which is concerned with being a taxpayer or shareholder... Thus they remain loosely connected and essentially remote from each other...So deep is the separation between man and man in *Gesellschaft* that...(it) becomes a social world in which latent hostility and potential war are inherent in the relationship of one to another"[4]

This, for Tönnies, is the basis of human relationships in modern industrial societies wherein the eclipse of *Gemeinschaft* is reflected in the predominance of *Gesellschaft* and its related thought process, rational will.

Whilst it is believed that Tönnies' notion of *Gesellschaft* can be used as an organising principle for understanding the structure of relationships in modern industrial society, it is *not* to be taken as implicit in what is being said here that there should be a reversion to a pre-industrial social order with the many constraints it undoubtedly imposed on individuals such as, for instance, what has sometimes been called the 'tyranny of custom'. But the industrial social order has imposed a new and perhaps more dangerous tyranny—a tyranny of *Gesellschaft* institutions which have become more and more detached from life at the community, or what Ivan Illich has called the 'vernacular' level of society. This detachment has not only meant the virtual eclipse of community life, but the fragmentation of society into discrete and relatively autonomous institutional complexes which are able to set standards in their respective areas of health, education, production, etc. relatively free from public assessment and control. As long as such institutional conditions prevail, the social milieu is not favourable to the emergence of a totalistic and holistic *Weltanschauung* (world view) characteristic of a *Gemeinschaft* social order. It is the contention here

that the ideal of a future based on ecological principles must have, as a fundamental prerequisite, the re-emergence of *Gemeinschaft* in social relationships.

The Disenchantment of the Modern World

For Tönnies, as we have seen, the notion of 'rational will' denotes not only the dissociation of thought from being, but the *paramountcy* of thought *over* being in the modern world. The implication of this is that thought becomes detached from those human values expressed within the culture which give ultimate meaning and purpose to life. This detachment of thought from the ends or purposes of life, reflected in Tönnies distinction between 'natural' and 'rational' will, is similar to the dichotomisation of reason which has formed the basis of the analysis of many other writers. For instance the existentialist theologian, Tillich, has distinguished between 'ontological' and 'technical' reason in the following way:

> "According to the classical philosophical tradition, (ontological) reason is the structure of the mind which enables the mind to grasp and to transform reality. It is effective in the *cognitive, aesthetic, practical* and *technical* function of the human mind . . . In the concept of *technical* reason, reason is reduced to the capacity for *reasoning*. Only the *cognitive* side of the classical concept of reason remains, and within the cognitive realm only those cognitive acts which deal with the discovery of *means* for ends."[5]

For Tillich a concomitant of the industrialisation process is the predominance of technical over ontological reason, with the result that the:

> "ends (of life) are provided by non-rational forces . . . Critical (ontological) reason has ceased to exercise any controlling forces over norms and ends."[6]

This narrowing of the scope of reason through the accentuation of means over ends has had considerable implications for the institutional structure of industrial society, a structure which increasingly reflects the outward manifestation of technical reason. The consequences of this for the totality of human life has been well expressed in the writings of Max Weber, and later Ivan Illich, to whom we now turn.

For Max Weber, the attachment of industrial capitalism to relentless economic growth and expansion in the interests of profit has meant the displacement of what he calls 'substantive rationality' wherein human actions are given meaning within a given individual's framework of values. Instead the 'rationalisation' of the modern world is characterised by formal rationality in which reason is constrained to seek the most efficient, scientifically and logically based means to achieve predetermined ends. The growth of science and technology in particular have played a key role in the reinforcement of this form of rationality. The stress is thus on the *mechanisms* by which action is effectuated, rather than on the purposes which such mechanisms serve. The outcome of this for Weber is a flight from a cultural milieu in which holistic understanding is possible:

> "Let us clarify what this intellectualist rationalisation, created by science and scientifically oriented technology, means practically. Does it mean that we, today . . . have a greater knowledge of the conditions of life under which we exist than has an American Indian or a Hottentot? Hardly. Unless he is a physicist, one who rides on the streetcar has no idea how the car happened to get into motion . . . The savage (sic) knows incomparably more about his tools . . . How does it happen that one can buy something for money—sometimes more and sometimes less? The savage (sic) knows what he does in order to get his daily food and which institutions serve him in this pursuit. The increasing intellectualisation and rationalisation do *not*, therefore, indicate an increasing and general knowledge of the conditions under which one lives."[7]

In this passage, Weber makes his position quite explicit—the growth of a scientifically backed formal rationality does not extend our vision or grasp of meaning in the world. On the contrary, the myth, legend, folklore, poetry and magic necessary for the creation of ultimate meanings in human societies, and the emergence of a holistic world view, are rejected. This is an inevitable outcome of the transcendence of formal rationality wherein reason is reduced to mere technical considerations, a process which Weber has called the 'disenchantment of the world'. And a consequence of this disenchantment, as Weber says in a reference to Tolstoi, is that humankind can no longer grapple with fundamental existential questions such as "what shall we do and how shall we live?" A society in which formal rationality predominates lacks a framework of understanding in which such a question can be posed, let alone answered. It is this value-emptiness—a function of the fragmentation of reason—which inhibits holistic vision and lies at the heart of the human dilemma to which modern industrial society gives rise.

For Weber, formal rationality receives its institutional expression in the bureaucratic organisation. In modern society, the bureaucracy becomes the means, *par excellence*, by which technical questions are resolved. As he says:

> "The decisive reason for the advance of bureaucratic organisation has always been its purely technical superiority over any other form of organisation. The fully developed bureaucratic mechanism compares with other organisations exactly as does the machine with the non-mechanical modes of production."[8]

But as Giddens argues this reliance on bureaucracy, and the specialised expertise on which it increasingly depends, has, for Weber,

> "consequences which contravene some of the most distinctive values of western civilisation, such as those which emphasise the importance of individual creativity and autonomy of action. The rationalisation of modern life, especially as manifest in organisational form in bureaucracy, brings into being the ('iron') 'cage' within which men are increasingly confined."[9]

There is thus no doubt that Weber recognised the tension between formal and substantive rationality in the modern world; this is made quite clear in his extremely pessimistic prognosis of a future described in such terms as the 'iron cage' and 'mechanised petrification'. But his

commitment to a value-free social science meant that such views had to remain at a personal level. Social science can evaluate means as to their appropriateness for the pursuance of particular ends or goals; but an evaluation of the ends themselves cannot be scientifically assessed.

For Illich, however, there is no such qualification. For him, following Weber, there is antagonism between the institutional arrangements in society and the realisation of human freedom and autonomy. But unlike Weber he does not hesitate to make a commitment to the belief that freedom and autonomy must be sought through the transformation of existing social arrangements. We shall now consider Illich's position on this in some depth.

The Institutionalisation of Values

We can get to the centre of Illich's thought through his concept of the 'institutionalisation of values'. The basic premise is that human needs or values can only have meaning if they arise from spontaneous, autonomous and creative interaction in a given cultural milieu. Thus the test of technology and institutions is the extent to which they serve this end, namely, the realisation of human freedom and autonomy in the creation of values. As we have seen, however, in our earlier consideration of the ideas of Tönnies and Weber, industrialisation has fragmented *Gemeinschaft* with the result that modern society has become patterned by *ad hoc Gesellschaft* institutions informed by formal rationality. Within this framework the will of the people—Tönnies' 'rational will'—cannot be spontaneously expressed because the instruments of a culture (institutions), which give force and meaning to life, have been both externalised and made inaccessible, spiritually and cognitively, to the people as a whole. The public world of institutions, and the private lives of citizens, therefore become locked in a dialectical relationship with each other, rather than interacting in an organic whole. This, for Illich, is an outcome of the growth of industrial society. He has extended Weber's critique of bureaucracy by arguing that as society has grown more and more complex a professionalised élite has emerged, working largely within bureaucratic institutions, with the result that the lay person has been increasingly excluded from the creation of fundamental human values or activities such as worshipping, healing, learning and even moving. Control over the creation of such values means that the professional is able to achieve:

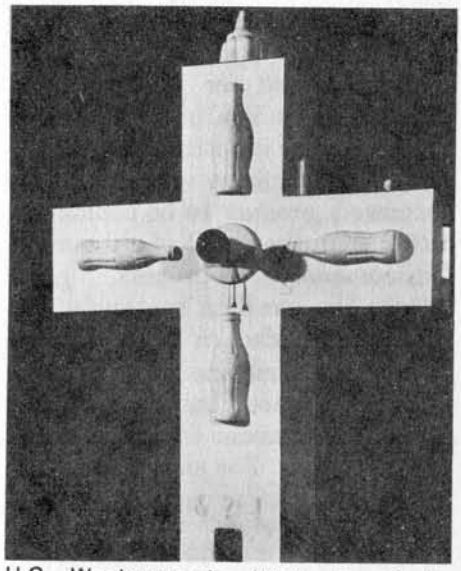
> "a monopoly over the social imagination setting standards of what is valuable and what is feasible."[10]

Values thus become imposed by professional fiat, rather than emerging independently in a given culture; in short the professional fiat 'radically' monopolises both the creation and satisfaction of human needs.

The notion of 'radical' monopoly requires explanation because it is fundamental to understanding the process by which values have become institutionalised. It is the situation in which industrial 'over-efficiency', reflected in the use of sophisticated technologies within highly planned bureaucratic settings, dominated by professionals, undermines independent and spontaneous activity in the satisfaction of a crucial human need. Radical monopoly is to be distinguished from an ordinary monopolistic situation where a particular institution commands the market for one product *brand*, without controlling alternative ways of meeting the particular need. Illich gives as an example Coca-cola who might establish a monopoly over the market for soft drinks in a particular area, but this would not take on radical form if a person were still free to quench his or her thirst in other ways. However if Coca-cola's control were over the meeting of the need itself—if people *believed they had no alternative* but to drink Coca-cola in order to quench their thirst—a *radical* monopoly would have been established. Thus:

> "a branch of industry does not impose a radical monopoly on a whole society by the simple fact that it produces scarce products, or because it drives competing industries off the market, but rather by virtue of its acquired ability to create and shape the need which *it alone* can satisfy." (emphasis added)[11]

Central, then, to the notion of radical monopoly is the institutional power to so constrain peoples' perception of reality that a need can only be defined in a particular way. In his writings Illich examines the development of radical monopolies in transportation,[12] education[13] and medicine.[14] But radical monopoly is not merely confined to these areas. For Illich it is a characteristic of all major institutions in modern industrial society, and their tendency to take on this form is seen as a function of the process of industrialisation itself.



H.C. Westermann's, White for Purity (1959-1960).

The Consumer Mentality and social Imbalance

Illich's concept of the 'institutionalisation of values', and its social outcome by which human beings can no longer actively formulate their needs and become instead passive consumers of the ever-increasing products of institutions, seems very close to the process which Peter Berger and Thomas Luckman called 'reification'. For them,

> "reification implies that man is capable of forgetting his own authorship of the human world, and, further that the dialectic between man, the producer, and his products is lost to consciousness. The reified world is, by definition, a dehumanised world. It is experienced by man as a strange facticity, an *opus alienum* over which he has no control rather than as the *opus proprium* of his own productive activity."[15]

In his discussion of modern education, Illich makes the same point.

Thus, he says,

> "we are taught that valuable learning is the result of attendance; that the value of learning increases with the amount of input; and, finally, that this value can be measured and documented by grades and certificates."[16]

In this way, learning becomes transformed into 'education'—an objectified product of an institutional process. The outcome of this is that the 'well-educated' person becomes synonymous with someone who has maximised his or her 'consumption' of educational credits. If this view is widely held in society—and Illich argues that it is—the capacity to learn on one's own, and to be positively regarded for it, is negated through the radical monopolisation of learning by institutionalised education. Learning as education thus becomes a *product* to be consumed, rather than the result of a dynamic, autonomous, social process.

Once the 'need to be taught' becomes embedded in consciousness 'people lose their incentive to grow in independence' and increasingly rely on institutions for the meeting of other needs. For example:

> "Medical treatment is mistaken for health care, social work for the improvement of community life, (and) police protection for safety."[17]

In short 'whatever good there is, is (seen) as the product of some specialised institution.'[18] For Illich, this is equated with a regression in human consciousness, or rather

> "a mutation of collective consciousness which leads to a conception of man as an organism dependent not on nature and individuals, but rather on institutions. This institutionalisation of substantive values, this belief that a planned process of treatment ultimately gives results desired by the recipient, this consumer ethos, is at the heart of the Promethean fallacy."[19]

It is clear from the above passage that Illich believes rampant consumption of the products of institutions to be the essential problem, or universal hubris, of modern industrial societies. Moreover the impact of such consumerism has thrust such societies into permanent imbalance which, if not reversed, can only have a catastrophic outcome. By giving causal priority to the institutional structure of industrial societies, Illich argues that such an outcome can be avoided, and social equilibrium restored, only through institutional inversion, or what he calls the 'de-institutionalisation of values'.

This position clearly lays Illich open to severe criticism, especially from the Marxist viewpoint that such institutional arrangements are primarily a reflection of the underlying economic realities. Though we cannot enter this debate in depth here, it is important to note that Illich's critique is of industrial society in general rather than capitalism in particular. This is made clear in the following passage:

> "Our present ideologies are useful to clarify the contradictions which appear in a society which relies on the capitalist control of industrial production; they do not, however, provide the necessary framework for analysing the crisis in the industrial mode of production itself."[20]

The crisis in the industrial mode of production is the crisis of consumerism arising from the institutionalisation of values which Illich believes is a characteristic of *all* industrial societies. Consumerism acts, therefore, as an independent force in the creation of instabilities through the undermining of freedom in industrial societies, whatever their political differences. There are, of course, various Marxist perspectives on this debate and some writers, especially those associated with the Frankfurt Institute of Social Research, come close to Illich's position in many respects. Marcuse, for instance, has stressed the importance of analysing consumption as a relatively autonomous element of oppression; he makes this explicit in the following reference to the Soviet Union:

> "There is no reason to assume that technical progress plus nationalisation will make for 'automatic' liberation and release of the negating forces . . . The more the rulers are capable of delivering the goods of consumption, the more firmly will the underlying population be tied to the various ruling bureaucracies."[21]

Hubris

Tillich has argued that an essential paradox of human existence is that self-consciousness enables humankind to transcend the world and transform it. Thus human beings are in a situation in which they can, or are free to realise their potentialities, but a fundamental element of the human condition is finitude, or the certainty of death. As Tillich says:

> "If man does not acknowledge this situation—the fact that he is excluded from the infinity of the gods—he falls into hubris. He elevates himself beyond the limits of his finite being and provokes the divine wrath which destroys him."[22]

What Tillich is saying here is that the *limits* to human capacities must be recognised if human life is to remain viable; the consequences of the non-recognition of these limits is nemesis—divine vengeance or retributive action.

Illich uses the concept of hubris, but without Tillich's explicit theological connotations. For Illich there are 'natural scales and limits' to human activities which must be recognised if nemesis is to be avoided:

> "To formulate a theory about a future society both very modern and not dominated by industry, it will be necessary to recognise natural scales and limits. We must come to admit that only within limits can machines take the place of slaves; beyond these limits they lead to a new kind of serfdom. Only within limits can education fit people into a man-made environment: beyond these limits lies the universal schoolhouse . . . Only within limits ought politics to be concerned with the distribution of maximum industrial outputs, rather than with equal inputs of either energy or information. Once these limits are recognised, it becomes possible to articulate the triadic relationship between persons, tools and a new collectivity. Such a society . . . I will call convivial."[23]

But it is clear that Illich sees the industrial system as having failed to come to terms with the notion of limits:

> "The human equilibrium is shifting. It is capable of shifting within flexible but finite parameters. People can change,

but only within bounds. In contrast, the present industrial system is dynamically unstable. It is organised for indefinite expansion and the concurrent unlimited creation of new needs, which in an industrial environment soon become basic necessities."[24]

Industrial societies have thus entered a state of hubris which if not contained can lead to nemesis and the eventual breakdown of society. No reform of the existing society is possible—what must be done is a radical inversion of the existing institutional structure. For Illich, an industrial society's institutions make manifest the hubris of humankind.

Other writers share Illich's concern that the instability of modern industrial society is a function of uncontrolled growth and expansion. For instance Schumacher has said that:

"Economically, our wrong living consists primarily in systematically cultivating greed and envy and thus building up a vast array of unwarrantable wants . . . If greed were not the master of modern man—ably assisted by envy—how could it be that the frenzy of economism does not abate as 'higher standards of living' are attained?"[25]

It is clear that Schumacher does not regard greed and envy as inherent factors of human nature, but as qualities stimulated by social arrangements based on a materialistic ethos. Fromm echoes this approach in his argument that 'having', in contrast to 'being', is the prime mode of existence in modern industrialised society. For Fromm,

"*greed* is the natural outcome of the 'having' orientation . . . (and) whatever constitutes their greed, the greedy can never have enough, can never be 'satisfied' . . . Besides, since production, great as it may be, can never keep pace with *unlimited* desires, there must be competition and antagonism among individuals in the struggle for getting the most."[26]

The message received from the writings of Illich, Fromm and Schumacher is clear. Mere control of growth is not enough; what is needed are *qualitative* changes in society's values, technology and social organisation, if harmony and balance are to be achieved in a genuinely *post*-industrial future. The dilemma has been posed; but can it be resolved?

Towards an holistic Perspective

The emergence of an eco-future depends on the transformation of the values upon which our existing industrial system is based. In particular the evolution of a new holistic consciousness is necessary in which the drive in industrial societies to establish domination over nature must be put into reverse. This attitude to nature is central to the value system underpinning industrialisation and gives legitimacy to a whole range of activities such as urbanisation, monoculture farming, the mining of non-renewable resoures and the development of nuclear power.

The development of the Cartesian scientific paradigm in which the subject (mind) is separated from the object (matter) has both reinforced and contributed to this prevailing attitude to nature. Nature (matter) is seen as objective, inert and lifeless, but subject to laws which, once understood, can put it under the direct domination and control of humankind. But our 'apartness' from nature is apparent not real. It is derived from our capacity to reflect intellectually on ourselves as separate beings in the world. Such rational self-reflection, when unaccompanied by an intuitive awareness that we have a spiritual affinity with nature, desensitises us to the fact that we are an integral part of that which we seek to dominate and control. An abuse of nature thus becomes an abuse of ourselves. The extreme specialisation of the analytical rational mind in industrial societies has been detrimental to the development of those intuitive powers of human beings which enables us to grasp the 'oneness' of all things, and through such holistic or ecological vision to be aware of our affinity not only with nature but with the cosmos as a whole. Capra puts this well:

"I see science and mysticism as two complementary manifestations of the human mind; of its rational and intuitive faculties. The modern physicist experiences the world through an extreme specialisation of the rational mind; the mystic through an extreme specialisation of the intuitive mind . . . Science does not need mysticism and mysticism does not need science; but man needs both. Mystical experience is necessary to understand the deepest nature of things, and science is essential for modern life. What we need, therefore, is not a synthesis but a dynamic interplay between mystical intuition and scientific analysis. So far, this has not been achieved in our society."[27]

But the fact that this complementarity between rationality and intuition has not been achieved means, for Capra, that industrial societies are in a serious state of imbalance. He illustrates this by reference to the Taoist categories of Yin and Yang which represent the polar extremes of the Tao cycle of change. All reality is seen 'as a process of continual flow and change' between Yin and Yang and harmony and balance are achieved when neither the one nor the other is over-emphasised.[28] Yin and Yang are *not* polar opposites, but complement each other in the social whole. As Capra says

"Nothing is only Yin or only Yang. All natural phenomena are manifestations of a continuous oscillation between the two poles, all transitions taking place gradually and in unbroken progression."[29]

Capra, whilst admitting that no direct translation of the notions of Yin and Yang can be made, has nevertheless conceptualised them broadly in the following way:[30]

Yin	Yang
Feminine	Masculine
Contractive	Demanding
Responsive	Aggressive
Cooperative	Competitive
Intuition	Rational
Synthesising	Analytic

In his comments on this comparison between Yin and Yang Capra says:

"it is easy to see that our society has consistently favoured the Yang over the Yin—rational knowledge over intuitive wisdom, science over religion, competition over co-operation, exploitation of natural resources over conservation, and so on. This emphasis, supported by the patriarchal system and further encouraged by the dominance

> of sensate culture during the past three centuries, has led to a profound cultural imbalance which lies at the very root of our current crisis—an imbalance in our thoughts and feelings, our values and attitudes, and our social and political structures."[31]

We need now to make explicit the relevance of Capra's analysis of modern industrial society to our earlier examination of the ideas of Tönnies, Weber and Illich. Tönnies' notion of natural will compares with Capra's complementarity between rationality and intuition. By putting Being before Thought it makes Thought relevant to Being and thus acts as an important unifying force in the culture as a whole. Such unification reflects the harmonisation of the Yin and the Yang. But the industrialisation process has meant the transformation of *Gemeinshaft*, which is characterised by rational will, and the emergence of *Gesellschaft* institutions relatively isolated from the cultural system; such isolation favours a non-holistic form of rationality—Weber's formal rationality or Tönnies' rational will—which is orientated to the *means* by which the particular purposes of institutions can be pursued. Stimulated by society's attachment to growth and progress such means are relentlessly pursued, especially through the development of professional expertise which has the effect of isolating the institutional structure still further from the cultural system. This professionalised meeting of human needs, Illich's 'institutionalisation of values', reflective of the over-emphasis of the Yang principle, is an advanced, or perhaps final, stage of the disintegration of cultural life. The narrow single-minded perspective of the professional or specialist is antithetical to the cultural balance and harmony on which holistic vision depends. McBeath has summed up this position well in his comment on the impact of specialisation in modern life:

> "specialists . . . concentrate their attention on a narrow field and they are apt to neglect its context and background . . . Their attitude is like a searchlight—the narrower and the brighter the beam the closer it shows the object on which it is focused, but the more certainly it banishes everything else into outer darkness. Thus, what specialists see they see clearly, but they don't see it in its proper perspective, and therefore the conclusions at which they arrive are apt to be one-sided, only partially true . . . Today we live in an age of specialists, an age in which the condition of success, whether in the theoretical or the practical sphere, is concentration, narrowing one's range, and therefore we are all likely to commit the specialist's fallacy. Accordingly we tend to be lop-sided individuals, overdeveloped on one side, underdeveloped on others, our views on life distorted, one-sided, out of focus."[32]

This distortion of knowledge through specialisation would seem to be an inevitability in a society committed to Yang over Yin values. To overcome this changes in the social arrangements of industrial societies will be necessary if Yin is to play a significant role as an organising principle of social life. Indeed:

> "The survival of our whole civilisation may depend on whether we can bring about such a change. It will depend, ultimately, on our ability to adopt some of the Yin attitudes of Eastern mysticism; to experience the wholeness of nature and the art of living with it in harmony."[33]

The Relevance of Sociology to the ecological Debate

So far sociology *as a discipline* has made very little contribution to the debate on environmental issues or alternative futures. There have, of course, been post-industrial theories developed by sociologists such as Bell and Touraine, but there is a tendency among them to accept a model of technological determinism. That there are sociologists working in this field there is no doubt, and perhaps Krishan Kumar has made the most important recent contribution to this debate. In his book, *Prophecy and Progress*, published in 1978, he has, refreshingly, included a section on the 'Relevance of Utopianism' in which he argues that utopianism must not be dismissed lightly because:

> "Environmental deterioration, overcrowding, the depletion of resources, the costs of large-scale organisation and rapid economic growth, all remain issues which must concern the industrial societies over the coming decades. Of continuing relevance too is the rediscovery of the 'quality of life' as a criterion of value that takes into account imprecise but significant factors not adequately tapped by the economic and social indicators of the industrial and welfare bureaucracies. Nor can the élites of the society afford to ignore the renewed concern with human scale ('small is beautiful'), human control, and personal satisfaction as irreducible requirements of any system of industrial and political organisation."[34]

Classical theorists such as Tönnies and Weber, to whom considerable reference has been made in this article, posed important questions relevant to the problems associated with the fragmentation of modern life. Similarly Durkheim believed that the rise of industrialisation could lead to the destabilisation of society. But both Durkheim and Tönnies argued that mechanisms should be established *within* industrial society so that individuals could adapt to the changing environment in which they found themselves. Weber was much more pessimistic about the future, but as we have seen his commitment to a value-free social science did not permit him to construct any theory which would provide a basis for the transcendence of the existing social circumstances in industrial society.

Marxist theory has also been more or less silent on these issues. Possibly the main problem here has been the ambivalence in Marx's own writings: for him human 'species-being' is realised through the transformation of nature. There is thus a tendency to regard the advance of science and technology as a positive rather than negative aspect of industrial development, because 'species-being' realises its potential through the *extention* of its productive powers. But the extention of such powers are only fully realised when the contradictions arising from the class struggle have been overcome. By focusing on these issues Marxists have tended to overlook

the ecological messages in Marx's writings.

That there are these ecological messages is demonstrated by Marx's sensitisation to the need to protect and conserve nature. Capra makes this explicit in this quotation from the *Economic and Philosophic Manuscripts:*

> "Nature is man's inorganic body-nature, that is, in so far as it is not itself the human body. 'Man lives on nature' means that nature is his body, with which he must remain in continuous intercourse if he is not to die. That man's physical and spiritual life is linked to nature means simply that nature is linked to itself, for man is part of nature."[35]

What is needed is a critique not just of capitalism, on which Marxists have tended to concentrate, but of industrial society as a whole. The work of the Frankfurt Institute of Social Research has certainly broadened this perspective within Marxism by focusing its analysis on a critique of technical reason, rather than specifically on the economic relations of production. For instance in his critique of science and technology Marcuse, one of the original members of the Frankfurt School, has referred to the material destructiveness of *all* industrial societies arising from their accentuation of quantitative rather than qualitative growth. The framework of analysis used by the Frankfurt School—critical theory—which concentrates not just on the economic relations of production, but on the totality of society, does seem the best prospect for the development of an analysis of ecological issues as an aspect of social exploitation. Moreover the firm commitment of critical theory to the principle of human emancipation, and its inter-disciplinary approach, lends strength to this argument.

There are some continuities between the thought of radical humanists such as Illich and Schumacher, and those of the Frankfurt School. Perhaps the exploration of these continuities provides the best basis both for the development of a sociological perspective on ecological issues of current concern, and the emergence of a new theory of industrialisation.

References

1. R. Frankenberg, *Communities in Britain,* Penguin, 1969. ch.11
2. F. Tönnies, *Community and Association,* RKP, 1955
3. J. Freund, 'German Sociology in the Time of Max Weber', in T. Bottomore and R. Nisbet (eds) *A History of Sociological Analysis,* Heinemann, 1979. p.154
4. F. Pappenheim, *The Alienation of Modern Man,* Modern Reader Paperbacks, 1968. pp.66-77
5. P. Tillich, 'Systematic Theology', vol.I, in W.A. Weisskopf, *Alienation and Economics,* Clarke, Irwin & Co., 1971. p.38
6. *Ibid.*
7. H.H. Gerth & C. Wright Mills, *From Max Weber,* RKP, 1970. p.139. 'Science as a Vocation'
8. *Ibid.* p.214
9. A. Giddens, *Capitalism and Modern Social Theory,* CUP, 1971. p.184
10. I. Illich, *Deschooling Society,* Penguin, 1973. p.11
11. I. Illich, *Energy and Equity,* Calder & Boyars, 1974. p.59
12. *Ibid.*
13. I. Illich, *op.cit.,* 1973
14. I. Illich, *Limits to Medicine,* Penguin, 1977
15. P.L. Berger & T. Luckman, *The Social Construction of Reality,* Penguin, 1971. p.106
16. I. Illich, *op.cit.,* 1973. p.44
17. I. Illich, *Ibid.,* p.9
18. *Ibid.,* p.109
19. *Ibid.,* pp.114/115
20. I. Illich, *Tools for Conviviality,* Fontana, 1975. p.11
21. H. Marcuse, *One Dimensional Man,* Abacus, 1972. p.47
22. P. Tillich, *Systematic Theology,* Vol.II, Nisbet James & Co. Ltd., 1957. p.56
23. I. Illich, *op.cit.,* 1975. p.12
24. *Ibid.,* p.60
25. E.F. Schumacher, *Small is Beautiful,* Abacus, 1974. p.30
26. E. Fromm, *To Have or To Be?* Sphere Books Ltd., Abacus, 1979. p.114
27. F. Capra, *The Tao of Physics,* Fontana, 1976. p.324
28. F. Capra, *The Turning Point,* Wildwood House, 1982. p.17
29. *Ibid.,* p.18
30. *Ibid.,* p.21
31. *Ibid.,* p.22
32. A. MacBeath, 'The Need for a Social Philosophy', in W.D. Birrell *et al* (eds), *Social Administration,* Penguin, 1973. pp.283/284
33. F. Capra, *op.cit.,* 1976. p.325
34. K. Kumar, *Prophecy and Progress,* Penguin, 1978. p.260
35. K. Marx, 'Economic and Philosophic Manuscripts', in F. Capra, *op.cit.* 1982. p.217

Alwyn Jones is Senior Lecturer in Sociology in the Department of Behavioural and Communication Studies at the Polytechnic of Wales.

Resisting History

by Ashis Nandy

The experience of suffering of some Third World societies has added a new theme to utopianism by sensing and resisting the oppression which comes as 'history'. By the oppression of history I mean not only the limits which our past always seems to impose on our visions of the future, but also the use of a linear, progressive, cumulative, deterministic concept of history—often carved out of humanistic ideologies—to suppress alternative worldviews, alternative utopias and, even alternative self concepts. The peripheries of the world often feel that they are constrained not merely by partial, biased or ethnocentric history, but by the idea of history itself.

One can give a psychopathological interpretation of such scepticism towards history, often inextricably linked with painful, fearsome memories of man-made suffering. Defiance of history may look like a primitive denial of history and, to the extent the present is fully shaped by history in the modern eyes, denial of contemporary realities. But, even from a strict clinical point of view, there can be reasons for and creative uses of ahistoricity. What Alexander and Margarete Mitscherlich say about those with a history of inflicting suffering also applies to those who have been their victims:

> A very considerable expenditure of psychic energy is necessary to maintain this separation of acceptable and unacceptable memories: and what is used in the defence of a self anxious to protect itself against bitter qualms of conscience and doubts about its worth is unavailable for mastering the present.[1]

The burden of history is the burden of such memories and anti-memories. Some cultures prefer to live with it and painfully excavate the anti-memories and integrate them as a part of the present consciousness. Some cultures prefer to handle the same problem at the mythopoeic level. Instead of excavating for the so-called real past, they excavate for other meanings of the present, as revealed in traditions and myths about an ever-present but open past. The anti-memories at that level become less passionate and they allow greater play and lesser defensive rigidity.

What seems an ahistorical and, even, anti-historical attitude in many non-modern cultures is often only an attempt, on the part of these cultures, to incorporate their historical experiences into their shared traditions as categories of thinking rather than as objective chronicles of the past.[2] In these cultures, the mystical and consciousness-expanding modes are alternative pathways to experiences which in other societies are sought through a linear concept of a 'real' history. In the modern context these modes can sometimes become what Robert J. Lifton calls 'romantic totalism'—a post-Cartesian absolutism which seeks to replace history with experience.[3] But that is not a fate which is written into the origins of these modes. If the predicament is the totalism and not the romance, the *history* of civilizations after Christopher Columbus and Vasco da Gama also shows that that totalism can also come from a history which seeks to replace experience. Especially so when, after the advent of the idea of scientific history, history has begun to share in the near-monopoly science has already established in the area of human certitude. Albert Camus, it seems, once drew a line between the makers of history and the victims of history. The job of the writer, he reportedly said, was to write about the victims. For the silent majority of the world, the makers of history also live in history and the defiance of history begins not so much with an alternative history as with the denial of history as an acreage of human certitude.

In their scepticism towards history, the oppressed cultures have an ally in certain recessive orientations to the past in the Western culture, manifested in the ways of thinking that have been formalised in recent decades by structural anthropology and psycho-analysis, which see history either as a language, with its own semiotics or as a 'screen memory' with its own rules of psychological defences. Both these disciplines see the construction of history as an important clue to the principles of the human mind, on the one hand, and the experiences of the here-and-now, on the other. The dynamics of history, according to such a point of view, is not in an unalterable past moving towards an inexorable future; it is in the ways of thinking and in the choices of present times.[4]

There is a fit between this hostility to history and the need to protect self-esteem and ensure survival in many Third World societies. History, as it is commonly defined, has never been fair to them. Nor could it be otherwise, given the structure of cognition it presumes. The more scientific a history, the more dangerous a kitbag of ideas it is for the inhabitants of the experimental laboratory called the Third World. It is history which has frequently allowed ideas of social intervention to be swallowed up by ideals of social engineering in modern times. In the dominant cultures of the West, history has always been the unfolding of a theory of progress, a serialised expression of a *telos*

which, by definition, cannot be shared by the communities placed on the lower rungs of the ladder of history or outside the scope of history. Even the histories of oppression and the historical theories of liberation include stages of growth which, instead of widening the options of the victims, reduce them. In fact, one of the main functions of these theories is to ensure the centrality of cultural and intellectual paradigms within which not only the experiences of a few societies dominate, but within which even the models of dissent from these experiences can be accommodated. Following an old Bengali saying, such paradigms first bite as snakes and then offer a cure in the incarnation of witch doctors.

The ethnocentrism of the anthropologist can be corrected; he is segregated from his subject only spatially and, some day, his subjects can talk back. The ethnocentrism towards the past often goes unchallenged. The dead do not rebel, nor can they speak out. In this sense, the subjecthood of the subjects of history is absolute, and to admit the existence of a real or scientific history is to admit a continuity between subjecthood in history and subjection in the present.

The refusal to acknowledge the primacy of history, thus, is also the refusal to chain the future to the past. This itself is a special attitude to human potentialities, an alternative form of utopianism that has survived till now as a language alien to, and subversive of, every theory which, in the name of liberation, circumscribes and makes predictable the spirit of human rebelliousness.

Ashis Nandy is a fellow of the Centre for the Study of Developing Societies at Delhi. He is the author of "Alternative Sciences" and "At the Edge of Psychology".

Notes

1. Alexander and Margarete Mitscherlich, 'The Inability to Mourn', in Robert J. Lifton and Eric Olson (Eds.), *Explorations in Psychohistory, The Wellfleet Papers*, New York: Simon and Schuster, 1974, pp. 257-270, quote on p.262
2. See a fuller discussion of these themes with reference to Gandhi's worldview in my 'The Psychology of Colonialism: Age, Sex and Ideology in British India' in *The Intimate Enemy: Loss and Recovery of Self Under Colonialism*, New Delhi: Oxford University Press, 1983, Part 1. A brief earlier version of the essay is in *Psychiatry*, August 1983, 45(3), pp. 197-218
3. Robert J. Lifton, *Boundaries: Psychological Man in Revolution*, New York: Simon and Schuster, 1969, pp. 105-106
4. I need heardly add that within the modern idea of history too, this view has survived as a latent—and, one is tempted to add, unconscious—strain. From Karl Marx to Benedetto Croce and from R.G. Collingwood to Michael Oakeshott, students of philosophy of history have sometimes moved close to an approach to history which is compatible with traditional orientations to past times.

Extracted from 'Oppression and Human Liberation: Towards a Third World Utopia', to be published in the author's forthcoming book *The Politics of Awareness: Traditions, Tyranny and Utopias*. An earlier version of the longer essay was published in *Alternatives*, 1978-79, 4(3)

RIVERS—a hymn

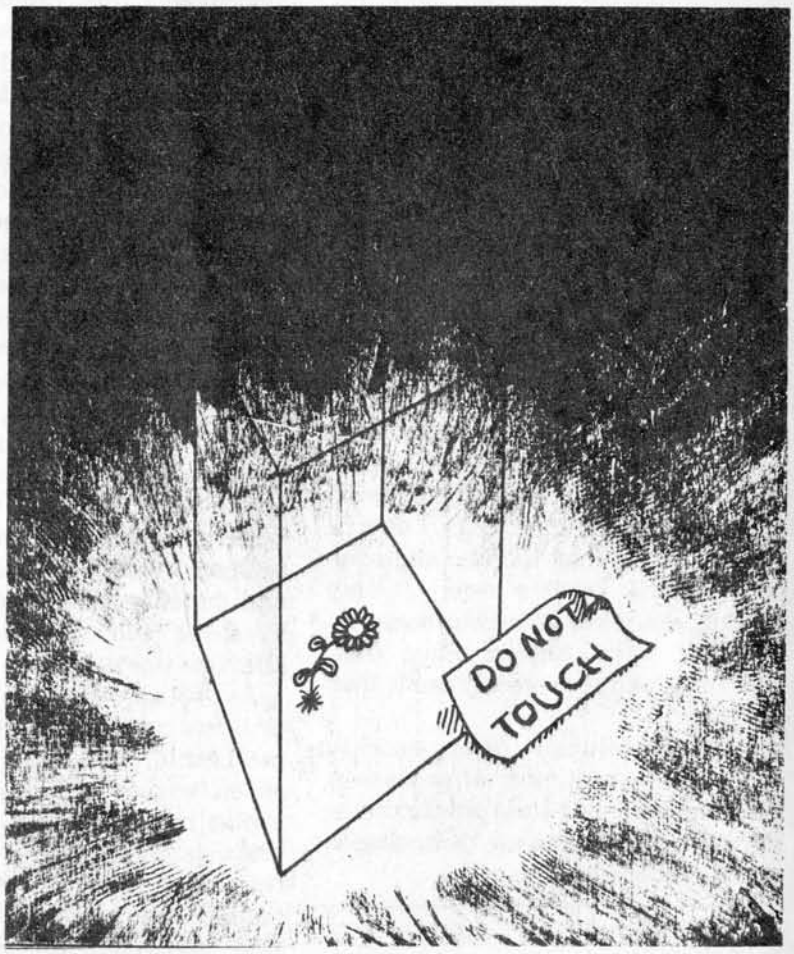
Praise be to God for making rivers
To carry off our toxic wastes;
Divinely prescient and wise
He had foreseen our future states
Constructing nature for our good.
He knew we must industrialise
To prosper as his creatures should.
And so a billion years ago
Before we made the mighty nations
Bade rivers to the oceans flow
So they could drain our connurbations.
Praise be to God . . .

THE SPIRIT OF THE TIMES

Such is the spirit of the times
  Farmers expect to be paid
For every flower in every patch
  They've left unsprayed.

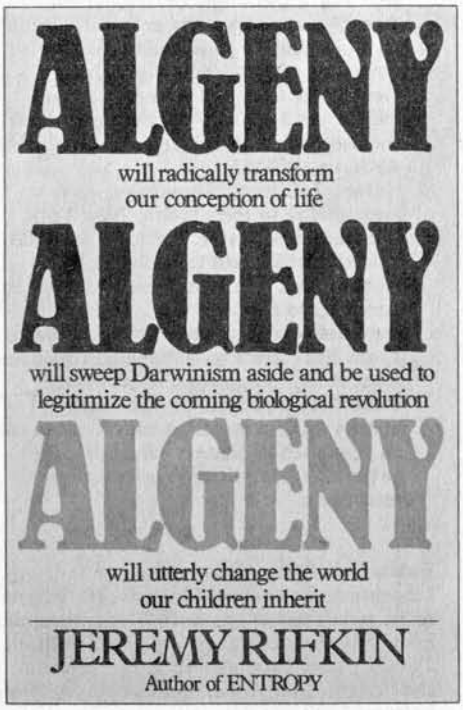
Surveyors are sent
To estimate the profits lost
So they can be recompensed;
Prodigious is the cost
Of leaving half a rood
Of nature undisturbed
When the nation's barns are stacked
With unsold food.

Robert Waller



FROM ALCHEMY TO ALGENY*

An Interview with Jeremy Rifkin



by Michael Totten

In what may turn out to be a watershed date in church history, June 8th, 1983, leaders from every major church of the U.S. Judeo-Christian community took an unprecedented move in jointly issuing a resolution opposing genetic engineering of the human germline cells (the sex cells). The church fathers served warning to the nation's business leaders and government officials that they are unequivocably, morally opposed to entering into this greatest of faustian bargains yet offered to human kind.

The person responsible for organizing this unlikely coalition of evangelicals, fundamentalists, charismatics, main-line liberals, and radical church leaders was Jeremy Rifkin, author of numerous books including, *Who Should Play God, Entropy,* and the recently published, *Algeny**.

The Resolution was quickly attacked by a number of prominent bioengineers as being premature in worrying about genetic technologies that are decades away.

Alexander Capon, director of a special Presidential commission on the ethical implications of genetic research, complained that the Resolution was tantamount to "yelling fire when there is no fire. What there is is a smouldering ashtray with the fire department watching over it."

In the short run this certainly seems true. A 1979 report by Congress, *Impacts of Applied Genetics,* reads like a litany of biotechnology's wonderful solutions to humanity's numerous problems: vaccines for controlling major infectious, parasitic, and viral diseases, pharmaceuticals for cancer, diabetes, bone disorders, nerve damage, wounds and burns, and others.

In industry, genetically engineered microorganisms offer the hope of concentrating and reducing toxic industrial wastes and chemical pollutants; creating a renewable energy system based on microorganisms capable of digesting wood and fibre residues; microorganisms designed to leach metals from low grade ores, and produce cheap and plentiful raw materials for plastics, fibres, solvents, and rubber. In agriculture, a new green revolution is in the makings where microbes will be designed to attack crop-eating insects, produce fertilizers and pesticides, and superior strains of plants and livestock will be cloned to help alleviate world hunger.

As Rifkin notes, stock market analysts estimate that fully 70 per cent of the GNP will be influenced to some degree by gene engineering by the turn of the century. There is no mistaking the euphoria that permeates the business community and government agencies, who see phenomenal profits—a whole new economy—to be gained while promoting the "general welfare."

Rifkin, however, does not share this optimism, and argues persuasively that we may be just as naive about the promises of splitting genes as scientists once were about splitting atoms. The long term perils appear to cancel out the short term promises. It is a promise of perfection, he suggests, coupled with the threat of extinction. For Rifkin, "the biggest single assault in history on the ecology of this planet is recombinant DNA."

MT: What is algeny?

JR: It means changing the essence of a living thing by transforming it from one state to another; upgrading existing organisms and designing wholly new ones with the intent of "perfecting" their performance. More broadly, it is humanity's attempt to give metaphysical meaning to its emerging technological relationship with nature. An algenist is the ultimate engineer. His task is to accelerate the natural process by programming new creations that are mo. "efficient" than those that exist in the state of nature.

For an algenist the whole idea of species boundaries, which is the starting point for ecology, is completely archaic. There are no species boundaries, laws, or identifiable structures for an algenist, there is just pure biological information that can be combined across all boundaries.

MT: You argue that Algeny is the metaphor for the coming age of biology, replacing Alchemy, the old metaphor for the passing industrial machine age.

*Viking, $14.75.

JR: Right. For thousands of years we have been engineering, fusing, melting, soldering, forging, and burning the cold, inanimate crust of the earth into all sorts of new combinations, shapes, and forms that did not exist in the natural state: "alchemically" producing economic utilities like cement, steel, glass, synthetics, etc. Now, human beings are setting out to engineer the internal biology of living organisms in the hope of staving off the crisis of exhausting earth's stock of burnable energy and usable matter, and laying the base for a new world epoch. We are moving from the machine driven age of pyrotechnology to the computer designed age of biotechnology.

Our ultimate goal is to rival the growth curve of the Industrial Age by producing living material at a tempo far exceeding nature's own time frame and then converting that living material into an economic cornucopia.

MT: But isn't this just an extension of the tampering we've always done with nature?
JR: Certainly we have been cultivating, breeding, domesticating and hybridizing nature for thousands of years. But genetic engineering is qualitatively different. It's not an extension of the pyrotechnology, it is comparable to and a leap beyond it. Never before could we engineer life, change the internal morphology of a living system, or cross all species' boundaries and create entirely new forms of genetic material.

MT: You argue that central to this transition is the displacement of the non-renewable energy base with a renewable one.
JR: Yes, to many people genetic engineering is a set of products, or a group of technologies, but it isn't, it's a method. It's a philosophical and technological approach to the age of renewables, fundamentally different in both theory and applications to an ecological approach.

MT: What is the idea behind the biotechnical approach?
JR: Quite simply: renewable resources are fine, but nature's tempo is too slow to provide an ever expanding growth curve and an increased GNP. So, if we are to maintain the standard of living in the coming age of renewable resources that we have enjoyed up to now using up the stored sun of the carboniferous era, we will have to "hot wire" the gene pool. We will have to engineer biological resources to convert them into living products faster than nature's own production process would allow.

MT: This is substantially different from the environmentalists vision of a renewable resource age.
JR: The environmental community has won a battle, and perhaps in doing so has lost the war. I say this because for years the environmental leaders have been urging, pleading, and beseeching the American public to move from non-renewable to renewable resources.

Implicit in that transformation was the idea that we would develop a "small is beautiful" society, we would live more equitably with each other, share the resources, be a partner with nature, decentralize our lifestyles, and move in concert with the rhythms and periodicities of the natural system. What we are finding, however, is that every major industrial civilization on this planet is now moving towards renewable resources—biologically reproductible resources—but they are not picking the ecological approach to organizing renewable resources that we had in mind.

MT: Yet many environmentalists and futurists look to the computerized information economy based upon renewable resources aided by applied genetics, as the cleanest, most efficient, anti-entropic future option available to mankind.
JR: I think they share that gross naivete of the "Atari Democrats" who are offering us two solutions to our economic and ecologic woes: high tech and biotech. Nothing could be wider of the mark.

We are conning ourselves by believing that reproducible biological resources are renewable. They aren't. As Nicholas Georgescu-Roegen, the great entropy economist, once said, "matter matters." Scientists designed thermodynamics for energy, and never really took into consideration matter. Yet matter also has an entropy bill. Every blade of grass grown today is one less blade grown tomorrow.

We are going to witness tremendous biological pollution as living material gets converted faster and faster. It's a magnitude of difference from chemical pollution, where we deal with inert, dead material. Biological pollution is alive, it reproduces, it grows. It cannot be called back to the laboratory like an automobile. It could well be irreversible. For example, what happens if one out of the millions of newly introduced microorganisms develops a niche, is unfavourably predisposed to other life forms, and reproduces?

An associated peril is the monoculturing of genetic diversity—genetic erosion. Let's say you clone a super herd—50 million carbon copies. Experience one disease pattern to which that clone genotype is not immune and you've wiped out your entire herd. If we begin monoculturing ourselves to eliminate so-called genetic diseases, in the short run we might secure the individual medical well-being of the person involved, but in the long run we will eliminate the genetic diversity in the human gene pool essential for it to maintain and readjust to ever-changing environments.

MT: This is the faustian bargain you refer to—a "perfecting" technology that harbours the potential risk of species extinction?
JR: That's right. There's no doubt that it's enticing, compelling, and filled with enormous economic promise in the short term, but the long term is filled with quite frightening prospects that even the bioengineers cannot dispute. For example, you can't do genetic engineering without being into eugenics. When scientists say "Here is a good gene to engineer into this organism, and here is a bad gene to engineer out," they are making eugenic decisions.

The new eugenics is not social with cries of racial superiority and the Aryan perfect race. The new eugenics is *commercial.* All the ethicists keep a lookout at the front door for Hitler, but the eugenics came in the back door via the market-place in Genex, Genetech, Biogen and all the other biotechnical corporations. The new eugenics is coming to us not as a threat but as a promise; not as a scourge, but as a blessing. A way to increase the GNP after the

industrial order comes to a halt.

MT: A new version of the "atoms for peace" campaign, like "genes for prosperity."
JR: Very much so. Which goes to the core of what this is all about: who are we going to trust with the ultimate authority of deciding who has a good or bad gene? The White House? Congress? The Supreme Court? Corporations? Bioengineers? Theologians? This is the supreme politics. Politics up to this point in history has always been external control. The ability, however, to design the blueprint of a plant, animal, or human being in advance, so that they carry out the instructions biologically, is the ultimate power.

MT: A central thesis of *Algeny* is that with each major shift in technological production, society also changes its cosmology, its concept of nature, and, as you say, that "coincidentally, the new concept of nature always bears a striking compatability with whatever the new technological relationship with nature is." Can you give us an example?
JR: Before Darwin the concept of nature was the Great Chain of Being, a brilliant synthesis of Christian ideas of origin developed by St. Thomas Aquinas. Aquinas' God was a craftsman. Interesting, because in the thirteenth century, craft industries were the mode of technological production. Nature was organized as a hierarchy, with God creating every species out of a unique mould. There was no moving up or down the chain, no meritocracy. St. Thomas' concept of nature bore a striking likeness to the way medieval social institutions were set up from serf to knight to lord to Pope.

Then you go to Darwin. Darwin did not pen his idea of nature from "immaculate perception." He was a product of his age, subject to the language, metaphors, technology, and culture in which he lived. Darwin saw nature not as replicas out of a craftsman's mould, but as an assemblage of individual parts by chance and opportunity into more efficient mechanisms, or organisms, better able to utilize scarce resources more efficiently. Well, that is what an entrepreneur and an industrial machine does.

St. Thomas' cosmology was suitable for a relatively static and rural economy, while Darwin's was developed for a rapidly changing and industrializing society. Darwin's nature was the first meritocracy. Each organism in nature's hierarchy had to work hard to eke out its place in the natural scheme of things. It fitted well with the temperament of a rising middle class that prided itself on being self-made.

MT: Now with the passing of the industrial era you note that it is no surprise it also marks the passing of Darwin's concept of nature. What's the temporary theory replacing it?
JR: The new theory of evolution is emerging out of the research findings in embryological development, field theory, and biological clock experimentation. The theory challenges the notion of fixity anywhere in nature. Our new concept of nature is taking all the language of the information sciences, systems theory, and cybernetics and projecting it into the life sciences. It is heralding a movement from a spatial to a temporal theory of the origins and development of the species.

Darwin said each species fights for scarce space, is a better built machine, and better able to utilize scarce resources more efficiently. The new theory is likely to say each species fights for scarce time, is a better built programme, and is better adept at processing greater stores of information in shorter time spans. We are moving from Descartes "universal machine" and the mechanistic model of "matter in motion," to the new cosmologists' "universal mind" and the cybernetic model of "mind in motion."

The meshing of computer and living tissue will result in a new type of world economy. Controlling the future by designing the temporal programmes of living organisms is the central dynamic of the age of biotechnology. We are about to engineer the life spans of all living things in advance, and our cosmology is changing, reflecting this fundamental shift in the way we go about organizing the world around us.

MT: By abandoning the mechanistic model of nature, these new theorists also claim to avoid the pitfalls of reductionism.
JR: This, to my mind, is the ultimate deception. Why do we think that since every concept of nature up till now has been used to allow us to manipulate, exploit, and use nature in a reductionist way, that somehow this new concept of nature is any more benign?

MT: As with your previous books, *Algeny* is a scathing indictment of the reductionist mentality that tends to desacralize nature, and your appeal for a more holistic, ecological approach. Can you elaborate on this?
JR: We need to reappraise our relationship with technology and what knowledge is. Technology has traditionally been considered a neutral tool, and could be used for good or bad, depending on who was controlling it. I think this is an utterly wrong analysis. History shows us that every technology increases the power of the user, at the expense of appropriating from somewhere else. As Elias Canetti has said, "Each of us is a king in a field of corpses." Power is not neutral, it's value laden. The real question is: how much power is appropriate? Can you ever say more power is inappropriate?

Similarly, there is another approach to knowledge. The prevailing view is that knowledge is power which enables us to control and appropriate nature for our well-being. I am finding a new generation of professors are suggesting an alternative view, empathetic knowledge. Here we use our tremendous ability to perceive, conceptualize, and understand the workings of nature so as to better rejoin the world as a participant in that natural process.

MT: For example?
JR: Take architecture. The old architect wanted to build a Sears-Roebuck Tower— a powerful, invincible fortress that gives you a sense of total power and also total weakness at the same time. That Sears Tower reeks with imperialism. It is laughing at all the resources it had to soak up to claim its own identity.

A new generation is saying, "Let's build structures that are so unobtrusive, elegant, and integrated with the surrounding environment that it's almost impossible to discern where the building materials leave off and nature's rhythms begin."

When you build a passive solar home you don't feel the intoxication and power that you get from a Sears Tower, but one does feel a sublime sense of contribution, and a feeling of being more a part of the rest of the world one is involved with.

I believe the debate here between empathetic and controlling knowledge is key to the understanding of whether we will have nuclear disarmament, and whether we will be able to resist genetic technology.

MT: Your last book, *Entropy*, was on Japan's best seller list for five months, which must be some kind of record, given that English books rarely succeed in Japanese culture. Do you think *Algeny* will be as well received?

JR: Well, it's interesting that the Japanese say they will be the first fully biotechnical nation by the turn of the century. I think the reason *Entropy* did so well is that it articulated a fundamental conflict they are experiencing: what Japan is trying to do technologically flies in the face of their traditional nature religions. Their idea of living within the confines of a benign nature is totally at odds with their technological gestalt.

MT: You seem to suggest as much for the Judeo-Christian community, first in *The Emerging Order*, and now most recently with the Resolution opposing gene-splicing of the human germline.

JR: Yes. God's second instruction in the Book of Genesis is that man shall have dominion over the animals. For many hundreds of years we have thought that dominion has meant subdue nature, appropriate it, and transform this "waste" into something productive.

Now, leading Christian scholars are saying they were wrong. They are saying that dominion did not mean subdue nature, it meant stewardship. Whenever we despoil, manipulate, or rearrange nature to our image we are not acting as a steward, we are in rebellion as stewards. A steward has a nurturing role to protect and take care of the creation for God. The full implications of this redefinition of dominion and stewardship ripple out into the Judeo-Christian world. We could see hundreds of years of the Christian work ethic substituted with a Christian conservation ethic.

MT: At the same time, you warn that this emerging religious movement coud be as easily manipulated in a malignant way.

JR: True. As we suffer from the decline of the industrial era and experience worsening economic conditions over the next 50 to 100 years, without a deep-rooted new covenant of ecological stewardship, it is likely that the increasingly bad times could co-opt our religious fervour into supporting a fortress mentality and a kind of techno-fascism.

The evangelical and charismatic movement could go either way. It could go toward the biotechnical computer society, where we become the architects of the second genesis, the creators of life—we become God and play out the final hubris of the fall from grace. Or, it could move us towards finally realizing our role as a participant and as a protector of the natural endowment, within which we remain, not which was made for us.

MT: How would you sum up the looming choices before us?

JR: When confronted with our own existence, two choices present themselves. To accept life as a gift to be enjoyed, or as an obstacle to overcome. If we experience life as a gift, we give thanks. If, however, we experience life as an obstacle to overcome, then we will be relentless in our search for ways to defeat its most essential attribute, its temporary nature, its limited duration. We will devour the life around us in order to extend our own. We will exhaust the very reservoirs of life from which the future is secured—two futures and one critical choice.

Michael Totten is Director of Critical Mass Energy Project.

Books

De-Skilling Society

THE NEW TECHNOLOGY—SOCIAL IMPACTS AND HUMAN CENTRED ALTERNATIVES. M.J. Cooley, Technology Policy Group, The Open University, £2.

This is only a short report of thirty pages or so, including references, but it is very well done. The subject is one about which a great deal has been written in recent times, much of it nonsense. Indeed, the author quotes J. Wiezenbaum who likens those who would automate everything that could possibly be automated to "children with a hammer who view the world as a nail".

Among other things, such people have succeeded in persuading themselves, by an astonishing feat of mental acrobatics, that the introduction of micro-electronics will actually lead to the creation of new jobs rather than aggravate unemployment to the point where it threatens the very existence of industrial society.

Unfortunately, the trade unions, as the author points out, are "fragmented at both a national and international level, and often possessed of a simplistic technological optimism." They are thus "ill-equipped organisationally or ideologically to cope with this increasingly threatening situation." It is, as Professor Noble of Massachusetts' Institute of Technology (MIT) puts it: "A War about new technology in which only one side is armed."

The author does not regard it as conceivable that the microchip will provide anything like enough new jobs to compensate for those it will destroy. He refers to a report by A.D. Little which estimates that in a ten year period, in four major sectors producing micro-electronic based products, only one million jobs will be created in North America and Western Europe. Of these only 400,000 will be in Europe—"a mere drop in the ocean of the nine million estimated unemployed now, with a predicted twenty million by 1988, on EEC figures."

Particularly interesting are the author's comments on the quality of the new automated jobs. In the early sixties, there was a lot of optimistic discussion on the subject of 'human-machine symbiosis', the principle being that the machines would undertake boring work, freeing man for more stimulating functions. One field in which this was supposed to manifest itself was that of 'computer-aided design' (CAD). On the (as yet) comparatively small experience of the working of CAD installations, that optimism appears singularly misplaced. Indeed, H.A. Rosenbrock suggests that the design of such systems reflects "a loss of nerve, a loss of belief in human abilities and a further unthinking application of the division of human labour."

In general, the micro-electronics 'revolution' is seen as leading to the further de-skilling of our labour force. "It has been reported recently," the author notes, "that in respect of certain forms of work on numerically controlled (NC) equipment the ideal workers would be mentally retarded and a mental age of twelve has been mentioned. If the objective was to create jobs for the mentally retarded, clearly the aim would be laudable. This, however, is not the aim. In fact, NC equipment is replacing some of the most highly skilled and satisfying work on the shop floor, such as jig-boring, milling, universal turning and highly skilled workshop practices." Professor Noble of MIT goes further, he says, "today designing for idiots is the highest expression of the engineering art."

The problems are similar in the case of clerical work, and the author also points to the serious de-skilling of work traditionally done by women. In banking, a research programme on the effects of automation in Swedish banks concluded that "increased automation converted tellers who were in effect mini-bankers into automatons."

Of course, one effect of the introduction of the new technologies is to increase centralised control. Harley Shaiken, a researcher for the United Auto Workers, describes it as 'power masquerading as technology'.

To de-skill people is undoubtedly to make them the more easily controlled. Indeed, Margelin goes so far as to suggest that this is as much the object of introducing the new technology as is the resultant increase in productivity.

It may be that the skills of a few people are enhanced, but that those of the majority are unquestionably diminished. The author quotes Sandberg, who notes; "The conceptualisation and planning of work on a day-to-day basis, is taken away from the immediate producers and concentrated within departments of planning. Many planners have interesting, meaningful jobs demanding a high level of qualification. Some of these few qualified jobs were created as a result of on-going automation while at the same time many other jobs were degraded. One may talk of a polarisation of skills."

Not surprisingly, many Trade Unions throughout the EEC are now beginning to realise that their early optimism regarding the introduction of the new technologies was—to say the least—premature.

Edward Goldsmith

The Rape of Africa

AGRIBUSINESS IN AFRICA, A study of the impact of big business on Africa's food and agricultural production. Barbara Dinham and Colin Hines, Earth Resources Research Publications, 1983, £4.95

This is a very useful report done by a research group that has already done valuable work. Readers of *The Ecologist* will remember, for instance, *Automatic Unemployment*, its excellent report on the impact of micro-electronics on UK employment, which was written by Graham Searle in conjunction with Colin Hines, one of the authors of this new report.

Agribusiness in Africa is neatly produced as a high-quality paperback. It contains 224 pages, and is divided up into six chapters together with an introduction, a conclusion and a number of interesting appendices.

The first chapter is on the general state of agribusiness in Africa. The second and third chapters are respectively on the international coffee and sugar trades and their impact on Africa. The fourth deals specifically with the situation in Kenya, the fifth with that in Tanzania and the sixth examines the role that agribusiness plays in Africa's food crisis.

The first thing one learns on reading this report is the tremendous importance of agriculture to the economy of most African countries. This is dealt with in the introduction and in greater detail in Appendix A. The agricultural exports as a percentage of export earnings is low in the case of oil producing countries, such as the Gabon and Nigeria, and uranium exporting countries like Namibia, but it is very high in most of the other states: 72 per cent in the

case of Benin, 80 per cent in the case of Chad and Mozambique, 82 per cent in the case of Rwanda, 85 per cent in the case of Somalia, 86 per cent in the case of Madagascar, 90 per cent in the case of Ethiopia, Uganda, the Sudan and Gambia, 94 per cent in the case of Burundi and 95 per cent in the case of Malawi and Mauritius.

This in itself explains why peasant agriculture is everywhere being superceded by plantation crops for export. Only in this way do African countries have access to the foreign currency they require for paying the interest on their debts and for buying oil and the other commodities required for the economic development to which they are all committed.

The authors briefly describe the advantages of traditional agriculture in Africa. "Food security and self-sufficiency were common", they write. "For example, in Upper Volta the population always had three harvests in reserve as an insurance against drought and it was socially unacceptable to eat grain that had spent less than three years in the granary."

Agricultural practices were highly sophisticated and included "irrigation, terracing, crop rotation, green manuring, mixed and swamp farming. Cultivation was based on an experienced evaluation of soil potential, essential on a continent where the soils are very delicate and easily destroyed by intensive farming." Agricultural surpluses were common though, sufficient in the case of the Niger Delta to support groups "of wood-carvers, smiths, salt-makers, potters, traders, diviners and doctors and many other activities."

However, the agricultural practices of traditional peoples in Africa were disrupted, as were all other aspects of their lives, by the arrival of the Europeans. First there were the slave traders who devastated vast areas for 300 years; then the traders who flooded the market with cheap manufactured goods thus destroying local crafts; then the settlers (particularly in East, Central and South Africa) who took over the land for the cultivation of cash crops for export to their home countries. The authors point to the further devastation caused by the 'concession companies' in the 1870s who were given sole rights to the land and labour and to the fruits of the forests and soil over large areas, in particular in Central, Eastern and South Africa. The inhabitants of those areas were literally sold to the concession authorities and subjected to the most appalling treatment which apparently caused their population to halve between 1880 and 1908.

Then came the big plantations, which from the very start were given the best possible terms enabling them fully to exploit Africa's cheap manpower and resources. For example the Firestone Rubber Company was granted one million acres at a rate of $0.04 cents per acre developed. The authors describe in great detail the growth of plantations in the post colonial era and document the effect of their establishment on the local people.

Their adverse effect is made particularly clear in the case of Kenya. In this country, only seven per cent of the total land area has good soil and sufficient rainfall, yet nearly all of this has been taken over by large plantations. Four and a half per cent has adequate soil and the remainder is poor or suitable only for raising stock. The authors point out how nevertheless this country was traditionally self-sufficient in food. It is only since 1980 that it has had to import maize, its staple food.

The history of agriculture in Kenya is very much the same as it has been in other parts of Britain's colonial empire. Traditional agriculture was destroyed by the introduction of a hut and poll tax which compelled subsistence farmers to earn a money income, thus forcing them into the cash economy or else causing them to abandon their farms and move to the cities in search of jobs. Since independence this trend has been maintained with the encouragement of foreign agricultural enterprises such as Nestlé. President Moi of Kenya has himself realised the adverse consequences of past and present policies. He recently stated: "The problem is that unless a process is initiated whereby the allocation of certain assets, particularly land, housing and effective schooling is completely removed from the marketplace, the market will work in such a way as to counteract egalitarian reforms. Those allocated low-cost housing will sell it to landlords; beneficiaries of land redistribution will sell to efficient farmers; schools charging higher fees will hire more effective teachers, etc. In other words the intervention necessary to achieve true social harmony may be more thorough-going than a merely populist regime is able to envisage." Those words, however, do not seem to reflect any visible change in agricultural policy.

Tanzania is the only country in Africa to have avoided private foreign investment. Nevertheless, traditional agricultural practices have been effectively destroyed by the introduction of the Ujamaa village programme which has forced the rural population away from their traditional tribal areas into 8,000 large Ujamaa villages—the largest resettlement scheme in African history.

The World Bank has played its usual destructive role by encouraging the large scale cultivation of export crops and thereby pushing the peasant farmers into the more arid parts of the country. Tanzania's main export crops are cashew nuts, coffee and sugar and tea which make up 80 per cent of the country's export earnings. However, production of these commodities has been disappointing, largely because of the refusal of the tribesmen whose lives have been disrupted by the Ujamaa villages and the World Bank's financial ventures to cooperate with the government. As a result, Tanzania has become increasingly dependent on aid. By 1979 Tanzania was receiving more than 580 million dollars in aid every year or 70 per cent of its development budget, again much from the World Bank.

The authors conclude that "there is a conflict between the need to grow cash crops for export and the need to grow foodcrops." They also point out that the problem cannot be solved merely by increasing agricultural output. Most African countries still have a large peasant population "which has shown itself to be unwilling to adopt the solutions proposed by national governments." Needless to say, it is not in their interests to do so. Governments are not particularly interested in the fate of the peasants; they pay them lower prices for their products and "their prime allegiance is to their political base in the towns and the Westernised privileged elite." Because of the opposition of the peasant population to their destructive programmes, "governments have adopted advanced agricultural schemes bypassing rural people and further isolating them both politically and economically." These take the form of ever more massive farming enterprises, often devoted to the production of a single cash for export. A case in point is the large rice growing project now being set up in the Caramance region of Senegal: 30,000 hectares will be farmed using high technology in order to grow rice for the urban population. Such schemes, needless to say, can only increase the already serious problem of malnutrition in Africa.

The only answer, it is intimated, is to find 'radical solutions structured on peasant organisation'. Such change, however, will be difficult to achieve. Caught up in the orbit of the world market economy, governments have become dependent on foreign currency earned by exporting plantation crops for their day-to-day survival. For them, radical change could mean their own suicide.

Edward Goldsmith

Rivet-Popping

EXTINCTION. The Causes and Consequences of the Disappearance of Species. Paul and Anne Ehrlich, Gollanzc, £9.95

Some ten years ago, an article—entitled 'Give me the Old Time Darwin'—appeared in *The New York Times*. Written by a certain Sam Witchell, the article argued that there was no need to be alarmed by the increasing rate at which natural species were being driven to extinction by man. Quite the opposite: if only the conservationists would read their Darwin, they would see those extinctions as evidence of the health of the natural world. "The Darwin people tell us that species come and go, that this is nature's way of experimenting with life. The successful experiments survive for a time: the failures disappear to no-one's detriment."

Witchell's views are by no means unique. Indeed, one of the disturbing points made by the Ehrlichs in their excellent and timely book *Extinction*, is that many people are no longer shocked by the idea of extinction. One reason, undoubtedly, is that they do not believe that the damage being done is of any consequence: another is that they are incorrigibly optimistic about the ability of technology and market forces to deal with the problem. Thus the Ehrlichs recall a meeting with an economist: "He challenged us to tell him something that couldn't be produced if one was willing to pay enough. We answered, 'Produce a living *Tyrannosaurus rex*'. After claiming (incorrectly) that, given enough time and money, one of the giant carnivorous dinosaurs could be produced, he fell back on a familiar theme. The dinosaurs, after all, were nothing of value. They became extinct and he certainly did not miss them. This argument is sometimes generalised to: the dinosaurs became extinct and nobody misses them: why then should we worry about extinction at all?"

It is to counter such views that the Ehrlichs have written *Extinction*—and an excellent job they have done of it. Not only does the book avoid the trap of preaching to the converted, it also avoids watering down the case in order to attract converts. The result is one of the most hard-hitting and cogently argued cases for putting a halt to the ravages we are inflicting upon the natural world that I have ever read.

The Ehrlichs begin their case with an analogy. Imagine an airline passenger about to board a plane. As he walks up a gangplank, he sees a man busily prising rivets out of the airplane's wings. In panic, the passenger turns to go back to the terminal, only to be told: "Don't worry, we're certain the manufacturer made the plane much stronger than it needs to be, so no harm's done. Besides, I've taken lots of rivets from this wing and it hasn't fallen off yet."

The point is well made. "A dozen rivets, or a dozen species, might never be missed. On the other hand, a thirteenth rivet popped from a wing flap, or the extinction of a key species involved in the cycling of nitrogen, could lead to a serious accident." The problem, of course, is that no ecologist or biologist can predict in advance which species will prove to be the 'thirteenth rivet'. What is known however—and ignored by the Witchells of this world—is that the extinction of species is now proceeding at a rate which far exceeds the rate of natural loss, let alone the rate of natural replacement. "In the last twenty-five years or so, the disparity between the rate of loss and the rate of replacement has become alarming: in the next twenty-five years, unless something is done, it promises to become catastrophic for humanity."

Despite such warnings, mankind seems hell-bent on pulling out the thirteenth rivet. On the one hand, species are endangered by such direct assaults as the wildlife trade: on the other hand, there is the indirect threat posed by the spread of cities and roads, the cutting down of tropical rainforests, the spread of modern intensive agriculture, the use of pesticides, increased pollution and, all too probably, nuclear war.

In documenting those threats, the Ehrlichs stress that the loss is ultimately our own. Thus, they argue, there are four prime reasons why we should seek to preserve 'our fellow travellers on Spaceship Earth'. Firstly, because compassion alone demands that we preserve them. Secondly, because to continue the destruction would be to destroy some of the most beautiful life-forms on earth—even if that beauty is at times only in the eye of the biologist. ("Many people find beauty in such unlikely places as the fine scaling on the wings of a malaria-carrying mosquito, the iridescent patches on the back of an African tick, or the delicate sculpturing of the shell of a microscopic single-cell diatom.") Thirdly, because by destroying species today, we are robbing future generations of potential benefits—the as-yet-undiscovered drugs and food that undoubtedly exist, for example, in the Amazon. And, finally, because "By deliberately or unknowingly forcing species to extinction, *Homo Sapiens* is attacking *itself*: it is certainly endangering society and possibly even threatening our own species with extermination."

That last reason is seen by the Ehrlichs as the most important—and the least frequently understood. Undoubtedly they are right. But whilst the Ehrlichs succeed remarkably well in putting that case across, I have my reservations about the solutions they propose for halting the destruction. Indeed, the last chapter of the book—'The Strategy for Conservation'—at times appears curiously at odds with what has preceded it. It is almost as if the Ehrlichs felt that they must offer hope even where little hope exists. Thus, they call for a steady-state economy, a new type of development in the Third World, the end of 'overdevelopment' in the industrialised world and a general redistribution of wealth. All are proposals which have been well-aired before and—more important still—criticised by many as grossly inadequate to the task in hand. Perhaps it is unfair to expect the Ehrlichs to have replied to those criticisms—to do so in detail would undoubtedly require a book in itself—but if the debate is to be pushed further, then those criticisms must sooner or later be answered.

That said, however, *Extinction* is an invaluable book. Even if it is more successful at pointing out the road we shouldn't take in the future—rather than the road we should—it is essential reading. I cannot recommend it highly enough.

Nicholas Hildyard

Classified

MISCELLANEOUS

FOUNDER MEMBERS required for a new political party and conservation society, with the aim of stopping and reversing the destruction of wildlife, as well as improving general standards of life. Especially welcome are people who are willing to stand for parliament, or who will help run the organization. Membership is free, but please send S.A.E. for details. Box No. 148.

NATIONAL TREE WEEK 19th—27th NOVEMBER 1983. PLANT A TREE FOR £1.

In order to celebrate National Tree Week the Woodland Trust is inviting the public to "Plant a Tree for £1" and is aiming to add 30 new planting projects to the scheme. Projects include Chiphouse Wood near Reigate in Surrey, land at Upton Cheyney near Keynsham in Avon, Trigmoor Wood near Kingham in Oxfordshire and areas in Cumbria, Lincolnshire, Devon, Gloucestershire and Sussex, all of which the Trust owns, as well as many areas planted by arrangement with other landowners.

Members of the public throughout Britain will be invited to sponsor tree planting in areas cared for by the Trust, a registered charity.

Details of "Plant a tree for £1" are available from the Woodland Trust, Westgate, Grantham, Lincolnshire NG31 6LL.

SITUATIONS VACANT

SMALL DEVELOPING COMMUNITY, 40 acres mixed farm and woodlands, beautiful area (Shropshire Hills), seeks new members prepared for hard work. Some experience farming, gardening, forestry, alternative technology, crafts preferable; also some capital. Inventive type, prepared for research, innovations; also aware of full implications of ecological lifestyle in present world crisis, and prepared for self-development. Details from: Highwood Agroforestry Research Trust, Roman Bank, Rushbury, Church Stretton, Salop. SY6 7ED.

CONFERENCES

The International Professional Association for Environmental Affairs will hold their XVIIth Symposium on the 6th and 7th October 1983 at the Astoria Hotel, Brussels. The subject will be DEVELOPING ISSUES AND NEW LEGISLATION IN ENVIRONMENTAL AFFAIRS. The Symposium is open to non-members and full details may be obtained from the Secretariat: Miss C. Vander Borght, IPRE, Square des Latins, 49 Bte 11, B 1050 Brussels, Tel. 6406041 (afternoons only).

ENVIRONTECH '84—India's largest Exhibition and Conference on Pollution Monitoring and Control will be held in Bombay on February 8-12, 1984. Call for Papers: abstracts (200-300 words) by September 30, 1983, on Air Pollution, Water Pollution, Solid Effluents. Further details from Chemtech Secretariat, 210, Dr. D.N. Road, Bombay—400 001, India. Telex No. 011-3757 JSGR IN.

CREATE THE RIGHT ATMOSPHERE
by restoring the air's natural electrical balance

The Mountain Breeze air ioniser quietly emits health-giving negative ions into the air, clears cigarette smoke, aids breathing, increases alertness and efficiency. The air becomes generally fresher, can bring relief to those who suffer from asthma, bronchitis, migraine and catarrh.

This is a high performance British ioniser for only £39.95 (inc p/p). Send for further details, including our money back guarantee to:

GF Air Products,
Dept 34 Petersfield Road,
Birmingham B28 OAT.
Tel: 021-777 8450

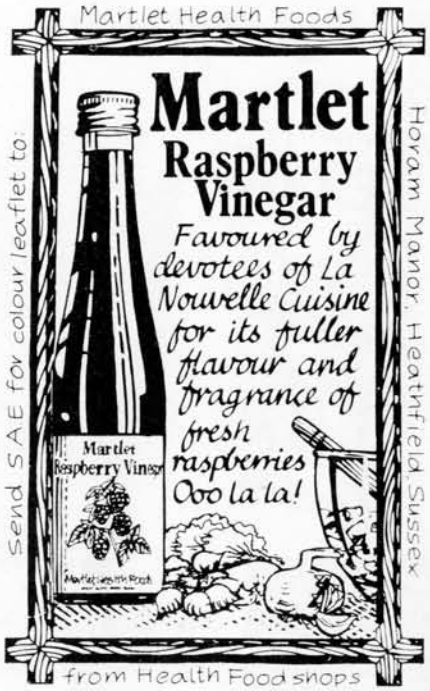
CAR IONISERS only £29.90 (inc p/p)

FOR SALE

1984 WHOLEFOOD CALENDAR from Surrey/Hants Border Group Friends of the Earth, 47 Fellows Road, Farnborough, Hampshire. Farnborough 517567, £1.10 post paid. Bulk Discounts.

IDEAL COMMUNITY CENTRE, four houses built around studio, workshop, hall complex, all imaginatively rebuilt to highest standard. 5 acres, gardens, orchards, pasture. Ideal creative business, community. Brochure write to: Wholesailin, Craigmill, Newburgh, Fife, Scotland, Phone 03374 8345.

OFFERS WANTED. Complete run of Vole Magazine. Vol. 1 No. 1 to Vol. 3 No. 12 plus two binders. M. Hardy, Russet Wood, Tadworth, Surrey.



CLASSIFIED ADVERTISEMENTS MUST BE PREPAID.

To: The Ecologist Advertisement Dept., Worthyvale Manor Farm, Camelford, Cornwall, PL32 9TT.
Please insert the following advertisement in the next ..... issues.
Cheque/P.O. to *The Ecologist* enclosed.
(Word rate 15p per word. Minimum charge £3.00. Box No. £1.00)

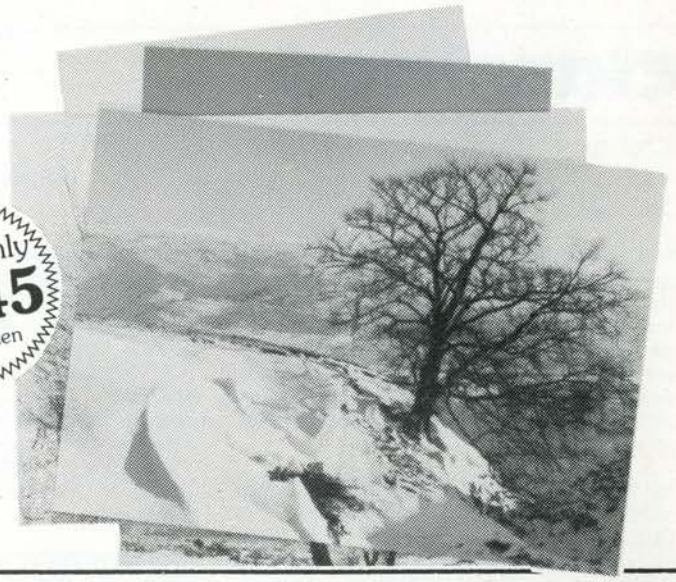
Name: (Block letters please) .....

Address: .....

Date: ..... Signed: .....

Exclusive recycled 'Trees in Winter' Christmas Cards

From only **£1.45** per dozen



Full-colour on high quality white recycled card

The four beautiful, richly coloured photographic studies portray a majestic Oak in Yorkshire snowdrifts – a Silver Birch on a wintry Frensham Common – a snow-clad stream-side setting for pollarded Willows – and a dramatic study in snow and sun, with gaunt branches in silhouette. Each card bears the message 'Season's Greetings' inside.

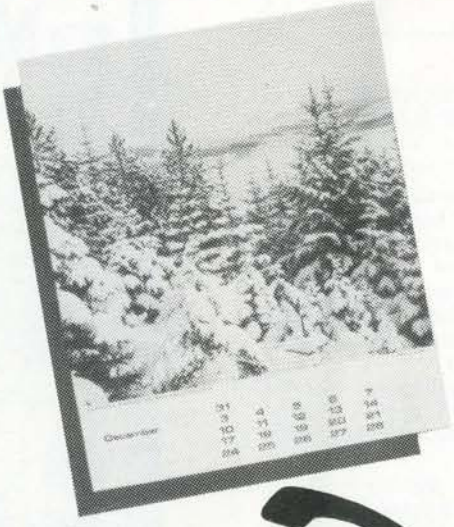
These original Yuletide greetings are printed on high quality *100% recycled white card.* They are offered in packs of a dozen, three each of the four designs, with matching envelopes made from *100% recycled paper.* Card size is 5.8 × 4.1 inches. Remember, the more you send instead of ordinary cards, the more paper you SAVE. You **SAVE £££s** too by buying several packs – see order form for details.

Think of the mountain of paper – the thousands upon thousands of acres of trees – consumed each year to produce Christmas Cards and their envelopes. Think about it – and *do something about it* this year by sending your greetings on *100% recycled card* in envelopes made from *recycled paper.*

Delightful full-colour 'Trees for all Seasons' Calendar

From just **£2.65** each

An ideal Gift for Nature Lovers



To echo the unfolding seasons, the twelve beautiful full-colour plates show trees in winter, spring, summer and autumn livery – each plate appropriate to the calendar month on which it appears. Scenes such as Flowering Cherry by Richmond Bridge – the Autumn splendour of Beech, Larch and Birch – a breathtaking vista of Balmoral Estate in high summer and Conifers in snow in Achnashellach Forest – make up a calendar to please and delight the nature lover throughout the new year. This attractive tribute to Britain's woodland heritage is published in association with the Forestry Commission.

The calendar is high quality litho printed, measures 11.7 × 9.7 inches and is supplied in a cardboard envelope suitable for posting. And it's offered at the same price as last year. Buy several for friends and **SAVE £££s** – see order form for details. Altogether, an inexpensive and most acceptable gift for all who treasure the richly varied and ever changing beauty of our trees.

ORDER NOW AND BEAT THE RUSH

Save Time – Order by Phone

You can save time by using Access or Visa and ordering by phone ANYTIME – even at night or weekends.

READING (0734) 663281 24 hours

How to order

There are **NO HIDDEN EXTRAS** – prices include UK postage, packing and 15% VAT. You can pay by cheque, PO, Access, or Barclaycard/Visa. Please use the form below and send it, with payment, to **Conservation Books, Dept 142, FREEPOST, Reading RG6 1BR.** You may post your order without a stamp anywhere in the UK and we will pay your postage. And you can order with complete confidence because your satisfaction is assured by our **Replacement** or **Money Back Guarantee.** Delivery: please allow 28 days, especially near Christmas. Overseas orders: if paying in a currency other than Sterling, or by cheque drawn on a bank outside the UK, please add £2 bank charge.

To: Conservation Books, Dept 142, FREEPOST, Reading RG6 1BR

Please supply the following order:

Quantity	£
12 Christmas cards for £1.95 inclusive	
36 Christmas cards for £4.85 **(SAVE £1.00)**	
72 Christmas cards for £9.30 **(SAVE £2.50)**	
120 Christmas cards for £14.50 **(SAVE £5.00)**	
1 calendar for £2.95 inclusive	
5 calendars for £13.75 **(SAVE £1.00)**	
10 calendars for £26.55 **(SAVE £2.95)**	
TOTAL ORDER VALUE	£

Your name and address BLOCK LETTERS

Mr/Mrs/Miss: Initials:

Surname:

Postcode:

Your payment method

☐ I enclose cheque/PO made payable to **Conservation Books** OR

☐ Please debit my Access/Visa credit card, number:

Cardholder's signature: Date:

Note: if ordering by credit card, please ensure that the name & address given is that of the cardholder.