

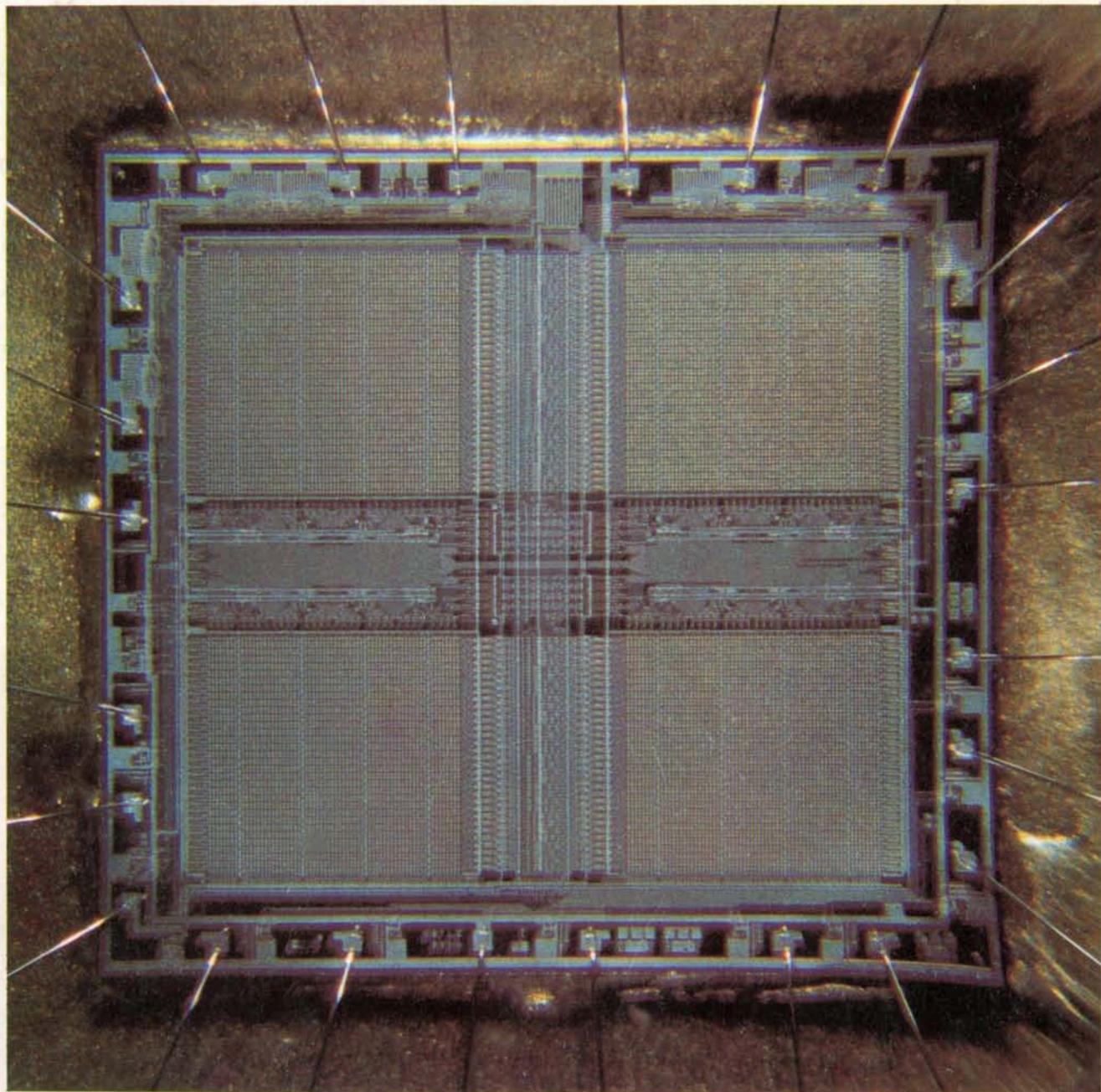
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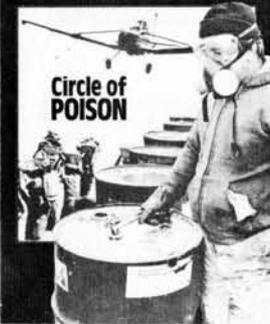
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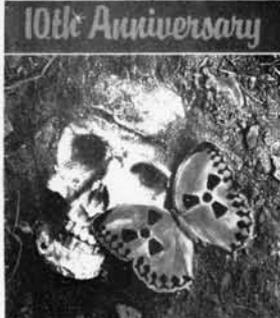
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Information theory uses the entropy law in proposing that the most effective means of communication is one which minimises redundancy. Applied to biological systems information theory totally distorts reality. On the contrary, living organisms require a high degree of built-in redundancy at all levels of organisation, from the genes to social communities, if they are to survive in the highly complex world of natural ecosystems. Moreover the very notion of hierarchy in the organisation of the components of living organisms goes against the simplistic levelling out associated with entropy and hence with information theory.

- Des Wilson* **Lead — A Clear-cut Issue?**117

The evidence that lead in petrol gets into the bloodstream and brain, causing long-term damage, particularly in children, is gaining ground. Scientists who needed convincing have now been convinced. How long before the government accedes to popular demand that petrol sold in the pumps be free of lead?

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Such 'collectives' adhere very closely to Marx-Lenin directives and consequently their collective attitude to the environment is purely exploitative, with nature to be subjugated to human materialistic interests. Yet not everything in the kibbutz is following the Communist Manifesto, despite a valiant start. Thus the author has some interesting observations on the re-establishment of the family and on the role of women in modern kibbutz life. The socio-biologists are having a treat.

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Digest

The Retreat from Stockholm

I recently spent two weeks in Nairobi. I was there at the invitation of the Environmental Liaison Centre to act as a 'resource person' for the NGO meeting. I also attended the first few days of the official meeting of Government delegates who had assembled to attend 'the Session of Special Character' at which the achievements of UNEP over the last decade were assessed and its programme for the next decade considered. A couple of weeks later, I attended the 'Hearings on the Environment' also organised by UNEP which took place in London at County Hall.

All three meetings left me profoundly depressed.

At the UN conference at Stockholm, ten years ago, I remember between two sessions seeing Sir Frank Fraser Darling sitting by himself on a chair in a corridor adjoining the conference hall. I remember too sitting down next to him and asking him what he thought of the proceedings. He shook his head and looked thoroughly miserable. "We are doomed" he said. At the time, I did not really believe him. Perhaps, I was still (relatively) young and naive. Today, after having attended these three meetings, I know that he was right.

It is not so much that we are systematically annihilating life on this planet, but that there is nothing really being done about it, and worse still, nobody cares. "For want of interest, the future has been cancelled", ran the title of Paul Ehrlich's film that appeared about a decade ago.

Indeed for governments throughout the world, the environment is little more than an embarrassment. Their main preoccupation is to earn the necessary foreign currency required to assure the economic development on which their prestige, power and future must depend. To this end they will sacrifice anything — their forests, their land, their topsoil, not to mention their traditions, their culture, their religion, indeed all that their ancestors, for countless generations held to be most holy.

Government indifference to the real problems that confront us today is well illustrated by UNEP's predicament. It is the only international agency, we must not forget, that has been set up to prevent the further degradation of our planet and hence the further impoverishment of the lives of those who inhabit it. Yet Governments have consistently refused to fund it properly. UNEP's budget was originally fixed at 30 million dollars a year, a mere pittance if one considers the nature of the problems it has to deal with. Today inflation has reduced its value to 15.59 million at 1973 prices, as a result UNEP can spend only 3 million dollars a year on its ocean programme, 5 million dollars a year on its terrestrial ecosystem programme, 3 million dollars a year on its arid land programme. These are token sums, especially if one considers the hundreds of billions of dollars spent every year on pillaging and contaminating the oceans, degrading terrestrial ecosystems and desertifying our arid lands.

A further illustration is that from the start UNEP has been given no executive functions nor any means of compelling other agencies or national

governments to abide by its policies. In reality the situation is much worse since UNEP only exists by virtue of the voluntary contributions it obtains from member states and it knows only too well, that to obtain them, it must carefully abstain from criticising their policies — however environmentally disruptive they may be.

Clearly UNEP is muzzled. It can only say things that do not offend member states and can only do things that do not run counter to their political and economic interests. Consequently its easiest option is to undertake or sponsor scientific research and to set up monitoring programmes, hence the collecting of information that nobody in authority is willing to face, let alone act upon.

As Holdgate, White and Kassas admit in that massive tome "The World Environment 1972-1982" specially produced for Nairobi, "effective action is more difficult where the need goes beyond information collection, analysis and dissemination and involves joint management of commercially important resources, especially when national interests conflict."

UNEP has also been active in seeking to influence other agencies, as well as governments of the Industrial West, who are most responsible for the degradation of our planet into adopting less destructive means of achieving their economic priorities. Thus UNEP has proposed that the emission of key pollutants be reduced or controlled; Nevertheless, it has always made clear that such action should not interfere with the far more important economic priorities. (Principle No. 8 of Stockholm's Declaration of Principles states explicitly that "Environmental policy must not hamper development.")

Moreover UNEP's effectiveness in the field was curtailed from the beginning by siting it strategically in Nairobi, as far away as possible from the agencies and governments whose activities it might otherwise influence.

A further illustration of the irresponsibility of governments has been their reaction to the findings of UNEP's highly informative Conference on Desertification, held in Nairobi in 1977. Delegates learned there that up to a third of the world's agricultural land was likely to be lost to desertification before the end of the century, while much of the world's remaining agricultural land would be subjected to serious erosion to the point that its productivity would be progressively reduced — with a corresponding increase in malnutrition and starvation.

To counteract those fatal trends, UNEP set up a special account to raise 2.4 billion dollars for twenty years, the sum that according to its consultants was required to bring the trends to a halt. Clearly, governments, if they had had the slightest sense of responsibility, would have fought to contribute to this special fund. But the opposite has happened. By the end of 1981 only 5,000 dollars had been contributed to the special account, a donation from the government of Mexico.

The behaviour of delegates at Nairobi faithfully reflected the callous and cynical irresponsibility of the governments they represented. Each one of them had undoubtedly received specific instructions to underplay environmental problems in order to justify their government's environmentally destructive policies. Some of the more honest delegates actually admitted as much to me. The German delegate did so in writing. I obtained a copy of a report they wrote to the Ministry of Foreign Affairs in Bonn; it apologised for not having been able to prevent a debate on the issue of Armaments and the Environment as they have been instructed to do.

In London, at the Hearing on the Environment, our own Secretary for the Environment, Mr Heseltine outdid them all. His opening speech was specifically designed to underplay the seriousness of the problems that confronted us, as well as grossly to exaggerate our ability to solve them and the extent of the efforts already made in that direction.

Equally depressing as the behaviour of the government delegates and representatives was that of the behaviour of the delegates of the large international agencies and in particular of FAO. At the meeting in Nairobi FAO actually vetoed a UNEP proposal to reduce the global use of pesticides, which as everybody knows, are everywhere contaminating rivers, estuaries, coastal waters, inland seas, soil and just about all our food. In some countries human milk contains levels over one hundred times higher than those authorised by WHO.

According to FAO the consumption of pesticides will have to be increased five-fold over the next decades in order to feed the starving millions, a contention that is simply laughable to anyone who knows anything about the problems involved (see *The Ecologist* Pesticide Issue, March 1980).

What was equally depressing were the efforts to rationalise and hence legitimise the priorities of governments and international agencies. We were assured that there had been considerable progress in the understanding of environmental issues and we now knew that the environment was far more resilient than we had thought. Hence our destructive activities were nothing like as destructive as had been made out at Stockholm. In fact since Stockholm the environmental establishment has been busily back-peddalling so as to interpret the problems that confront us in such a way as to make their solution compatible with the continuation of the developmental process to which it is still so totally committed. As *Earthscan* tells us the general attitude at Stockholm was that "economic growth was suspect, today it is regarded as essential". That change is reflected in just about all the major statements presented to us at Nairobi. UNEP in its document "Retrospect and Prospect" says so explicitly. "A decade ago the desirability of further economic growth was questioned in some quarters but the negative effects of the recent slow-down in economic growth have reinforced the view that it is *an essential instrument in achieving social goals*. In developing countries particularly, economic growth is *vitaly important* and remains a major force for improving the health and welfare of people." UNEP makes no attempt to reconcile this statement with another published in the same document which

states that practically all the disastrous environmental trends that it carefully documents "flow from a failure to reconcile policies for environment and development." In spite of admitting that failing UNEP insists that "economic growth can often be managed not only to avoid environmental deprivation, but also in many cases, *to improve the environment*." I think many of our readers may agree that UNEP is going too far here to curry favour with the national governments that finance it.

Another change in attitudes since Stockholm is the accent on poverty as the main cause of all our problems. Thus *Earthscan* tells us that poverty is "often the cause of pollution and resource degradation" and also "the basic cause of population growth." This means that it is the poor who are causing all our problems not the rich, and since development or economic growth is the only means of combatting poverty it must follow that it is also the only means of solving our environmental problems. This insidious thesis underlay all the discussions both in Nairobi and in London; discussions which remained on a very superficial level. No-one suggested for instance that the terms used should be defined. For instance there was no attempt to distinguish between the 'poverty' of a tribal society living in its natural environment from that of detribalised slum dwellers in the shanty towns of the larger cities. Nor did anyone, of course, dare to suggest that development was the real and only cause of our problems, for to do so would have assured his immediate dismissal from whatever office he might have held within the environmental establishment, or any establishment for that matter.

Yet a little reflection should make it clear that traditional societies living in their natural habitat refrained, for hundreds of thousands of years from cutting down their forests, eroding and desertifying their land, exterminating their wildlife, poisoning their water supplies, polluting the atmosphere to the point that the rain derived from it was, as it is in many cases today, as acid as vinegar.

A little further reflection should make it equally clear that as those societies are made to develop, hence to adopt our energy-and-resource-intensive life-style, so do they start perpetrating such disasters; indeed the more they develop the more hooked on such development they must be.

Indeed I would say, such behaviour is part and parcel of the developmental process. In this issue of *The Ecologist* Dr Lusigi demonstrates very convincingly that a country cannot both develop (especially in the tropics) and at the same time preserve its wildlife. Neither can it preserve its forests, nor its soil let alone its culture or social structure, nor any other part of the natural world to which it has been adapted by its biological and cultural evolution.

But, what depressed me unutterably was the NGO meeting. Its most important task was to draw up a statement to be read out at the official meeting. I expected that statement to be strong, critical and at the same time positive, telling government delegates exactly what had to be done to prevent the annihilation of life on this planet, however unpalatable that might be.

It was to be nothing of the sort. The drafting committee dominated by Tom Burke the rapporteur, decided in advance what the statement would be. It

studiously noted all criticisms of the various drafts, but in the end although the preamble was modified, the recommendations remained exactly as Tom Burke wanted them. Governments were deferentially requested:

- to enforce existing environmental legislation
- to re-examine concepts of development and to develop mechanisms to plan for the longer term
- to guarantee public access to official information bearing on the environment and to sustain the freedom of the media
- to recognise and guarantee the right of environmental associations to exist and to

participate in the formation of policy — to accede to, ratify and implement international treaties and conventions on the environment.”

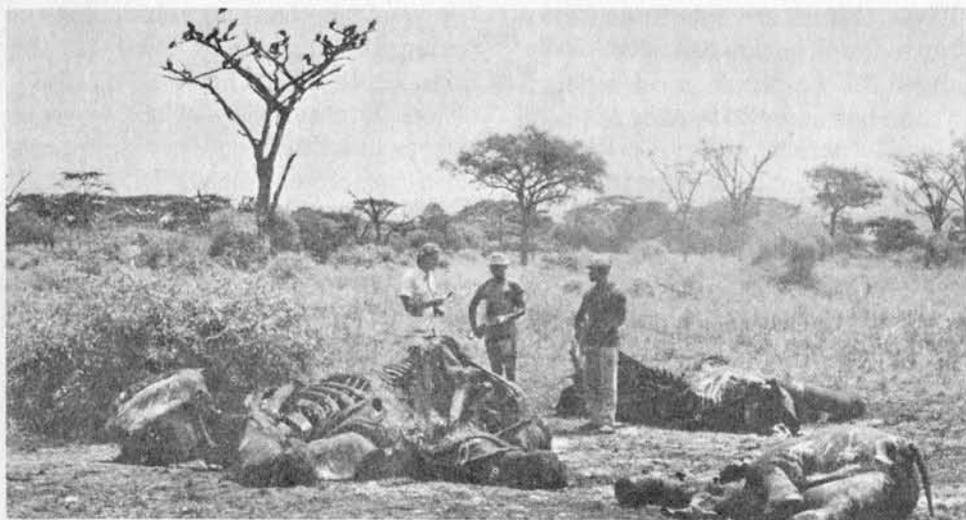
Here then is Tom Burke’s formula for saving the world. The organisers of the NGO conference had achieved their task, which was clearly to ensure that the statement be as inoffensive as possible so as to cause the minimum embarrassment to politicians who, as everybody knows have very much more important preoccupations.

It is difficult to avoid agreeing with Sir Frank Fraser Darling that “we are all doomed”.

Edward Goldsmith.



Don't you see, he'll go on sprouting more and more heads. Its the beastly itself you must go for.



Elephant numbers in one National Park dropped from 30 000 to below 2000 as the result of massive poaching. Five elephants were killed in this one group by poachers armed with automatic weapons.

NEW APPROACHES TO WILDLIFE CONSERVATION IN KENYA

by Dr. Walter J. Lusigi

Co-ordinator for UNESCO MAB integrated Project in Arid Lands

The practical conservation problems to be reconciled by the national parks planner in Kenya today could be divided into two categories of equal importance. First on one hand are the cultural, political and socio-economic problems and on the other, the ecological factors.

The cultural, political and socio-economic problems arise from the fact that the national parks idea as presently put remains an alien idea unacceptable to the African population. The transformation necessary to make the idea culturally and socially acceptable to the people has not taken place and in my opinion, may never take place if present trends continue. Conservation plans implemented in Kenya were over protective of the wildlife resource and based on the assumption that Kenya was on the same line of development as the industrial nations and that conservation ideas could be transplanted directly unadjusted to suit the new environment. There was no assessment of the local cultures, values, fears and human needs. Recent developments have shown these earlier assumptions to have been wrong because

the culture of the people was stronger than it was assumed and Kenya, because also of the lack of basic minerals will never develop in quite the same way as the industrial nations.

The ecological problems are of recent origin and arise from unplanned development. Kenya's population has doubled itself in the last forty years and will double itself again in the next twenty years. Coupled with this is the fact that Kenya is an agricultural country and all these people will be seeking to derive their livelihood from the ever decreasing land resource. There will be increasing population pressures and, the land set aside for wildlife conservation purposes such as parks and reserves must be seen in this context.

The solution of the cultural, political and social economic problems as they apply to wildlife conservation is precedent to the solving of the ecological problems and these will be discussed here in this order. I suggest that the tourist dollars or marks and strict conservation laws alone will not save Kenya's wildlife heritage. In my opinion, to gain any

degree of acceptance throughout the population, the conservation effort simply must be aimed at cultural mores and the long standing ties between man and his natural environment. Planning must be based on an appraisal and evaluation of the cultural, ecological and socio-economic factors and resources must be balanced against local human needs in both the short and the long term. Above all, the resulting conservation system must be acceptable to the African. It is not intended in this presentation to give the details of management strategies but rather to suggest a framework within which planning and management could be undertaken to fit specific situations. A brief analysis of the origin of present prejudices and suggestions on how to overcome them is made here.

Brief History

A knowledge of the history of an area—human activities, habitat changes, fauna density and density changes — are important background to planning. Without historical facts as a background to present ecological setting, "there is a risk of making serious mistakes in both management and research because the factors determining the prevailing situation are not understood" (Curry-Lindahl, 1972). In Kenya, the problems threatening the survival of national parks are largely historical. For any conservation programme to be successful, prejudices and suspicions of long standing, created by the ivory trade, slave trade, colonisation and independence, must first be allayed, and the African must be enabled to see for himself the advantages to be derived from realistic conservation of the wildlife resource.

The ivory trade was a major connecting factor between Kenya and the outside world for a long time as has been documented by early writings dating as far back as 110 AD (Frisk, 1927). Largely due to the need for porters to transport ivory from inland to the coast, slave trade was born in East Africa. What this meant in burnt villages, destroyed crops, and slaughtered, starved and kidnapped inhabitants may be read in half a dozen travelogues of that

period. Perhaps the most appalling features of these accounts is their reiterated emphasis on the merciless exploitation of human beings. Ivory was sought with blood and it is from this period there came most of the circumstantial accounts of women forced to abandon the child at the breast rather than the precious tusks. This was the beginning of African polarisation of attitudes towards wildlife which they had lived with in harmony for many years before.

Then came the period of colonisation and settlement. First there were the two World Wars which almost saw the total extermination of wildlife which was used to feed prisoners of war. The period after the war witnessed a concentrated effort to develop Kenya's agriculture and all game was classified as vermin and treated so. It was considered in the best interest of the country to destroy everything on four legs and there were no rules. It is in this period that the Society for the Preservation of the Fauna of the Empire was established and immediately pushed for the control of indiscriminate slaughter of game and the establishing of national parks and reserves based on the American experience.

First there was establishment of a system of reserves covering virtually the whole of the country in which game could be shot only on permit. Then came the first national park in 1946 followed later by others all established to conform with the definition of the 1933 International Convention. These were game preserves where no settlement or hunting was allowed.

Throughout this period, the African needs were hardly given any consideration. First, settlement of Europeans pushed most of them from their home lands, secondly the game laws which allowed hunting by permit only made subsistence hunting which was their normal way of life illegal, and thirdly national parks further displaced many from their home lands. Usually land left for them was poor and confrontation with game laws sent a lot of the males to prison. These experiences solidified the negative attitudes of the people towards wildlife and its conservation.

These things are mentioned here because the situation has never really changed for the people and I believed the time has come to re-examine our national parks policy critically before it is too late. The independence government never sought a solution but instead, with international support, continued old policies making game laws even more strict. Now hunting is totally banned in Kenya disregarding the subsistence needs of the people and so drowning their hopes of ever receiving reasonable attention. National parks cannot survive when surrounded by a hostile population waiting for any opportunity to move in and exterminate the wildlife.

Cultural Factors

Living in a balance with the environment is part and parcel of the African culture and the present concentration of plains herbivores which we now seek to conserve, exist because of a tolerance for wildlife which was lacking in other societies. Ever since childhood the African is taught how to co-exist with the natural world around him. He is taught that he is part and parcel of the system. The African religion has specific reference to the preservation of natural things and it was in fact taboo to kill what one did not need in one form or another for survival. The land ownership system which was communal, was aimed at the enhancement of this type of living with nature. Land belonged to the society at large to which individuals had use rights only. Wildlife was looked on as a source of support for life and spiritual satisfaction. Thus it was hunted for food and clothing and also used for tribal ceremonies and rituals. In pastoral societies they looked at wildlife as second cattle and was particularly used during drought periods when cattle were scarce. The Africans therefore had through many years evolved some type of co-existence with the wildlife around them which enabled them to survive in a form of balance. The neglect of how these survival strategies worked has resulted in a tragic loss of centuries of experience.

Conservation as a concept, although still the centre of many controversies, seems to fit well into

the western sense of values are experiences, and when used in the abstract it meets little or no opposition. The majority of the western efforts in wildlife conservation have been resource oriented; which is an outgrowth of the western history and heritage and the focus of the institutions within which most biologists work. Indeed Sour (in Spoehl, 1956) suggests that the concept "natural resources" may well be limited in meaning to the industrial oriented civilizations. It cannot, therefore, be taken for granted that the outlook towards natural things in one culture is by necessity the same in other cultures. The African outlook towards natural things is largely commodity oriented and this view must be incorporated in the planning of parks.

In the few cases where studies have been made of the African opinion, these have shown that Africans do not support conservation efforts as presently presented (Aerni, 1970; Capon, 1971; Lusigi, 1977). Not only was the concept unknown but the practice of single purpose allocation of land for example for parks, was foreign to the cultures upon which it was imposed. To ensure the survival of National Parks in the long run, the system must be adjusted in recognition of this factor to include "Perpetuation and Use" (Foster, 1973).

Socio-Economic Considerations

Kenya has a total population of approximately 14 million with a growth rate of about 3.6 per cent. The three national censuses taken in 1948, 1962 and 1969 underline this growth. In 1948—5,405,966; 1962—8,636,263 and in 1969—10,942,705. Over 90 per cent of the population is rural with fast growing urbanisation.

Kenya has no minerals or oil which means that it has to support itself entirely from land. This is a major constraint in Kenya's development because a country which has to base its entire development on agriculture, cannot hope to achieve the standards of living of the industrial nations. However, Kenya has set itself a fast pace of development so that developments which took industrial nations many years

are being telescoped into only a few years. Coupled with the growing population this means that for people to be able to survive, every piece of land must be developed to its maximum.

Tourism, which is based mainly on wildlife is now Kenya's number one foreign exchange earner and surpasses any other single agricultural export. This factor alone seems to provide the justification needed for the continued support of the national parks. Seen nationally, therefore, parks are a big economic asset. But dollars and marks in the central tender office hold little promise to the local people whose lands have been appropriated and who see wildlife which wanders from the parks using their land every day. To these people ten shillings in their pockets is quite the equal of a thousand shillings paid to the central bank of Kenya.

A few other factors also influence the African view of their national parks. First the gate fees charged are beyond the reach of many local people and entry without a car, which many cannot afford, is prohibited. It is an ironical situation because the local people who have always lived with these animals on foot must now be required to have a permit and car to enter parks. Secondly the socio-economic structure of the Kenya society is such that recreation is at the bottom of the priorities and needs of most people even those who can afford it. The close extended family system plays a major role such that extra time and money is spent on relatives and friends, either visiting or assisting in one form or other. Indeed land and wildlife are looked at as prime commodities and not as resource bases for recreation. This has caused national parks to be identified with tourists who can afford the price of entry and accommodation in the parks. For the local population this is a continuation of colonialism which must be discontinued.

The problem confronting the national parks planner here is that of being able to compromise ecological goals, national goals of promoting tourism for capital and the local needs of the people to use the parks for other purposes especially

grazing, traditional hunting and freedom of access to the park on foot.

Kenya has a high growth rate and many hungry people to feed. It needs production. Kenya also has a high percentage of land of high wildlife potential. At present it would seem that a patchwork grid of production and natural systems is advisable. There is a danger that in the struggle to survive in the changed circumstances the value of natural ecosystems might be forgotten. Since the lives of people are at stake, nothing should be spared in developing some resources. But natural ecosystems do more than just produce. Since our long term good is at stake too, we must not squander commodities such as finite resources and gene pools which are conserved by natural ecosystems and which have contributed to making us what we are both physically and culturally.

Ecological Considerations

A major ecological consideration in the planning of the national parks in Kenya results from the fast population growth and the limited amount of productive land. Kenya has a total land area of 569,252 sq.km. Only one fifth of this land, however, receives enough rainfall for extensive and productive agriculture and this area on the other hand supports the greater part of the population. Most districts in this area have reached their carrying capacities and it is estimated that by the year 2000, a greater part of this population must find alternative employment and settlement elsewhere to maintain subsistence and avoid starvation. The rest of Kenya's land receives erratic rainfall and is destined to remain rangeland suited only for grazing and the support of sparse nomadic populations. Here, however, there has been a population explosion and many people have been surviving on famine relief for many years now.

While accepting that there is total commitment in Kenya to the concept of national parks serving as wildlife sanctuaries, it is felt that there may not be sufficient awareness of the dangers likely to jeopardize the effective continuation of even the present policies.

Enhanced human population pressures affect the national parks as they do other rangelands. Should the population continue to expand at present rates, and unless alternative proposals of human employment and endeavours can be implemented, there will undoubtedly arise an instant clamour that portions of parks be excised to permit subsistence farming. Eventually the parks could be completely engulfed.

Already the viability of national parks and certain game reserves is coming under increasing threat from the clamour of surrounding flanking populations, rendered even more vulnerable by sheer numbers underlying the outcome of their own land malpractices. Increased population pressure on the north-western flank of the Tsavo National Park, with the growth of subsistence agriculture and clearing for charcoal burning, have inhibited the normal free movement of wildlife between the park and the Chyulu Hills, and onto rangelands—until recently unoccupied—lying to the north east of the Chyulu Range. This area now bustles with human activity, itself having obvious repercussions on wildlife. In addition, a certain increase of poaching and shooting in defence of crops has drastically reduced game populations hitherto in or within the sphere of influence of the Tsavo Park. The north east part of Nairobi National Park towards Ngong Hills also suffers from this same problem and such examples could be cited for a dozen other parks.

Although as we have seen present herds of wildlife in Kenya are only remnants of the larger former herds, there has also been a great reduction in the animal habitat. Present national parks are too small for the purpose for which they were established and park animals have many times to wander outside the parks onto private land. In the establishment of national parks not enough attention was given to the needs of the migratory herds and they are not therefore complete ecosystems. The logical solution here would be to increase the size of the national parks to cover the year round needs of these animals. But such a solution is politically impossible at present with the already ob-

served population pressures on the park borders. As a matter of fact a national park in Kenya could hardly be big enough to cover the needs of every single animal species, since the range of some is thousands of kilometres in area. This means that the planning of national parks must not only concentrate within the park boundaries but must include the surrounding area. This emphasizes the point brought up earlier about the need for goodwill and continued tolerance for wildlife by the human populations around the parks. These people must be compensated directly for the use game animals make of their private land and they must benefit directly from the tourist income by being directly involved in the trade at the local level.

The other ecological problem is the large concentration of animals in the parks owing to a reduction of the habitat which results in damage to the natural habitat. This has been clearly observed in Tsavo National Park where elephants are grazing themselves into extinction and in Amboseli and Nairobi National Parks where thousands of animals have always died due to lack of grazing and water in the drought period. This necessitates some form of population control, through controlled cropping to ensure new balance.

All parks in Kenya were founded on preservationist policy whereby nature was allowed to take its course and no form of management was allowed. Because most parks were on derived grasslands which were partly maintained by fire, the absence of fire has resulted in the development of woody vegetation which is unsuitable for plains game. Parks are becoming less and less suitable as habitats for these animals. A suitable vegetation management programme based on an understanding of all ecological factors involved is necessary if suitable habitats are to be maintained.

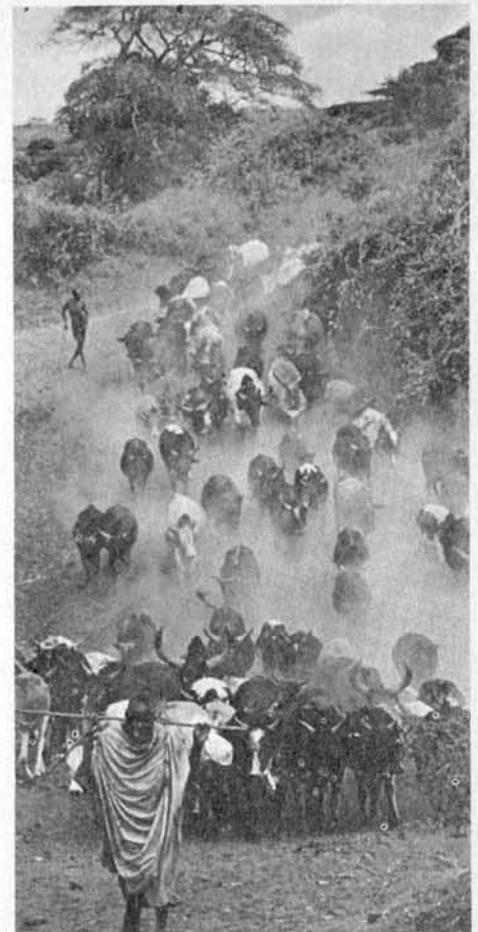
The other factor involves visitor facilities in the parks and tourist pressure. Tourist lodges are constructed in parks and these in turn have developed into small towns within parks. Most of the time these are constructed near high game concentration centres and this is ecologically incompatible with wildlife

movements and migrations. The tourist lodges compete for water with game and their sewage systems are ill planned. There is a need for a re-examination of the continuation of this policy. Another problem results from "off road" driving in parks which has been documented to cause damage to vegetation that takes long to recover. It also disturbs the hunting success of carnivores which have to starve as a result, especially the young. Birds are chased off their eggs, thus disturbing the breeding process particularly the ostrich. Lodges should never be built in the parks and off road driving should be prohibited by state law.

The Basic Planning Philosophy

The basic philosophy and approach is an indispensable part of every programme. Park planning can involve complex and elaborate procedures, but the details of its methodology are less important than the basic philosophy, and effective planning must proceed from a clear understanding of the physical and intangible resources of an area and all the objective factors which bear upon them (Foster, 1973). In Kenya we have seen how activities in wildlife matters disturbed the long standing balance and left prejudices and hardened attitudes of the local people towards wildlife. We have also seen how conservation as presently put to them is not meaningful to their way of thinking, and does not fulfil their needs and expectations.

African traditional outlook towards land and natural things is commodity oriented and this must be an important consideration in conservation and national parks planning and management. It is suggested that national parks in Kenya be seen as "areas of land of high wildlife potential or special biotopes where among other land uses the perpetuation of these special features is given priority". National parks will not, therefore, be isolated islands but integral parts of land use in the whole area, contributing to the social and economic development of the area where they are located. Use should not only be touristic but also include cropping, controlled grazing and controlled traditional hunting.



Mirella Ricciardi

Such an outlook should be backed by policies which will encourage the participation of the local people in activities in the park. Free movement of unarmed local people on foot should for example be allowed, payment of gate fees for local residents should be discouraged and control and patrolling of the park should be entrusted to the local residents of the area with state support and encouragement in matters needing technical solutions like research.

For many here, the thought of having controlled use activities in the park other than tourism might seem strange or even not in line with the national parks concept. But it must be understood that in African savanna systems, man has played a very significant role in maintaining the ecosystem as a grazer with his livestock, as a predator through hunting and as a bush regulator through burning and wood cutting for cooking and building use. In my opinion, exclusion of such activities introduces disastrous elements in the ecosystem leading to deterioration. The starvation of thousands of elephants in Tsavo Park and dying of others in Nairobi National Park due to protection is to me a clear sign of ecological irresponsibility.

The Conservation Unit Approach to Park Planning:

Major factors for consideration

It is seldom that a wildlife park can be established to include an entire ecosystem, especially all of the factors necessary for the year round needs of migratory species. To establish and develop a park without management control of surrounding land will set the stage for great problems in managing the animals and the area. Therefore, park management must be co-ordinated with management of the surrounding lands.

Since wildlife is the major attraction and primary reason for establishing Kenyan-parks, the entire ecosystem related to the park must be considered. Many wildlife species are migratory and usually spend a portion of their annual life cycle outside the park boundaries. Unless the seasonal habitats beyond these boundaries are controlled (protected from overgrazing, fencing and unplanned cultivation), the herds are likely to be decimated or migrations hindered or stopped. When this happens, the park wildlife will no longer be a viable part of a large dynamic ecosystem, but will consist only of remnant resident groups. This "outdoor zoo" then may be attractive for tourism but one of the world's heritages of migratory herds of a variety of species will be lost.

A wildlife park must also be culturally and economically viable to the local people in order to be permanent in nature, to survive changes in political regimes and periods of financial stress. Few developing nations can afford the luxury of a park for purely aesthetic or philosophical reasons. It is therefore necessary to consider the local economics and traditions in addition to the ecological factors of park management in the development.

Proposed Concept

A broader concept of wildlife park development should be initiated if new and existing parks are to be economically, culturally, and ecologically viable and stable. It is suggested that a co-ordinated management system be developed consisting of various categories of land use designations in addition to the wildlife park itself. This would in-

clude one or more ecosystems but important would also be the political and tribal boundaries which would make both the political and ecological administration and management of the area homogeneous.

When planning existing parks or considering the establishment of wildlife parks, much of the ecosystem affecting these parks should be designated as a "Wildlife Conservation Unit". Included in this large conservation unit would be three land use categories—National Park, Protected Area and The Multiple Use Area.

1. *The National Park:* This would include primary wildlife populations or ranges of special interest, or unique scenic features. The park area would be subjected to minimal development as only necessary roads for management and minimum tourist use would be established. A wilderness atmosphere would be encouraged with limited or no resident human populations permitted. The use of prescribed burning and water development to maintain wildlife range, carrying capacity would be used under special circumstances.

Objective: The preservation of a portion of a wildlife ecosystem and/or unique scenic area. Of secondary importance would be tourism for game viewing and occasional important tribal wildlife ceremonies.

2. *Protected Areas:* These areas would surround the park areas and would contain locations for intensively developed tourist lodges and associated maintenance and staff facilities. Restricted local grazing would be allowed on permit basis. Roads here would be of higher standard and air strips would be permitted near the lodges.

Objectives: a) Cultural—controlled grazing and tribal hunting. b) Tourism—lodges and game viewing for tourists. c) Wildlife management—wildlife populations would be harvested on a sustained yield basis for sale of meat and hides and to provide control for herds migrating in and out of the park. Cropping methods adopted would not interfere with tourism objectives. Selective harvest and night shooting to avoid disturbance of the animals would be initiated. The animals could be cropped and approached for

photography the next day as the animals have no association with vehicles to the cropping disturbance. This method has been used most effectively in Southern African Parks. Live capture of animals for sale could also be used for harvest of surplus animals.

Prescribed burning and water development programmes to maintain or increase carrying capacity of the ranges for wildlife would be instigated.

3. *The Multiple Use Areas:* Such large areas would surround or possibly be included within the protected areas. Tourist facilities would be permitted here but the major feature would be wildlife management co-ordinated with resident livestock operations. However, wildlife would be given priority. Resident pastoral tribes would be permitted to establish or continue their traditional ways of life. Safari hunting concessions may be included within these areas. The game cropping programmes as established in the protected areas would also be used here. The use of fire and water developments would also be part of the management plan.

Objectives: a) Cultural—grazing, residence and tribal hunting; b) Tourism organised mainly by local residents; c) Wildlife management co-ordinated with livestock.

The entire wildlife conservation unit should be managed as a single unit with marked and patrolled boundaries. Entry would be controlled through manned gates on access roads. (Figure 1). Benefits of such a management concept would be:

1. Unique wildlife populations, habitat types or scenic features would be preserved.

2. The portions designated as parks would retain a wilderness atmosphere without being isolated.

3. Migratory wildlife populations would be maintained as their ranges inside and outside the park would be controlled.

4. Wildlife populations would be managed to prevent one species from dominating the park or the rest of the ecosystems. Wildlife populations could be harvested outside the park with little or no cropping taking place in the park. It may be necessary to harvest surplus

animals to protect the habitat from destruction.

5. Culturally, harmony would be restored between the people and wildlife as they would be involved in their management and their lifestyle would not be disturbed through unnecessary prohibitions. Only the livestock numbers would be controlled but no difficulty is foreseen as wildlife populations would also be controlled.

6. Various economic benefits would be provided to the local residents.

7. Safari hunting would be controlled by the community and income from concession fees, trophy fees and meat sales would accrue to the community. Wages for operators would reduce unemployment for the communities.

Conclusion

The recent accelerated depletion in the wildlife resource in Kenya has been mainly due to a continuation of old policies which had failed to recognise the needs, fears and values of the local people, and is ill suited to today's development problems. This paper has tried to analyse trends leading to present prejudices, and to suggest a new approach based on the present available scientific, socio-economic and historical knowledge. There is every reason to believe that, even at this seemingly late hour, the implementation of imaginative policies as suggested here would go far to remedy the present critical position.

Since Kenya has no minerals or oil, the full potential of the land must be developed by every means. But development must take the form most suited to the prevailing circumstances and the purposes to which an area is best adapted. Development of faunal resources is as important as the development of any other organic natural resource and should be undertaken to the maximum extent consistent with its perpetuation. The natural surplus can be legitimately used and tourism can be instituted without detriment to the continuation of the resources.

Whatever the future of wildlife in Kenya might be, it is conditional upon the degree of support derived from the people locally. Success in

wildlife conservation will be possible only if the majority of the Africans favour the perpetuation of wildlife. To attempt to conserve without the co-operation of the local people is merely to fight a delaying action, and almost as short sighted as allowing it to be exterminated. This underlines the necessity for enlisting popular support from the people primarily concerned by letting it fulfil in part their expectations, needs and traditions.

The conservation unit approach suggested here recognizes three approaches to wildlife conservation in Kenya. Where it can be shown that wildlife should have priority, the state has an obligation to secure the land for wildlife conservation, such as national parks and reserves. This should be done in consultation with the surrounding population. At the other extreme, there will be areas where wildlife will be excluded for all practical purposes. In ranching areas this could be on commercial beef production farms where wildlife presents an unacceptable disease risk and where crops could be destroyed.

Elsewhere, the unit suggested that the development plan could assume a degree of compatibility between wildlife and domestic stock. Although it is common to ensure some common return to local authorities of some revenues derived from tourism, this is little compensation to the individual who sees wildlife using his land.

In this situation the best solution appears to be the ratification of land rights on a group basis and the implementation of wildlife utilization schemes that bring the maximum return to the group. Such schemes may involve organized cropping or private hunting and viewing. If controls are introduced by the state to the financial detriment of the group, then the state should be in a position to compensate the group.

In the final analysis, the primary necessity rationalizing wildlife conservation is an acceptance of reality. A nation like Kenya which has to base its entire development on the land amidst firm conservative tribal cultures, will never develop in quite the same way as the industrial world. And this applies to the national park concept as much as anything else. Expectations of their

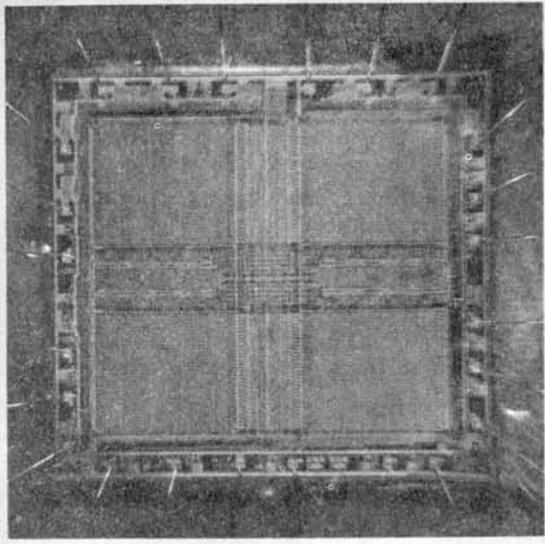
national parks are not quite the same as the recreation needs of the industrial world. To the local people parks are reserves for extra grazing and hunting in times of need and these views must be respected. It is quite pointless to extol the ecological virtues of wildlife and expect biomass and economic data to lead to a decision to eliminate livestock or to have the pastoralist relinquish his land rights. Equally there is no point in isolating parks by trying to prove that wildlife and livestock are incompatible, when there is no wildlife population in Kenya today, be it in parks or out, which does not spend part of its annual migratory cycle with livestock on the same range. In my opinion, all approaches adopted in this regard, and this I have also observed all over the world, must be a compromise.

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Many Paths to Nonsense

Information Theory applied
to the Living World

The Super — Informed Society

Information theory may be useful for modern communication, but is it relevant to the world of living things?

by Edward Goldsmith

It is at last clear that because of resource and pollution constraints, material progress has ceased to be a realistic goal for humanity.

Since the idea of 'progress' underlies that whole shaky edifice of beliefs with which we have been so deeply imbued since our earliest childhood, and which we can refer to as the world-view or Paradigm of Industrialism, psychologically, we are utterly committed to it.

We thus have no alternative but to redefine "progress" which means determining some way in which we can "advance" other than by accumulating material goods.

Since the quasi-religious world-view of industrialism accentuates the quantitative at the expense of the qualitative and largely ignores the notion and implications of organisation, "progress" is conceivable by us only in terms of the accumulation of some quantity, and if this cannot be of consumer goods, it must be of something else that is equally quantifiable and hence, equally easily accumulated.

'Information' admirably fits the bill. It is in the field of information processing and communications

that our scientists and technologists are making the most rapid progress and in which the most spectacular advances are yet to be expected.

What is more, the energy and resources required for constructing the equipment required for processing, emitting and receiving information is supposed to be so modest, and its cost so low, that its commercialisation on a massive scale is not seen as constrained by resource shortages, pollution emission standards nor the present, it is hoped short-lived decline in purchasing power.

In these conditions, it is not difficult to persuade ourselves that the growth of the 'information' industry is really serving some useful purpose — indeed that it may well provide the next stage in the progress of man in his quest for Paradise.

As Hald, one of the high priests of this new Progress, tells us; "We are moving from a society perceived as resource-constrained to one that is 'information-rich'. We are entering a new era in which economic growth is derived from the exchange of information and the creation of knowledge rather than from the ac-

celerated consumption of natural resources."¹

Hald, and he seems to be echoing a view that is very widely held, believes that the proliferation of low cost computers will "fundamentally transform how we think and perceive reality."

"Individual computer capability" he writes "tied into sophisticated satellite-, cable-, and broadcast-based telecommunication systems will permit millions of people to communicate simultaneously in vast interactive networks."¹

Among other things, he contends, this will not only make people more aware but will also enable them to think properly, "relating ideas and weaving patterns of understanding, developing a form of thinking that will be highly conceptual." He goes so far as to suggest that "our children's children may become the first genius generation."

According to Hald, governments will also be transformed. "Individuals in open societies" he writes "will be able to develop consensus networks through which an ongoing process of large-scale, many-to-many interaction could

distil meaningful options for the future. Political leaders tied into such consensus network would, by necessity, feel closer to the voters and more committed to the directions chosen."¹

Naïve Wishful Thinking

That the information-rich society is technically feasible, I have no doubt. That its development might enable us to prolong for a few more decades many of the features of our moribund industrial society is also possible — though very much more doubtful. That it will create a race of supermen and make our government truly democratic, let alone solve any of our real problems, I regard as no more than the most naïve wishful thinking.

To show exactly why I believe this to be so would mean covering a lot of ground. In this article, all I propose to do is to take the first logical step in this direction and consider what the term 'information' means when it is used in a precise and quantitative way. I refer to the concept of Information as developed by Shannon and Weaver.² I shall try to show that though their theory may be useful in the field of communications, it has little relevance to the world of living things — contrary to what is generally assumed by many scientists.

This suggests that we should reconsider exactly what "information" is, before we can talk seriously of mass-producing it as a means of solving the problems that our society faces today.

Shannon and Weaver's Concept of Information

Shannon and Weaver's theory of Information was developed as long ago as 1948. Since then other theories of information have been proposed, but they seem to constitute little more than minor variations on the original theme. In any case, they do not appear to have earned any general acceptance among scientists. They are listed, together with their most salient features, by Roger and Kincaid.³

Both Shannon and Weaver, when they developed their theory, were working for the Bell Telephone Company. Their chief concern was to determine how to maximize the amount of 'Information' — not just the number of signs — that could be transmitted via a communications channel with limited capacity. They found it convenient, for their purposes, to define information in such

a way that it could be measured in terms of Boltzman's mathematical formula for the measurement of entropy.⁴ Information is thereby equated with entropy, with the difference that whereas entropy is seen as the most probable arrangement of molecules in a particular energy state, information measures the most probable arrangement of signs in a message, both equating probability with randomness, in accordance with the Second Law of Thermodynamics, or the Entropy Law.

Randomness the 'Ideal'?

It is difficult to understand the philosophy underlying this notion unless one realises that, for the communications engineer, randomness (and thus the absence of any organisation or constraints on the order in which the signs appear) is equated with the freedom he enjoys in choosing the message he wishes to send and hence the order in which the signs must appear so as to satisfy his professional requirements. Randomness, or entropy, is thus for him the 'ideal', and must thereby, for his purposes, be associated with the highest information.

To quote Weaver:² "Information is highest when the probabilities of the various choices are as nearly equal as circumstances permit — when one has as much freedom as possible when making a choice, being driven as little as possible towards some certain choices which have more than their share of probability."

On the other hand, when a "situation is highly organized, it is not characterized by a large degree of randomness or of choice" and in these conditions, "the information (or the entropy) is low".

Linguistic Constraints

The sort of constraints that Shannon and Weaver regard as reducing this freedom of choice (and hence the information content of a message) are *linguistic* constraints. Each language has a particular structure or organisation. In terms of this structure, one can predict with a measure of confidence that certain words are more or less likely to follow other words. Thus to quote Weaver, "After the three words 'in the event' the probability for 'that' as the next word is fairly high, and for 'elephant' as the next word is very low."²

These linguistic constraints reduce the information content of a

message by forcing the sender to include signs in his message, not because he wants to, but because they are imposed on him by the structure of the language in which the message is formulated.

To him these former signs are *redundant*. Different languages are seen as having a different built-in redundancy, that of the English language being about 50 per cent. Thus one can say that the higher the organization, and hence the lower the entropy, the greater must be the constraints, the higher must be the redundancy, and the lower must be the information contained.

Measuring Information

The amount of information in a message is calculated in terms of the logarithm (Base 2) of the number of choices. The result is formulated in terms of 'bits' (the term 'bit' was first suggested by John W. Tukey, as an abbreviation for 'binary digit'). When numbers are expressed in the binary system there are only two digits, zero and one. These may be taken symbolically to represent any two alternate choices. In a situation in which there are only two choices, there is said to be *one bit of information*. The greater the number of free unconstrained choices, the greater the amount of information. If there are sixteen choices from among which we are equally free to choose, then such a situation is associated with four 'bits' of information.

Improbability

The greater the freedom enjoyed by the sender in the selection of signs or messages for emission, the greater must be the improbability that a particular sign or message will be sent. To illustrate this, I shall assume that Shannon and Weaver's 'information' takes 'meaning' into account. Thus, a message that told us that a horse called Green Crocodile would win a race in which there were sixteen contestants of unknown breeding and with no previous form (i.e. all in theory having the same chance of winning) would communicate four 'bits' of information. If we knew something about their breeding and form, and, on this basis, could classify the horses in accordance with what appeared to be their chances of winning the race, the information communicated would be correspondingly reduced. If one horse were backed down to even money on the theory that it

had one chance out of two of winning the race, then a message informing us that it would win would communicate still less information, in fact no more than one 'bit' — the same amount of information as it would communicate were Green Crocodile to have but a single other contestant to deal with rather than fifteen others.

This is clearly a very sensible way of calculating the value of information from the point of view of communications. The greater the number of 'bits' ascribed to a message, the more valuable the information must be. This is certainly so in the case cited, in any case to both the bookmaker and the punter.

Meaning

In reality it does not quite work this way since Shannon and Weaver are not concerned with the probability or improbability of a statement being true or false. This is the concern of the epistemologist not of the communications engineer. The latter is not even preoccupied with the probability or improbability of a particular statement, nor even of a particular word, but only of particular signs being emitted — regardless of whether these signs make up intelligible words or whether such words make up intelligible sentences.

In other words, the information content of a message, for them, does not take into account its meaning. This, both Shannon and Weaver fully admit. Thus Weaver writes, "Information must not be confused with meaning". And Shannon wrote, "The semantic aspects of communication are irrelevant to the engineering aspect."²

This means, as again they freely admit, that their use of the term 'information' is very different from its normal use in the English language.

Reducing the Information Content

An essential feature of Shannon and Weaver's theory is that during the emission of a message its information content is reduced. The reason is that as a message is spelled out along a channel, so does the probability or improbability of specific signs occurring becomes easier to calculate. Linguistic organization is seen to build up — as does 'redundancy', which means that 'entropy' and 'information' are correspondingly reduced.

Noise

Another reason why the amount of information contained in a message must fall as it is spelled out is that communication channels are subject to 'noise' or 'randomness'. Noise, of course, increases uncertainty or improbability. One might think that it would thereby lead to increased (rather than decreased) information. However, Shannon and Weaver distinguish between the type of uncertainty caused by noise, which they regard as undesirable and desirable types of uncertainty which they identify with "freedom of choice", and hence with information.

The information content of a message is thereby not equal to uncertainty but to "desirable" uncertainty minus "undesirable" uncertainty or noise.

The Extension of the Theory

The fact that the equations used to measure entropy and information are the same is to Weaver highly significant. He points out that for Eddington "the law that entropy always increases — the second law of Thermodynamics — holds, I think, the supreme position among the laws of Nature".²

Thus, Weaver notes, when the engineer "meets the concept of entropy in communications theory, he has a right to be rather excited — a right to suspect that one has hold of something that may turn out to be basic and important".²

It is undoubtedly this feature of Shannon and Weaver's concept of 'Information', (and by the same token its compatibility with the Paradigm of Science and hence with that of Industrialism) which make it so attractive to the scientist and which, quite wrongly, seems to justify taking it out of its original context — that of communications engineering — and seeking to apply it to the world of living things, which of course has only served to confuse the issue, and, at the same time, to delay the development of a theory that really explained what is information and what are the principles governing its use in the world of living things.

Measurement

To begin with, one of the aspects of the Communications Theory of Information that makes it so attractive to the scientist, is its quantifiability. For quantification to be

possible, however, as Apter points out, we must know the *exact number of possible messages* that could be transmitted at any one time. This may well be possible in the field of communications but not in the field of behaviour.

It is for this reason, as Brillouin points out that "the modest but, we think, significant applications of information theory to various psychological experiments have occurred in precisely those situations in which the set in question was strictly defined: a list of syllables to be memorized, associations to be formed, responses selected from etc. There was therefore no difficulty in quantifying the associated 'amounts of information' and relating such amounts to certain aspects of performance".⁵ But, as he points out, such situations are 'banal'. We can add to this that they do not normally occur in the living world.

Entropy and Disorder

A further consideration is that the concept of entropy itself does not apply to the world of living things (anymore than does that of information).⁴

It is supposed to be equated with biospheric disorder, but this means looking at the biosphere in purely energetic terms i.e. in terms of but one of its innumerable components — an error I have referred to elsewhere as energy-reductionism.⁴

An increase in entropy really means the homogenization of temperature — and it is simplistic to equate such a process with the disintegration of a natural system. Even if we accepted that it were, and identified entropy with biospheric disorder, it is easy to show that the Entropy Law has not applied to the world of living things, which over the last three thousand million years, rather than become increasingly disorderly, has on the contrary moved in precisely the opposite direction: — towards ever greater complexity and order. Those who still believe that the entropy law is the supreme law of the universe try to explain away this embarrassing fact in a number of ways, but none of them are at all convincing.⁴

In reality, disorder in the biosphere and hence, if we like, entropy, rather than being a highly probable state, is on the contrary an extremely improbable one as must be Shannon and Weaver's ideal source of information.

The Sender and the Source

In any case, the notion of a passive source of information (whether it displays order or disorder) — from which messages are selected by an external agent — does not correspond to anything that exists in the world of living things.

The natural systems that make up the biosphere are dynamic not static, active not passive and, what is more, they are self-regulating not regulated from the outside (asystemically) by an external agent such as a communications engineer.

The source of information and the sender of the message in the world of living things are in fact part and parcel of the same self-regulating system.

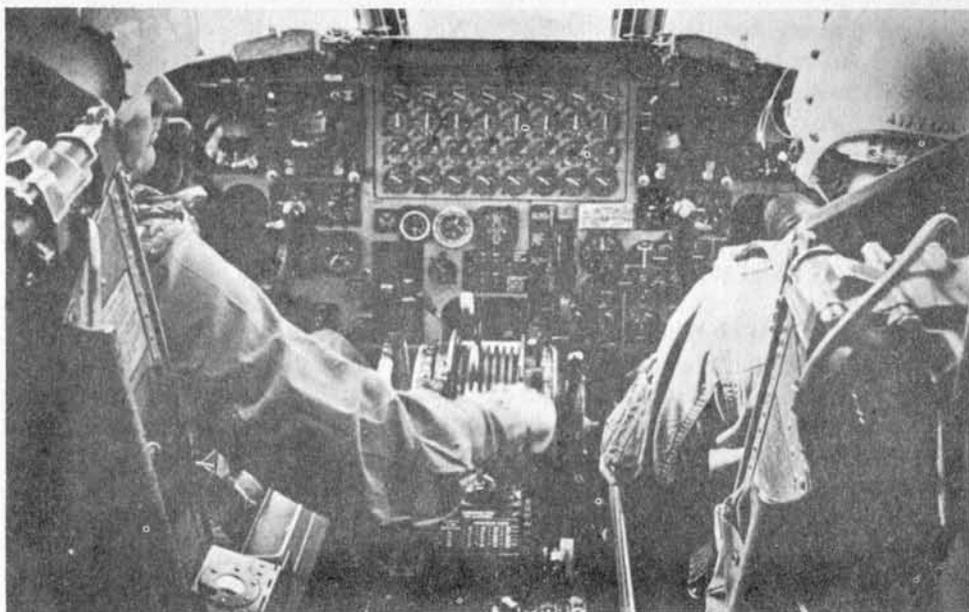
If we integrate Shannon and Weaver's sender of messages and the source of the messages into the same system, it *must cease to display entropy*, for one of the basic features of entropy is randomness and hence non-purposiveness, but the sender of messages *acts purposefully* since, as we are told, *he selects for emission those messages that display the minimum redundancy, and hence the maximum information content*. What is more, if the system is to achieve its goal efficiently, then the information it contains must be organized in that way which most favours the achievement of that goal. This we can predict with confidence on the basis of our empirical knowledge of the way patterns of information (brains, genes, genomes, gene-pools etc) are organised in the world of living things.

Improbability in the Biosphere

Another consideration is that the sort of improbability that Shannon and Weaver write about is not a useful concept for understanding the working of the biosphere.

For Shannon and Weaver, improbability is either improbability vis-a-vis the workings of the entropy law which we have seen does not apply to the world of living things or else it is improbability on the basis of probability theory which they wrongly take to be the same thing.

In the world of living things, improbability, if we are to use this concept, means improbability vis-a-vis a system's model or image of its relationship with its environment which reflects its experience and that of its cultural group (if a human animal) and of its species for a specific pur-



The Receiver of the information must be capable of acting adaptively.

pose — that of assuring the system's stability vis-a-vis its environment, and hence its survival. (I shall consider this issue in detail in a subsequent article).

Thus as living things evolve they develop the capacity to discriminate between an increasing range of different environment situations, to interpret them correctly and to react to them adaptively. A very simple organism such as the *Dyonea* Flytrap that so fascinated Darwin can, when something lands in its trap, do one of two things, close it or not, and it does so with the minimum powers of discrimination since it cannot discriminate between an edible insect and an inedible pebble.

At the other end of the scale is a human animal that can handle a vast number of different signals and interpret them correctly and thereby has at its disposal an exceptionally large repertoire of adaptive responses. In the language of Shannon and Weaver, one can say that the human animal is capable of handling messages with a high degree of improbability and hence of high information value — thousands of bits of information — as contrasted with the mere one bit that the *Dyonea* Flytrap can handle.

The human animal, however, cannot handle each of these messages with equal ease. Nature is incredibly efficient. The ease with which a living thing can handle messages seems to be a function of their importance or relevance to its behaviour pattern (I shall consider this question in detail further on) and also of the probability, in terms of its own experience and that of its species that such a message will actually be received. In other words,

information in the brain and nervous system is not arranged at random and hence does not display entropy but is on the contrary highly organized — as is all information made use of by natural systems within the biosphere (genetic information for instance).

This must be so, too, since *the behaviour mediated by such information is characterized by its orderliness*. The moves that make up a behavioural strategy — such as the development of an embryo in the womb, the bringing up of a child within the family unit, or the cultivation of a garden in a traditional society of horticulturalists for instance . . . are not arranged at random. They are highly organised.

Diversity

If information is organized, partly at least, in accordance with the probability of its being required, then systems living in a protected environment in which only probable things occur, will need to react adaptively only to a limited range of different environmental situations.

Those that live in a less well protected environment in which improbable things occur, will need to react adaptively to a wider range of more improbable environmental situations — and hence will have to make use of a correspondingly more sophisticated organisation of information, some of which may never have to be used.

Such a system is said to display behavioural diversity and to make use of information whose organization can be regarded as displaying a corresponding degree of diversity.

The behaviour that such diversity permits is referred to by Julian Huxley as "cladogenesis". Holling⁶

refers to a system capable of such behaviour as displaying "resilience".

The diversity displayed by a natural system can also be regarded as its *redundancy*, or at least its *apparent redundancy*. It is not a measure of what a natural system does, at least in the short-term, but of what it is *capable of doing*. It measures all the signals it is capable of handling and all the responses it is capable of mediating, even though during the course of the system's lifetime it may never have the occasion to exploit more than a minute fraction of these possibilities.

Redundancy in Natural Systems

It is astonishing just how much redundancy, in this sense of the term, is built into natural systems. To give an idea, if one of our lungs is destroyed, not only can we survive without it, but we can actually tolerate the destruction of most of the second lung as well. In fact, so long as six per cent of one lung remains, we can go on living a fairly normal existence. However, we would no longer be capable of undue exertions. Thus we would not react adaptively to a message which told us to sprint a hundred yards at breakneck speed in order to avoid being eaten by a tiger. However such a message, it may be argued, is unlikely to be received.

Lashley^{6a} has also shown that we can do very well with but a small part of our neo-cortex. A gene-pool and the population it gives rise to can also be decimated without bringing about the extinction of the species in question. When a human male ejaculates, he frees something like three hundred million spermatozoa, of these no more than one is required to fertilize a female.

Shannon and Weaver rightly regard a certain amount of redundancy as useful for counteracting the effects of noise. However they take it to be otherwise undesirable in that it reduces the information content of a message by reducing the freedom of choice of the sender, and hence the variety of messages he can send. But in the world of living things, as already mentioned, redundancy should, on the contrary, be identified with the diversity of variety of the messages that can be sent or received; rather than *reduce* a message's information content, it must, on the contrary, *increase* it, — since it permits the

mediation of an essential aspect of behaviour, its ability to adapt to improbable events.

Information is more than Improbability

An even more serious criticism of the extension of Shannon and Weaver's concept of Information is that it *only* provides a measure of the *improbability* of a message (whether it be the right or the wrong sort of improbability).

Information, in the world of living things, as I have already intimated is very much more than this.

This is also the view of Donald Mackay; "To dress improbability up as a definition of information as some exponents do, seems the most unfortunate obscurantism. Unexpectedness is a measurable quality or attribute of information — *not a definition of it.*"⁷

This is also the view of Brillouin⁵ "It is naive," he writes, "to take simply the flux of signals per second, to multiply it by bits per signal in the communication engineering sense, and call the result 'amount of information' in the sense of transmission of knowledge (labelling everything one does not like 'noise')."

First of all, in the world of living things, a message is not emitted because it is *improbable*, or, for that matter *probable*. It is emitted because it is of some relevance to the relationship between the sender and the receiver. Yet Shannon and Weaver are not in the least bit concerned with whether the receiver is interested in receiving a message, let alone whether he can understand it or is likely to believe it — all of which considerations must be of critical importance. Again this may make sense in the world of communications engineering, but not in the world of living things.

Information and its Receiver

As Waddington⁸ points out, information in the real world largely consists of instructions or programmes or 'algorithms'. Thus, genes combine to provide instructions for protein-synthesis. A gene-pool provides instructions for the renewal of a viable population. The brain and central nervous system provide instructions for the proper functioning of an individual's metabolism and for his day-to-day adaptive relation-

ships with his environment (neuro-geny). A culture provides instructions for the mediation of a society's adaptive behaviour pattern.

These instructions and hence this information are not designed to be transmitted *into a random environment*. Information, as Brillouin⁵ notes, is not something "that can be poured into an empty vessel like fluid or even energy." This is one of the most important things wrong with the Neo-Darwinist theory of natural selection in which behaviour is seen as determined by the genes acting in what is taken implicitly at least to be a random environment.^{9,10} The genes are not dictators, as Weiss¹¹ puts it, but "interact in cooperation with the whole of which they are part." The instructions they issue will only be obeyed by systems that have been programmed by their evolution and upbringing to receive, understand and believe them. This must be true of the transmission of instructions and hence of information in all living processes.

As Waddington¹² writes: "No transmission system can effectively carry information between a transmitter and a recipient unless the recipient accepts the message as meaningful . . . As the new born infant develops, for instance, it must be 'moulded' into an information acceptor . . . and an entertainer of beliefs." And "unless this happens the mechanism of information transfer cannot operate."

But this is not enough. The receiver of a message must also be structured in such a way as to be capable of *acting on* the information adaptively. As Waddington writes: "It is no use pushing the DNA of your sperm into an egg unless the egg contains the polymerases capable of transcribing it into a messenger and all the rest of the machinery for turning out a protein according to specification."

The cries of a baby in distress provide an *important* message to its mother who is not only geared to hearing them and understanding their significance but also to *responding to them effectively*. Otherwise there would be no advantage to be gained from the ability to detect them.

Importance

The quality of a message that will determine whether it will be detected, and interpreted by a natural system is its relevance to its behaviour pattern, or (what is the same thing) its *importance* to it.

Since information, in a natural system, is organized hierarchically — from the general to the particular — the importance of a message can be determined in accordance with its relevance to the most general and important information contained within a pattern of information or cybernism, which in turn should reflect its relevance to the most important or general phases of the associated system's behavioural strategy.

Simple forms of life, it can be shown, are only capable of responding to messages which in the psychological literature are referred to as "stimuli".

Oatley defines a stimulus as "that aspect of an event of *biological importance* to a particular animal to which it is sensitive, and by which the response is controlled."¹³

This is clearly illustrated, he points out, by the behaviour pattern of the tick as described by Von Uexhull¹⁴. "In the tick's world just three events are *important*: each is detected in terms of the presence of a single aspect of the situation, and each stimulus to which the tick is sensitive triggers a particular response. Thus when butyric acid is detected in the air, the tick releases its grasp on the branch from which it was hanging. It happens that butyric acid is a chemical secreted by the skin of mammals, and by letting go the branch when it detects this chemical it stands a good chance of landing on the back of a suitable host passing beneath it. Just as the zoologist classifies mammals by whether they suckle their young or have fur, the tick classifies them by whether or not they produce butyric acid. But unlike the zoologist, the tick when it is in the tree is quite insensitive to any other aspect of mammals. The tick is also equipped to detect mechanical stimulation from its host's hair. This stimulus causes the response of crawling about. Lastly it detects heat, and this causes it to bore into the host's skin. Thus events *rel-*

evant to the life of the tick might plausibly be detected simply by receptors sensitive to butyric acid, mechanical stimulation, and warmth."

Such receptors will be capable of picking up all messages relevant or important to the behaviour pattern of the tick, the tick simply *not being equipped to pick up messages of lesser importance*.

The principle involved is clear to someone running a business enterprise. Among other things he must develop the ability to distinguish between the messages he receives that are of importance to his business and those that are not. Since he is likely to have few assistants and must fulfil by himself all the tasks required to assure the survival of his enterprise, he does not have the time to deal with relatively unimportant messages which he must simply ignore.

As natural systems evolve, they develop the capacity to *deal with messages of lesser importance as well. This enables them to develop a correspondingly more subtle behaviour pattern which permits them to adapt with greater perfection to their specific environment*. Nevertheless it will still be the more important messages with which they are primarily concerned.

To return to the analogy with the managing director of a business enterprise, we would then regard his organisation as having expanded. This means that when messages arrive which are not sufficiently important for him to take the time off to read and act upon then rather than simply reject them, he can now delegate them to subordinates at the appropriate "echelon of command."

It is partly at least because our politicians and their scientific and economic advisers have, on the whole, failed to identify the important problems faced by the societies they have been elected to govern (population growth, social breakdown, deforestation, soil-erosion, desertification, pollution etc.) and devoted their time instead to dealing with short-term 'economic' trivia, that the world is in such a terrible state.

Nature, on the other hand, has proved very much more efficient. A natural system has a built-in capacity to select messages according to their *importance* to its welfare and survival and act on them at the appropriate "echelon of command"

and with the appropriate sense of urgency.

Complexity and Diversity

As we have seen in the case of the tick, the simplest informational and somatic organization permits adaptation to *important* events. On the other hand, that type of informational and somatic organization which must build up for a system to become capable of adapting to *trivial* events, I shall take to be its "complexity".

We thus have two types of biospheric organization: *diversity*, which, as it builds up, permits adaptation, to increasingly *improbable* events: and *complexity*, which, as it builds up, permits adaptation to increasingly *trivial* events.

Both complexity and density contribute to stability. The former by permitting ever more subtle adaptive responses to a *specific environment*, the latter by permitting adaptive responses (subtle or unsubtle, depending on their complexity) to *many different environments*.

The greater the instability of the environment, and hence the more it is likely to change, the greater must diversity develop even at the expense of complexity.

Importance and Improbability

There is indeed a necessary connection between the importance and the improbability of messages, but it is not of a nature to justify Shannon and Weaver's neglect of the concept of importance and their preoccupation with that of improbability.

On the contrary, it would be more accurate to associate the *importance* of a message with its *probability*.

From the point of view of a particular species, the most important genes are those that will confer on subsequent generations the most general features of this species, those, for instance, that assure that giraffes look and behave like giraffes rather than like fiddler-crabs or dung-beetles. It is extremely probable that these genes will be present and extremely improbable that the giraffe-gene-pool will give rise to populations of such alien beasties.

On the other hand, it is less important and less probable that all giraffes should display the same superficial characteristics, since as we shall see, diversity, in so far as these superficial characteristics are con-

cerned, is the rule rather than the exception.

The same can be said for messages coming from the outside. Living things both adapt to their environment and at the same time modify it so that it better satisfies their requirements and thereby becomes easier to adapt to. As this occurs so there is a corresponding increase in the probability of the emission and reception of important messages indicating the presence of those *environmental* constituents (the presence of food, shelter or the requisite members of the family and community) whose cooperation is required for adaptive behaviour. At the same time, important messages indicating the presence of events that threaten the generalities of the behaviour pattern of living things (such as famines, epidemics and enemy invasions) must become correspondingly improbable.

The process of adaptation can be represented graphically by reduced discontinuities or fluctuations, corresponding to the building up of increasingly stable relationships between a system and its environment.

If improbable messages are to be identified with important messages — then it can only be with the latter threatening or negative type, rather than with the former cooperative or positive variety.

In fact, the term 'important' is far from ideal, as it tends to obscure this critical distinction between messages that are important because they favour an important process, and those are important because they threaten to prevent the occurrence of this process.

The Non-plasticity of General Information

Stability is but another word for continuity, and if a system's behaviour is to be stable or continuous, so must the information in the light of which it is mediated.

The *generalities* of a system's behaviour pattern can be shown to reflect its long-term experience; the *particularities*, its short-term experience.⁴ The former must not thereby be modifiable to satisfy short-term ends — or the system's basic continuity would be lost. They must, in other words, be non-plastic. It is easy to show that, in normal conditions, this requirement is adequately met.

Thus the genetic information formulated in the language of DNA

which is transmitted from one generation to the next, and which provides the most general instructions for the reproduction of a population, is non-plastic in the short-term at least, though the position of science today is that it is non-plastic, even in the long-term.

In the same way, the basic features of a society's world-view — which we associate with its basic values — are also non-plastic. People imbued with these values are not willing to compromise on them, they are taken as given or self-evident. It is because such generalities are non-plastic that the continuity of information, as we have seen, can be maintained.

Plasticity and Diversity

Plasticity is of course a precondition of diversity, and hence of 'cladogenesis' or 'resilience'. If information cannot be changed, there can be no alternatives to it. If, on the other hand, it can be changed very easily then the existence of alternatives makes sense.

Since general information is non-plastic, it is not surprising that it should display low diversity, nor that trivial information, on the other hand, which is highly plastic, should display such *high diversity*.

It may be useful to see information, as used in the world of living things, as organised into something resembling an inverted cone which we can regard as made up of different strata like an onion. (see Figure 1)

Its generalities — chronologically the first part of the information to develop — are at the apex. They are non-plastic. There are no alternatives to them. Diversity is low or non-existent. They reflect the experience of the past and one cannot change the past. At the base are the particularities — chronologically the last to develop — the trivia that reflect the most recent experience. They are plastic. There are lots of alternatives. These strata display the highest diversity.

All biospheric organisations of information or cybernisms cannot be represented by a cone of this sort. A primitive cybernism would be represented by Figure 2.

It would display low complexity and low diversity. It would be extremely vulnerable to change. A system equipped with such a cybernism would be unlikely to survive by itself, therefore we would be more

likely to find it associated with a lot of similar systems to form a population, one whose behaviour would be characterised by fairly large oscillations. It could be represented by Figure 3.

A society possessing such an arrangement of cybernisms would display low complexity but high diversity. It would not be able to adapt with any great sophistication to its specific environment but it could survive when subjected to environments displaying a considerable degree of improbability.

Alternatively we could find a system equipped with a cybernism that could be represented schematically by a very steep sided cone (see Figure 4).

Such a cybernism would display high complexity and low diversity, which would enable a system so equipped to adapt with incredible sophistication to a highly specialised environment but not to survive were this environment to be subjected to any radical changes. Such a cybernism would be adapted to a highly protected environment such as that enjoyed by many parasites. It would be perfectly adaptive, contrary to what Holling⁶ tells us, so long as it could be predicted that its environment would remain so protected.

Information increases with Development

The final reason why Shannon and Weaver's theory is inapplicable to the world of living things is that the amount of information contained in a message as it is being emitted, is seen as decreasing (because of the accumulation of linguistic constraints and noise); whereas in the world of living things, *the opposite is true*, i.e. the information-content of a message can only *increase*.

Waddington¹² admits that there are a few exceptional cases in the living world in which the information-content of a message does not increase. An obvious example is the passage of electrical impulses through networks of nerves, perhaps too the transmission of hereditary information in the chromosomes of one organism to those of its offspring. But even then, as Waddington points out; "Biology has developed mechanisms more flexible than those used by telephone engineers".¹² Thus a gene may mutate; when it does, the information that the offspring receives is

Fig. 1.

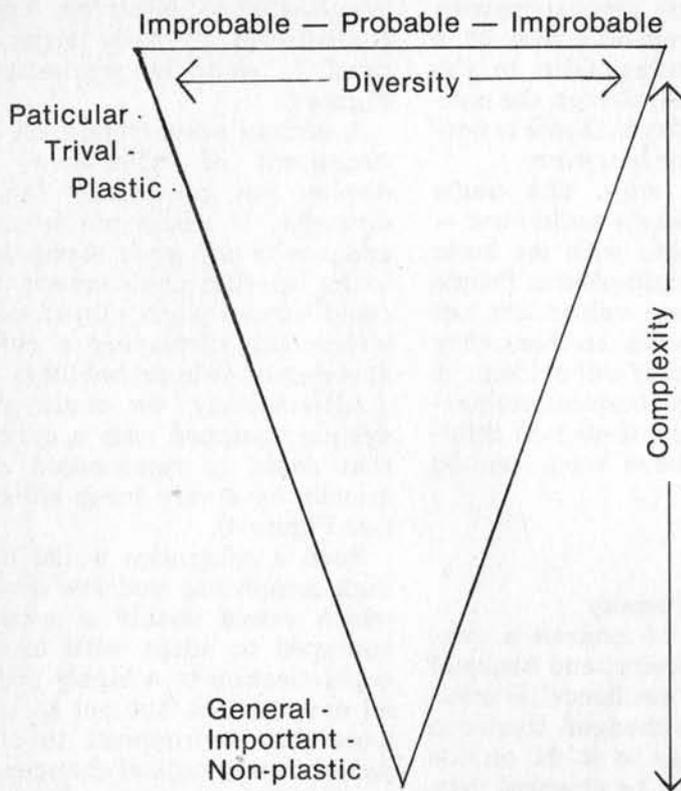


Fig. 2.

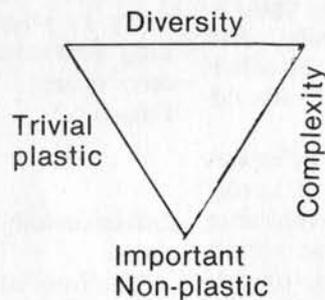


Fig. 3.

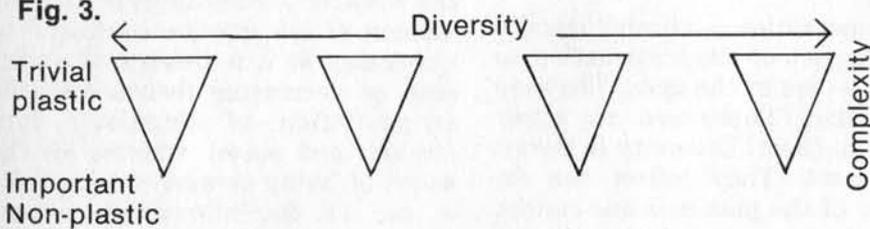
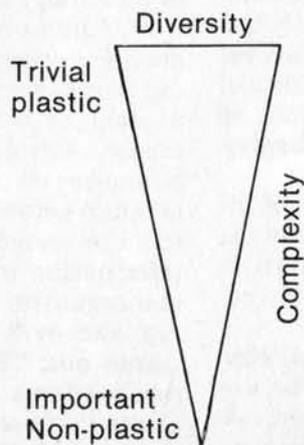


Fig. 4.



not exactly the same as that present in its parent. Shannon and Weaver, I suppose, would answer that a mutation is nothing more than an error in transcription and would thereby fall into the category of 'noise' which must reduce the information content of the message rather than increase it. But this of course would not take into account the rare instances in which mutations lead to adaptive behaviour. Also there are other mechanisms such as "chromosomal deficiencies, duplications, translocations, formation of isochromosomes, etc. by which the amount of information can be either increased or decreased."

However, it is in the transmission of information from the genotype to the phenotype that the "limitations of the theory become of overriding importance and rapidly render it not merely useless but a *dangerous snare*."

Thus, the phenotype of an organism is not simply made up of all the proteins associated with all the genes present in the genotype, it is very much more than this. In Waddington's words, it is "a highly heterogeneous assemblage of parts in each of which there are some, but not all, of the proteins for which the genes could act as patterns, and in each of which there are also many other substances and structures over and above the primary proteins corresponding to particular genes."¹²

It is fairly evident, as Waddington points out, that an adult rabbit running around a field contains a very much greater "amount of variety" or information than a newly fertilised rabbit's egg. How then, Waddington asks, can one deal with such a situation "in terms of an information theory whose basic tenet is that information cannot be gained?"

Waddington here seems to be associating information with the number of different things a system can do — its 'variety' or diversity, i.e. the improbability of a situation to which it can react adaptively. But the organization of information required to mediate more complex behaviour must also build up with development.

The Information Content of a Natural System

That the information content of a natural system increases as it becomes more complex seems clear to a number of writers who have sought to measure a system's complexity in terms of its information-

content, using Shannon and Weaver's concept of information.

Dancoff and Quastler¹⁵ tried to do just this. They postulated that the larger the number of different components in a system, and hence the greater its complexity, the greater must be the amount of information it contains, since the higher must be the improbability of building up such a system by assembling its components in a random manner.

Unfortunately, what Dancoff and Quastler actually measured has strictly nothing in common with the sort of complexity encountered in the biosphere.

This cannot be measured by adding up its component parts, because it derives its essential features, above all, from the way these parts are organized.

Biospheric organization, Dancoff and Quastler cannot, of course, take into account, for organization, and the constraints associated with it, as Shannon and Weaver themselves point out, are associated with *reduced not increased* information. Thus, unless increasing complexity is associated with reduced information and the nematode *Ascaris* be taken to contain more information than man, Dancoff and Quastler *have to ignore the all-important organizational component of complexity.*

Thus Atlan¹⁶ expresses certain reserves as to the validity of measuring complexity in terms of information-content because of "Le caractère statique et uniquement structurel de la complexité dont il s'agit, à l'exclusion d'une complexité fonctionnelle et dynamique, lié non pas à l'assemblage des éléments d'un système mais aux interactions fonctionnelles entre ces éléments."

Apter criticises Dancoff and Quastler¹⁵ on the grounds that they are only concerned with "the specification of parts with no reference to their interrelationships"¹⁷. As Apter notes, this means that "there would be an equal amount of information in a building and a mass of rubble, in a Shakespeare sonnet and a meaningless jumble of letters, indeed, in a living, a dead and a homogenised organism, provided only that there was the same number of building stones in each case and that the relative amounts of these needed were the same and provided the instruction list was the same length in each case."¹⁷

In other words, they "overlook precisely those qualities that are generally accepted as being the

significant features of *developing* rather than simply *growing* systems."

Significantly, Dancoff and Quastler themselves admit that their work yields but "crude approximations and vague hypotheses", and that their estimates are "extremely coarse". Nevertheless they insist that this is "better than no estimates at all." I do not think this is so. Mathematical calculations based on false premises and making use of inappropriate concepts can only, by virtue of the impression of great scientific accuracy that they convey, serve to mislead people and to obscure the real issues at stake.

The Attitude of Critical Scientists

I have tried to show that the use of the Communications concept of information for understanding behaviour in the world of living things cannot conceivably be justified on either theoretical or empirical grounds.

This is not altogether surprising, since it was not designed for this purpose, any more, for that matter, than was the associated concept of entropy.

This is Waddington's view too.¹² Information theory, he points out, "was developed in connection with a particular type of process and has limitations which make it extremely difficult if not impossible to use in many of the biological contexts to which people have been tempted to apply it."

Apter¹⁷ makes much the same point. "Information theory based on statistical considerations" he writes "is concerned with how data are transmitted, ignoring however any human factors involved."

Both Atlan¹⁶ and Brillouin⁵, as we have seen, also criticise the extension of this theory to the study of the world of living things.

Yet in spite of these criticisms, all these writers, with the exception of Apter still explicitly justify its use for this purpose.

Waddington¹², for instance, argues that it allows the concept "to be clearly expressed", though what I think he really means is "quantified." But what, one might ask, is there to be gained by quantifying a concept that corresponds to nothing in the world of living things to which it is supposed to apply? It can only serve to give an air of spurious precision to, what is in effect, little more than a fiction.

Atlan¹⁶ also regards Shannon and Weaver's concept of information as "a

valuable quantitative tool". Though he admits that information in the biosphere may be something very different, he still considers that "La métaphore n'est pas complètement fausse. En effet, il existe bien des cas en biologie moléculaire, assez isolés mais importants, de transmission d'information au sens rigoureux de Shannon."

This seems to be a very unconvincing argument. Indeed, that it should suffice for a theory not to be "completely false" for it to be accepted as part of the Corpus of Science is difficult to reconcile with Science's much vaunted objectivity and accuracy.

Brillouin's⁵ argument for the extension of Shannon and Weaver's theory is that if it is "to break out" of "its original habitat of bandwidths and modulations", then a proper beginning must be made, "which usually means a modest beginning" which presumably he regards Shannon and Weaver's theory as providing.

But why *not* allow the concept of information to remain "in its original habitat of bandwidths and modulations?" What evidence does Brillouin or anybody else provide to suggest that its use can profitably be extended to other fields for which it was not designed? The answer, I am afraid, is none whatsoever.

On the contrary, the only function that the extension of the theory is likely to serve is to perpetuate the myth that behaviour is atomised, and random, since the theory attributes precisely such features to the information in the light of which behaviour is mediated. This can clearly only serve to obscure important features of the behaviour of living things, such as, its goal-directedness, its stability and its organization.

This brings us to the real reason why many of our scientists have accepted the extension of the use of Shannon and Weaver's theory to so many other fields.

Scientists, and in particular, aristo-scientists, are committed to that view, of the world that we can refer to as the paradigm of science — the only one that justifies the performance of those tasks that they have been trained to perform, and on whose performance hinges their status as the high priests of our industrial society.

In terms of the paradigm of science, behaviour must, above all, be seen as atomised and random, i.e. as disorganised and goalless. Other-

wise, how can they justify induction — the random accumulation of data — as the basic method of acquiring knowledge?

How else can they justify the “analytic” or “reductionist” method which consists in breaking things up into their component parts, and hence in systematically eliminating, as a prelude to their scientific study, whatever organization they might have previously displayed?

How else can they justify examining systems in controlled laboratory conditions and, hence in isolation from all the other systems with which they have co-evolved, and in the context of which their true goal-directed function can only be determined?

How else can they justify quantification — that *sine-qua-non* of scientific method — unless the accent is on measurable components rather than on their unmeasurable organization?

Finally, how else can they justify “statistical method”, whose basic postulate, as Needham¹⁸ tells us, is that the laws of the biosphere are but words we give to statistical regularities? This being so, it is not difficult to see the attraction to scientists of Shannon and Weaver’s theory. By defining information the way they have, they have done the scientific world a truly great service. They have contributed to the coherence of that most unsatisfactory corpus of knowledge that we call science and enable it to embrace that much more of the

knowledge that could, if otherwise organised, help us to understand, which at present we do not, the essential features of the world we live in and what we are doing to it.

They have also done our economists and industrialists a good turn. Information, that is both random and atomised, whose value is neither dependent on its meaning, its accuracy or its relevance, and that is measured in terms of anonymous “bits”, provides those who have mastered the technology of computers and micro-electronics, with the ideal commodity for mass-production, mass-commercialisation and mass-accumulation.

They have also provided them all with the theory in terms of which it is possible to rationalize and hence legitimize, in the most “scientific” and hence the most credible language possible, the blind and euphoric hope that such a technology may be creating for us a new paradise on earth — the Information Rich Society — one, that in the light of the latest scientific breakthroughs, may appear less speculative than the other now largely discarded paradises of our disillusioned past.

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Lead: A Clear-cut Issue?

by Des Wilson

Director of CLEAR — The Campaign for lead-free Air

The Campaign for lead-free air - CLEAR - has gained widescale support from both the public and a considerable number of national organisations.* Indeed, as evidence has emerged of low levels of lead in the blood causing damage to health and particularly to the brain, the demands that lead be phased completely out of petrol have become more vociferous. Nevertheless, the petroleum industry, particularly under the guise of Associated Octel - the actual manufacturers of lead additives to petrol - has attempted to cast doubts on the validity of any findings on the harmful effects of lead in petrol. To date, the industry, with its gigantic vested interest in maintaining the status quo, has been supported in its contention by the government-sponsored Lawther Committee which recently produced its report *Lead and Health*. But the evidence of lead's potent neurotoxic effects is now beyond controversy. Indeed various members of the Lawther Committee have recently had to admit a change of mind and have come out firmly against leaded petrol. Meanwhile in *The Ecologist* we have published articles on the dangers of leaded petrol, notably by Professor Bryce-Smith of Reading University. Bryce-Smith's anxieties about lead, expressed so cogently some years ago, have now been completely vindicated. His courageous contribution in the fight to get a ban on leaded-petrol must not be forgotten. As this article indicates it is only a matter of time before the Government and the petroleum industry will have to capitulate to the demands for lead-free petrol.

If public opinion is a guide, then the vested interest in maintaining leaded petrol must surely be fighting a losing battle. An opinion poll run by the Mori Organisation, involving a sample of nearly 2000 people, revealed that 91 per cent believed lead in petrol to be a health hazard, 89 per cent wanted it banned and 77 per cent wanted it banned even if it increased the price of petrol. An opinion poll carried out by the *Doctor* established that 62 per cent of doctors believed that lead in petrol should be banned.

The petroleum industry, while vigorously lobbying the government to prevent an all-out ban, has been realistic enough to know that it will have to compromise somewhere. In its view, it is faced with two possibilities: either to adopt high-octane lead-free petrol; or to reduce the lead content in petrol now, and then proceed to lead-free petrol in a few years' time. The first possibility the petroleum industry has wished to avoid at all costs. The second would involve it in a considerable modification of refineries at some expense only to have such modifications become unnecessary at a later date. Accordingly the petroleum industry early last year offered Whitehall lead-free petrol provided it took the 92 octane route instead of the 97 octane route. Thus in a recent memorandum to its staff, British Petroleum stated that "the oil industry recommended to government, last year if it was decided that lead levels should be further reduced, the best way of doing so was to introduce unleaded petrol (2 star) as soon as possible".

Undoubtedly, the petroleum industry made its offer knowing that such an initiative would be of little cost to it, but possibly of considerable cost to the car manufacturers. The petroleum industry was also aware that the car manufacturers would in all probability try to resist the initiative. Thus, the petroleum industry was hoping to obtain the best of both worlds, appearing to be open to the idea of lead-free petrol and thus not obstructive to change, but at the same time expecting that the case for the *status quo* would be fought by the car manufacturers. At the same time the petroleum companies could hide behind Associated Octel, which they owned in its entirety, leaving it to conduct a virulent campaign for them against the anti-lead lobby. When it was announced in May 1981 that there was to be a reduction to 0.15 grams per litre — and newspapers carried authoritatively-based stories that Whitehall's decision to reduce to 0.15 by 1985 would stand for ten years after that date — the petroleum industry sensed that it might have landed itself with the worst of both worlds, namely expenditure on a reduction to 0.15 plus an early decision to go for lead-free petrol.

In the meantime, the car manufacturers found themselves in a situation where they were on no-one's side. The British car manufacturing industry had increasingly geared itself to the high compression engine. Considerable modification would appear to be necessary if it was to adapt to low-octane lead-free petrol. Thus, it preferred the *status quo*, but should a

* Footnote

The anti-lead lobby is now coordinated by CLEAR. The Campaign for lead-free Air, supported by 14 other national organisations, the Advisory Centre for Education, Association of Directors of Social Services, Association of Neighbourhood Councils, CALIP, Community Health Councils of England and Wales, Cleaner London Campaign, Conservation Society, Friends of the Earth, Health Visitors Association, London Amenity and Transport Association, Pedestrians Association, Spastics Society, Transport 2000, National Children's Centre and the National Union of Teachers. In addition CLEAR has over 200 signatories to its objectives in the House of Commons and 50 in the House of Lords.

decision be taken to move to lead-free petrol, it would directly oppose the petroleum industry in a battle over whether the high or low octane route should be chosen. One supporter of CLEAR wrote to a number of car manufacturers to establish their position in April of this year. British Leyland replied that "we will cooperate willingly should any decision be taken to further limit the use of lead in petrol, although if such a decision is taken we do need time to adapt the production methods to those of our engines that would need modification. As to whether BL should independently introduce cars that run on lead-free petrol, the answer is that some of our engines will already basically function satisfactorily on unleaded fuel, although there are other engines that require production modification. However, there is little point at present in undertaking this work since lead-free fuel is not available in the UK and currently only two countries in the world, Japan and the USA, require new cars to run on unleaded fuel."

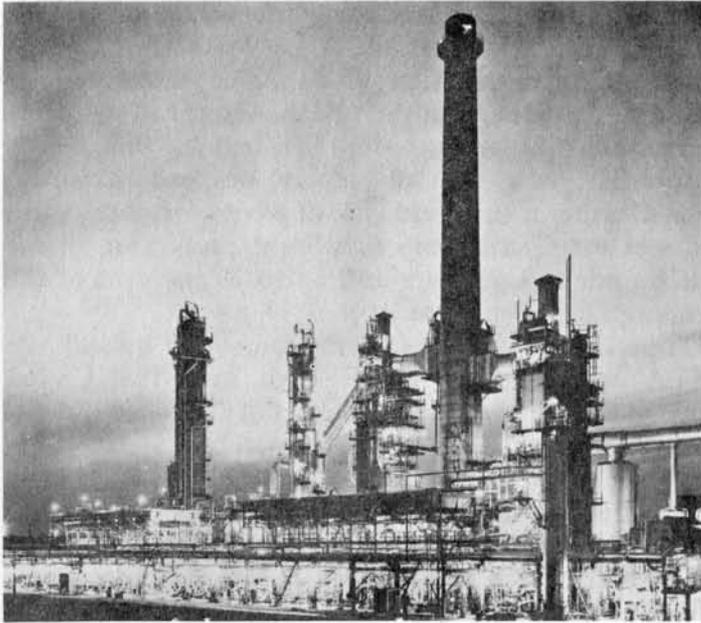
Meanwhile British Leyland did not make clear whether its cars would run on lead-free petrol if it was low-octane. Rolls Royce wrote to the same supporter to say "I can assure you that we are already producing cars which are designed to use lead-free petrol." Talbot wrote to say "we are determined to do as much as we possibly can to eliminate this problem. As you say, there are some countries in which cars are operating on lead-free petrol of the two-star octane. Unfortunately, in the interests of preservation of the world oil resources, the majority of the cars in production today are designed to operate on four-star petrol, thus giving the best possible fuel consumption, but equally requiring a very small amount of lead to achieve the fuel octane rating. Therefore, we are now working towards the dual objective of maintaining the fuel economy of our cars and reducing the octane rating demanded of the engines, so that lead-free petrol can be used. Such an undertaking is of very large proportions and it will be some time before the results of this work are available to the public." Vauxhall wrote to say, "our parent organisation, General Motors, are in the fore-front of automotive design, and you can rest assured that if legislation is introduced into the country which forces the petroleum companies to manufacture lead-free petrol then we, as a company, will be ready to meet that challenge." The Ford Motor Company wrote to say "you ask about the availability of Ford cars to run on lead-free petrol. Our policy is to build vehicles to use the available fuels, and lead-free petrol is not presently available in Britain . . . as soon as it is available then we shall meet the demand by manufacturing vehicles to use such petrol . . . rest assured that should lead-free petrol become available, then Ford cars constructed to run on it will also be available."

The car manufacturers are clearly on record as saying that they can meet the challenge. Nevertheless in all their public pronouncements and in private letters they still maintain that the health hazard of leaded petrol has not been proven. Moreover both the petroleum and motor industries have claimed great difficulties and costs in producing lead-free petrol. Such claims have proved to be far-fetched. Thus in

Australia the petroleum industry was asked for its estimate of the cost to move to lead-free petrol. In response the Vehicle Emissions and Noise Standards Advisory Committee decided that the industry's estimates had been exaggerated by five times. In Germany the petroleum industry estimated that the cost of the reduction to 0.15 grams per litre would be DM 1,000 million, yet the final bill was DM 300 million.

Both the petroleum and motor vehicle manufacturing industries have allowed Associated Octel to take the lead in opposing the CLEAR campaign. Not perhaps surprising, inasmuch as Associated Octel Company Limited, situated in Ellesmere Port, has no other business besides the manufacture and sale of lead additives to petrol. In 1980 the company made a profit before taxation of over £5 million; the retained profits at the end of the year were £ 21 million. Since Associated Octel is totally owned by BP, Chevron, Texaco, Mobil and Shell, the petroleum industry has the power to control its activities, to use it to contest the health evidence against leaded petrol with all the vigour it can. Associated Octel has reacted to the launching of CLEAR by devoting thousands and thousands of pounds to a major campaign to prove that lead in petrol is not harmful. One of its senior executives was quoted in the *Radio Times* as stating "lead in petrol in no way enhances the amount of lead in our blood". It is doubtful whether any other protagonist in the debate, including all the doctors and scientists who so far do not accept the evidence of a health hazard, could possibly accept that exaggerated position, yet it is typical of Octel's whole approach. The company's scientists, including the chief medical officer who has been with Octel for over 30 years, have produced evidence to promote their view of the Lawther Report. They have plied Members of Parliament, local authorities, community health councils, the media and others with their material.

But how do the medical and scientific professions stand with regard to leaded petrol? Undoubtedly the bulk of the medical profession are sympathetic to CLEAR. The *Doctor* survey revealed that. And nearly all magazines and newspapers published for doctors have supported CLEAR. Until recently the major exception has been the British Medical Association. However, that highly influential body has finally committed itself in a submission to the Royal Commission on Environmental Pollution. It states that "there is evidence that children who have body burdens of lead lower than that indicated by 30 micrograms per decilitre may be at risk. Associations have been demonstrated between impairment in mental functioning and lead levels below the range previously considered harmful. At first there was some doubt about the validity of these studies but it is now generally accepted that the association is real and it should not therefore be disregarded." The significance of this statement is that the DHSS safety threshold is 35 ug/dl. The BMA goes on to say that "on the basis of the evidence which it has received the BMA considers that lead is capable of causing harm at levels of



Petroleum Industry: unwilling to dispense with lead.

exposure previously considered safe . . . it therefore recommends that steps should be taken to reduce the amount of lead in the environment by progressive measures so as to protect those at risk."

The BMA then looks at the question of lead in petrol and comes to the conclusion that "taking into account all the available evidence it would appear that the elimination of lead from petrol would reduce considerably the concentration of lead in the atmosphere. This in turn would produce a reduction in the burden of lead absorbed by individuals. For those individuals already exposed to higher than average concentrations of atmospheric lead, the body burden might be reduced by as much as one third." One of the authors of the BMA statement was Professor Thomas Oppe, a member of the Lawther Committee.

In fact the Lawther Committee was set up by the DHSS and reported in 1980 on the subject of lead and health. It concluded that lead in petrol contributed only about 10 per cent to the body lead burden, was dismissive of much of the evidence of ill-health at low levels, and rejected the suggestion that lead in petrol entered the body via the food chain. The Committee could not agree on whether or not it should recommend a ban on lead in petrol and finally settled for a compromise, calling for lead in petrol to be progressively reduced.

Inevitably, given the Lawther Committee's apparent blindness to the weight of evidence against lead in petrol, one is led to question the abilities and objectivity of some of those scientists who both sat on the committee or were funded by such bodies as the Medical Research Council to carry out research on the health hazards of lead.

The Government Reaction

In all probability, both the DHSS and probably the Department of the Environment at one point wanted a move to lead-free petrol, but were opposed on economic grounds by the Treasury and the Department of Energy. And, as a consequence of the Lawther Report the government would probably have taken no action

to reduce lead levels from 0.40 grams per litre were it not for Sir Henry Yellowlees, the chief medical adviser for the DHSS, who in March of 1981 wrote to senior colleagues in Whitehall. In his letter Yellowlees took a very different line from the Lawther Report. Instead, he stated "(a) even at blood lead levels there is a negative correlation between blood lead levels and IQ of which the simplest explanation is that lead produces these effects; (b) lead in petrol is a major contributor to blood lead acting through the food chain as well as by inhalation". Then he added "there is a strong likelihood that lead in petrol is permanently reducing the IQ of many of our children . . . some hundreds of thousands of children are affected and as chief medical officer I have advised my Secretary of State that action should be taken to reduce markedly the lead content of petrol in use in the United Kingdom. The risk to children is now shown to be too great for me to take any other course . . ." Finally, he raised serious questions about whether the research currently being conducted was worthwhile; "further research is being mounted but we are dealing here with the biological sciences where truly conclusive evidence may be unobtainable and it is therefore doubtful whether there is anything to be gained by deferring a decision until the results of further research become available."

The effect of this was to force the authorities to decide that they would have to act on lead in petrol. The question was whether they would ban it altogether or reduce it. Inevitably, Whitehall moved towards a compromise, since it is accustomed to balance economic and political considerations with other requirements. Whitehall was also concerned at the problems of the motor-manufacturing industry which through its own economic troubles found itself in a powerful bargaining position. In addition politicians thought they could get away with compromise, having underestimated the strength of public opinion.

Thus, in May 1981, the petroleum industry, the car manufacturing industry, and Whitehall compromises won the day. Associated Octel were reasonably pleased; only the public, and in particular Britain's children were losing out.

But the safe ground that the government assumed itself to be on started to shift from under its feet. Undoubtedly if the same decision had to be taken today, it would have been for lead-free petrol. Indeed the opposition parties have become united behind a policy of lead-free petrol. The Labour Party carried a resolution at its Party Conference last year to ban lead from petrol, the party's NEC had committed itself to it, and Labour MP's are by far the majority in the 200 signatories to CLEAR's objectives. There is every reason to believe that Labour will proceed to commit itself in its manifesto. The Liberal Leader, David Steel, has personally committed himself, and the Liberal Party Assembly is expected this year to pass a resolution making it Party policy to ban lead from petrol. At the time of writing a ban of leaded petrol was being included in the draft policy document on public health being prepared by the SDP Working Party. The Scottish National Party is also opposed to

lead in petrol, as is the Ecology Party. The Tories are thus isolated. Even within their ranks, there are many who believe there should be a ban on leaded petrol and a significant number has signed CLEAR's objectives. Furthermore, two organisations of considerable importance to the Conservatives, the Women's Institute and the Townswomen's Guild, are both expressing serious concern.

Until recently environmental health officers have stopped short of supporting a ban on lead in petrol. Their president, Mick Archer, is particularly concerned about the health hazards of lead in paint and consequently made a trip to the United States with financial assistance from Associated Octel and the petroleum industry to look into that specific subject. Archer, as a member of the Royal Commission on Environmental Pollution, argues that he wants all forms of lead pollution tackled with equal vigour, not solely lead in petrol. Meanwhile the Institute of Environmental Health Officers appears to be moving towards formal support of a ban on lead in petrol.

Unquestionably support for a ban on lead in petrol is hardening, and the government is finding itself increasingly isolated on that issue, as are supporters of Associated Octel and the car manufacturers.

Nevertheless, the vested interests in leaded petrol claim that countries which have banned such fuel have done so out of concern that lead added to petrol damages the catalytic converters necessary to control exhaust emissions. Thus, a decision to introduce catalytic converters becomes automatically a decision to eliminate lead from petrol as well.

It is true in the United States that the Environmental Protection Agency was determined that emissions of carbon monoxide, hydro-carbons, and nitrogen oxides be controlled, and planned to introduce catalysts for that purpose. However, at the same time it was also considering the health risk from lead in petrol. Thus its decision to phase out lead in petrol by demanding that from 1975 all new cars be manufactured to run on lead-free petrol, and that all petrol stations be required to supply it, was based both on the health risk and because of lead's incompatibility with the catalytic converters.

At the time of introducing those regulations the Environmental Protection Agency stated: "On the basis of an evaluation of available scientific and medical information, EPA concluded that environmental lead exposure is a major public health problem, with present levels of lead exposure constituting a sufficient risk of adverse psychological effects for a small but significant proportion of the urban adult population and up to 25 per cent of the children in urban areas."

The United States Courts, too, have upheld the EPA's stand against lead in petrol. Indeed the United States Courts of Appeals, District of Columbia Circuit, when considering the Ethyl Corporation versus EPA case of 1975-6 stated: "for years the lead anti-knock industry has refused to accept the developing evidence that lead emissions contribute significantly to the total human lead body burden . . . However, Congress finally set up a legal mechanism by which that evidence could be weighed in a more objective tribunal. It gave the newly-created EPA authority to control or prohibit the sale or manufacture of any fuel additive whose emission products endanger the public health or welfare . . . It is beyond question that the fuel additive Congress had in mind was lead. Given this mandate, the EPA published advanced notice of proposed rule making. The administrator announced he was considering possible controls on lead additives in gasolines, *both because of their possible dangers to health* and because of their incompatibility with the newly-developed catalytic converter emission control system."

Despite such rulings the Reagan administration set out to reconsider the restrictions on lead in petrol. However new evidence emerged that the phasing out of lead in petrol had already had a significant effect in reducing lead levels. Consequently the EPA hastily pulled back from any proposal to relax the restrictions on the grounds of health.

In Australia, the government made it clear from the start that the decision to begin phasing lead out of petrol from 1985 was for health reasons and not because of the introduction of catalytic converters. Announcing the decision, the nation's Minister of



Children at risk.

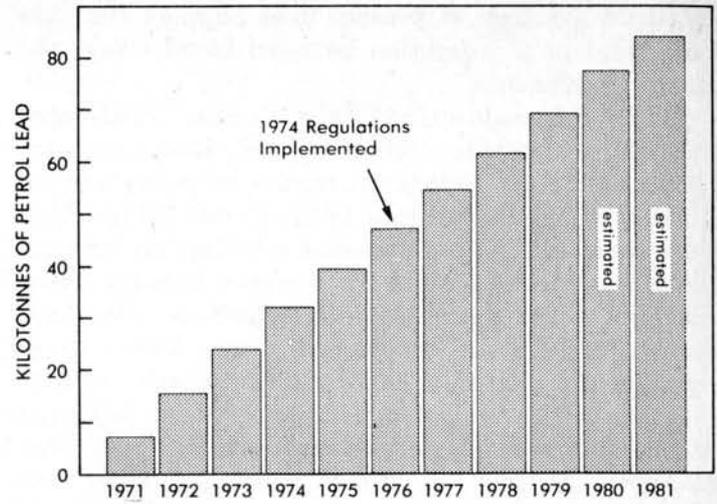
Transport said: "We are bound to a consensus . . . leaded petrol is a health hazard." At the same time the New South Wales government circulated a leaflet to its citizens spelling out the health hazard at considerable length: "as a result of intensive research in recent years, there has been increasing concern about the effects of even low concentrations on human health."

In first countering such opinions the authorities and vested interests claimed that harmful effects from relatively low levels of exposure were not proven. However as evidence has accrued, such critics have tried to claim that even if there is a health risk, it does not come from the use of lead in petrol. In this respect they have drawn heavily on the Lawther Report which concluded that the connection between lead in the air and lead in food is tenuous at best. Yet given that 90 per cent of all airborne lead comes from car exhaust, the Lawther supporters must explain where all that lead goes to. In its report *Land or Health*, the Conservation Society suggests that the "fall-out of lead is by far the major source of lead in typical food crops consumed by humans and farm animals, even crops grown on farms and/or mountain areas away from main roads and industrial sources."

Other research indicates a link between increased lead in dust with high traffic density. One of the key pieces of evidence derives from research by Dr I.H. Billick who compared the mean blood lead levels of 178,533 children in the New York area with the sales of leaded petrol over a six year period. The correlation between the rise and fall of blood lead levels and the rise and fall of sales of leaded petrol was astonishing. Recently two crucial pieces of evidence have emerged. The first is the preliminary result of a special study in the Turin area of Italy. That isotope study revealed the average input from lead in petrol to blood was 30 per cent. But the most crucial piece of evidence, comes from the United States. There lead-free petrol began to appear in 1975. By 1980 roughly 50 per cent of petrol was unleaded. In research conducted between 1976 and 1980 the National Centre for Health Statistics showed that in the four year period there was a 36.7 per cent reduction in the overall mean blood lead level. It stated that "decreases were found in all races, ages and both sexes. Further analysis indicated that the reduction was not due to seasonal sampling, income sampling, geographic region sampling, urban versus rural sampling, laboratory-measurement error or chance. The most discernible change in environmental lead sources was the reduced use of lead in gasoline . . . the decrease in mean blood lead levels reflected the decrease in lead used in gasoline production."

The Effect of Low Levels of Lead on Children

At the time of the UK Government's decision not to ban lead in petrol in May of 1981, the case that children could be harmed at much lower levels than previously thought rested largely on the work of Dr Oliver David from New York. He established clear relationships between relatively low lead levels in children and hyperactivity, mental retardation, and learning disabilities, as did the work of Dr Herbert Needleman, now of Pittsburgh. Professor Michael



Cumulative Total since 1970 (kilotonnes of petrol lead emitted in UK)

Rutter, who surveyed the evidence on those issues for the Lawther Committee, was critical of much of the previous research but acknowledged that "the study by Needleman et al. provides the most impressive evidence up to date on the possible damaging effects of raised lead levels in the range usually previously considered harmless and which are found in some 20 per cent of children in the general population. There are a number of important questions and reservations about the study and the inferences to be drawn from them, but none of these are sufficient to invalidate the findings."

Using dentine lead levels in shed milk teeth as a marker of long-term lead exposure, Needleman studied over 2,000 'normal' school-children from two towns in Massachusetts. Teachers were asked to rate a child's classroom behaviour on an 11-item scale. The incidents of non-adaptive behaviour rose with increasing lead burdens, and in most cases the relationship was dose-dependent. The deleterious effects were not confined to classroom behaviour. An IQ deficit of 4 to 5 points was demonstrated between the high and the low lead group, a deficit which could not be explained away on the basis of any of the other 39 variables analysed in the study. No child with high lead levels had an IQ greater than 125, whereas 5 per cent of low lead level children exceeded this level. At the other end of the scale, no child with a low lead level had an IQ less than 72, whereas 5 per cent of the high lead children had IQs of less than 66.

Studies in three other countries, subsequent to Needleman, tended to confirm the Needleman message. Of considerable importance, however, and not published until well after the decision to reduce to 0.15 grams per litre was announced, was a pilot study by Dr William Yule and Dr Richard Lansdown, two members of the Lawther Committee, who compared blood lead levels of 166 Greenwich children with their intelligence and attainment, dividing them into two groups, those with blood lead levels of 12 ug/dl and below, and those with 13 ug/dl up to 32 ug/dl. The higher lead group had an average IQ deficit of 7 points. While they have tended to play down the study, Dr Yule wrote a letter to *The Times* saying: "We concluded that there remained a small but real relationship between blood lead levels and children's attainments...the

scientific evidence at present does support the view that there is a connection between blood levels and school performance."

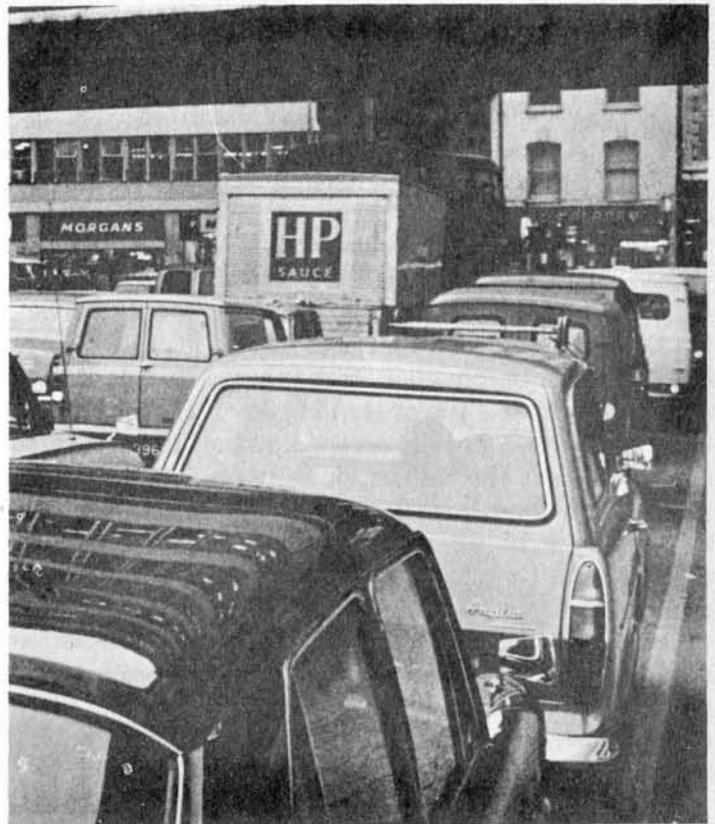
Yule and Lansdown, at CLEAR's May, 1982, international symposium on low level lead exposure, produced further significant results in replicating the findings of Needleman et al. in the United States. Thus they indicated a dose-response relationship between increased lead levels and an increased likelihood that teachers would record deviant behaviour. They also demonstrated that hyperactivity was found to be significantly related to children's blood lead levels.

Recently *The Lancet* carried a report from scientists at Birmingham and Glasgow on *Lead and Tetrahydrobiopterin Metabolism* which concluded that "our experiments have shown that in man blood lead values correlate with a biochemical indicator of neurological function, and they suggest that blood lead values currently accepted as normal may give rise to a small reduction in IQ score."

Of further significance has been the work of Otto et al. in the United States. They demonstrated adverse effects at blood lead levels as low as 7 ug/dl from a study of electrical brain-wave patterns in 63 children aged one to six years under conditions of sensory stimulation. They showed changes of slow wave voltage which varied according to the blood lead level within an observed range of 7-59 ug/dl and also discernible abnormalities in EEG spectra down to a level of 15 ug/dl. They concluded: "These results provide evidence of altered CNS (Central Nervous System) function at the lowest lead level ever recorded" and "the relationship between blood lead level and slow wave voltage is of particular interest since the data suggest that even very low levels of body lead burden affect this parameter of brain function i.e. a no-effect threshold does not appear to exist." And again "the slow wave observed in this study is presumed to be an index of sensory conditioning. The results therefore imply that lead exposure interferes in some way with conditioning or learning in children."

The chairman of CLEAR's international symposium was Professor Michael Rutter, one of the world's leading child psychiatrists, who had been a member of the Lawther Committee. At the conclusion he summarised all the evidence and demonstrated that he had now deserted the Lawther Committee's position. He took the view that the suggestion that lead in petrol contributed only 10 per cent to the body lead burden was inaccurate — it was nearer 30 per cent. He accepted that petrol lead entered the body via the food chain. And he continued "on the hypothesis that low level lead exposure leads to psychological impairment . . . the implication is that it would be both safer in practice and scientifically more appropriate to act as if the hypothesis was true, rather than to continue to act as if it was not true."

He then added: "The risk seems to be substantially more than a trivial one, at least in some individuals, the effects are likely to be of practical importance in causing impairment of functioning. The implication is that we now know enough to warrant taking such



Lead or not, the cars keep running.

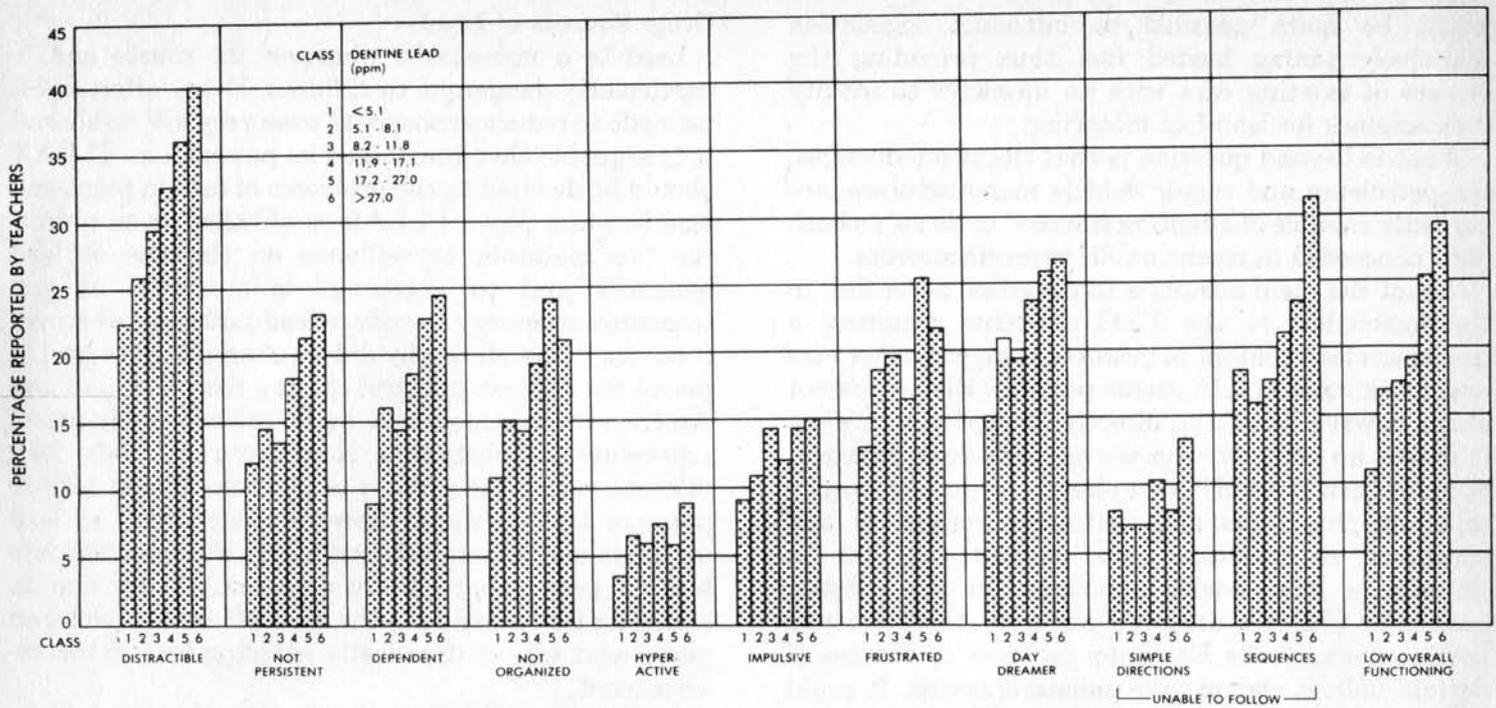
public health actions as are likely to reduce lead pollution in the environment, provided such actions do not have other hazards, and provided they are not prohibitively expensive. The removal of lead from petrol would seem to be one of those worthwhile and safe public health actions. The evidence suggests that the removal of lead from petrol would have quite a substantial effect on reducing lead pollution and the costs are quite modest by any reasonable standard . . . In my view, the reduction of lead in petrol to an intermediate level is an unacceptable compromise without clear advantages and with definite disadvantages . . . The reduction of lead in the environment should make some worthwhile difference to some children and that ought to constitute a quite sufficient justification for action now."

Burden of Proof

For anyone who studies the history of the leaded-petrol controversy it is hard to avoid the conclusion that the public — the potential victims of the practice — have had to find the burden of proof while the industries — the perpetrators of the practice — have had little pressure put upon them to prove the safety of leaded petrol.

Evidence of the industry's ability to avoid the safety issue is demonstrated in a statement by the manager of External Affairs for BP to CLEAR: "At the outset may I say that we do not consider ourselves qualified to express any view on the relationship between lead levels in petrol and public health — in our opinion that is a matter for the Government, who are in the best position to assess all the evidence."

It is also hard to avoid the conclusion that Whitehall and Westminster, supported by the industries, insist on demanding *conclusive* evidence even while knowing



Classroom behaviour in relation to dentine lead concentration; results for 2146 children. Distribution of Negative Ratings by Teachers on 11 Classroom Behaviours in Relation to Dentine Lead Concentration. The group boundaries were chosen to obtain symmetrical cell sizes for the median (Groups 1 and 6 = 6.8 per cent, Groups 2 and 5 = 17.6 per cent, and Groups 3 and 4 = 25.6 per cent).

that conclusive evidence is unobtainable. Sir Henry Yellowlees in his letter to his Whitehall colleagues said: "We are dealing here with the biological sciences where truly conclusive evidence may be unobtainable." He then went on "it is therefore doubtful whether there is anything to be gained by deferring a decision until the results of further research become available."

And yet that is exactly what is being done. Consequently we are now having to await further Yule and Lansdown studies, and also studies by other people, sponsored by the Medical Research Council. However, there are some people involved in research into the lead in petrol issue who have taken such a hard line that it is difficult to see how they could reverse their position without suffering a terrible loss of face and credibility. Thus, whether we can hope for genuinely objective results from the MRC is open to some doubt.

On the nature of risk, we are concerned with no less than the mental health of the nation's children. Whatever the detractors of the evidence of this effect may say, they cannot deny that mental health is the issue at stake, and we must bear in mind Sir Henry Yellowlees' assessment that "hundreds of thousands of children could be affected." At the very minimum, every child living in urban circumstances is at risk of low level exposure to lead with its health consequences. Thus if the risk is accepted as genuine, its scale in terms of potential victims is such that the case for the elimination of lead in petrol is overwhelmingly made.

How quickly and economically can lead be eliminated from petrol? In that respect we have to distinguish between new cars and existing cars. And we have to consider whether the low octane (2-star) or the high octane (4-star) route is adopted. If the decision is low octane lead-free fuel, then the major expense will fall

upon the car-manufacturing industry which will be required to produce new cars to operate efficiently on 2-star petrol (as the Japanese have done). Retooling and retesting may be required for some models and this could take at least three years. This is why CLEAR has not insisted on lead-free petrol before 1985. Unfortunately most cars currently produced by British manufacturers are designed to operate on 4-star high octane fuel and will not run efficiently on 2-star, so if the low octane route is adopted there will be little incentive for owners of existing cars to have their engines modified.

If the decision is to opt for the high octane route, then the major expense will fall upon the oil industry, who will be required to produce 4-star petrol without using lead additives. A number of solutions are available to them (more intensive refining or the use of an alternative octane booster such as MTBE). Once more, it is hard to see this course being possible before 1985.

Cars require only minor modification to run on high octane lead-free petrol and this relates to the lubricating properties of lead which prevent wear and tear on exhaust valve seats. New cars can be manufactured with hardened valve seats at minimum cost. Existing cars could also be modified at minimal cost, although CLEAR has not asked for regulations that this should be mandatory, preferring to recommend a phasing out of lead in petrol over a generation of cars as has been the policy adopted in other countries.

Whether the low or high octane route is adopted, the cost involved need not punish the motorist excessively. Lead-free petrol has a number of technological advantages, including reducing running costs, less frequent oil changes, and longer engine life, and it

would be quite possible to introduce legislation selectively taxing leaded fuel thus providing the owners of existing cars with an incentive to modify their engines for lead-free motoring.

What is beyond question is that the two industries, the petroleum and motor vehicle manufacturers, are perfectly capable of adapting if forced to do so, as both have conceded in recent public pronouncements.

One of the main obstacles to progress, according to the industries, is the EEC directive requiring a maximum lead content in petrol of 0.40 grams per litre and a minimum of 0.15 grams per litre. Britain cannot claim, however, that that directive is an obstacle, when it makes no attempt whatsoever to have it changed. Some British Euro-MP's are already beginning to open talks on this issue and major environmental and consumer organisations are coming together to organise a Europe-wide campaign on the subject, backed by CLEAR. Britain's first duty, therefore is to seek to persuade its European partners to change. If Britain fails, it should take unilateral action. It could do so under Article 36 of the Treaty of Rome citing the protection of public health. Or it can simply do so on the grounds that it has no choice for health reasons, and Europe can take it or leave it.

The second point made is that British cars manufactured to run on lead-free petrol will not sell on the European market. Why not? Cars manufactured to run on lead-free petrol will also run on the leaded petrol available there. In fact, as the world moves to lead-free petrol in view of the accumulating health evidence, British car manufacturers will do well to remain in the fore of development on this issue. In any event, any loss of sales overseas will be counterbalanced by increased sales in Britain. It is difficult to see, how the car manufacturing industry can claim it will be a disadvantage to overseas sales, when the Japanese car manufacturers are forced to provide cars to run on lead-free petrol in their own country, and yet have remained extraordinarily successful in the world market.

Other Sources of Lead

Lead is a neurotoxin whatever its source and is particularly dangerous to children. Every effort must be made to reduce exposure at even very low levels and it is arguable that campaigns as powerful as CLEAR should be devoted to the problems of lead in paint and lead in water pipes. CLEAR established as an objective "to maintain surveillance on the use of lead generally and to encourage enforcement of any measures necessary to reduce lead pollution wherever it occurs." Therefore why did we choose to give lead in petrol the highest priority? As the recent Italian and American evidence proves, we do believe lead in petrol represents a substantial contributor to body lead burdens across the country as a whole. Whilst lead in paint or lead in water pipes or other forms of lead exposure may be more serious in specific localities, it is lead in petrol that affects everyone. A decision to eliminate lead in petrol is the most effective, quick and permanent way of drastically reducing lead in the environment.

In summary, the position is as follows:

1. We have established that lead is a neurotoxin, and that at relatively low levels of exposure it can damage brain function and thus reduce the potential of children.
2. We have established that the use of lead in petrol has created a substantial source of lead. exposure to people all over the country.
3. We know that the relevant industry can adapt at not too prohibitive a cost so that this practice need not continue.
4. Public opinion, increasing medical and scientific opinion, and growing political opinion, demands a change. Conservative ministers are becoming increasingly isolated, their position supported only by the financial vested interests and a dwindling number of scientists of doubtful motivation.

For all of these reasons this is a battle we will win. I have no doubt about that. What is at stake is time . . . and a generation of children whose educational years are slipping away.

As I understand it
For reasons unknown
(Shall we say for the sake of a fight
An act of the natural God
Or the goof in the human factor)
A chain reaction starts.

Concrete shells cannot contain it.
The cellular skeleton turns uneasy
That lowest denominator
In the make-up of common things,
Cleverly cleaved in two,
Overrides the edges as we perceive them.

My skin is the skin of corrupting plums.
Charisma rots to its core of vital organs.
Not to mention the noise!
Thus we bring about a delayed
Echo to the Big Bang of the week
When He made it all matter,

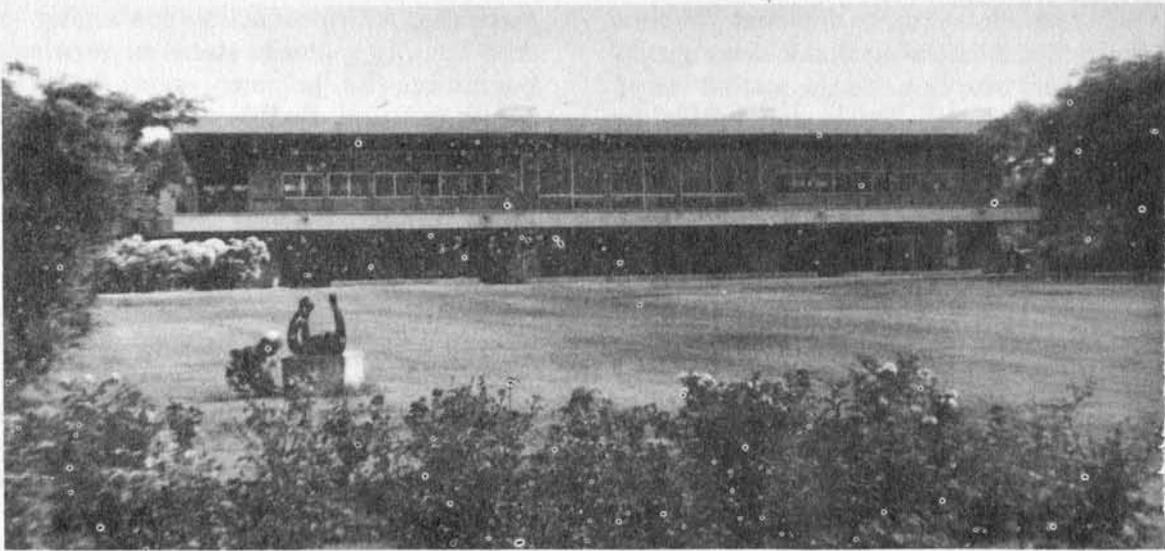
What we take down
In a giffy, like a wall
Of do-it-yourself shelves.

Dinosaur Blues

With policeman heels
And their tiny minds
They stomped this earth for aeons.

When it came to kneel
To the change in the winds
They keeled over in millions.

Laurence James



The Kibbutz — an ideal society

by Nigel Pollard

Ten years have passed since a *A Blueprint for Survival* (*The Ecologist*, January 1971) but in Britain there have been no appreciable moves towards practical implementation of any of its policies. However, a cursory examination of the 250 Kibbutzim—land-based collectives—in Israel—appears to reveal many of the features advocated in the *Blueprint for Survival* for the ideal society. Thus the Kibbutzim are decentralised, egalitarian, voluntary communities, with a mixed economy and of a size—approximately 500 people—such as to allow direct democracy to take place.

Closer scrutiny of the Kibbutz indicates that, while politically the special Israeli version of 'collectivism' is close to the ideal described in *The Ecologist*, with rare exception the attitude of the Kibbutz movement towards land and farming adheres to main-line Marxist-Leninist thinking. Indeed if the USSR wanted collective farming to work as a productive enterprise it could well have looked at the Israel example.

In point of fact the environment is not a major consideration in Kibbutz development. The Kibbutzniks thus see no contradiction in rearing battery chickens and with equanimity can keep new born calves confined to movement-restricting pens. Moreover their use of agrochemicals and of heavy agricultural machinery is on a par with those of big agro-industrial enterprises in other parts of the world.

Ultimately one has to question whether any community can remain integrated and stable when it cares apparently little for the environment that sustains it.

After nearly 2,000 years of dispersion the first wave of Jewish emigration to Palestine took place in the latter part of the 19th century. The immigrants, from Russia, and Eastern and Central Europe, had a background of ghetto existence, often of strict family and formal religious upbringing and were cut off from primary production.

Some of the Zionists were attracted towards making a new socialist life in collectives or communes, especially as the harsh conditions and lack of finance made cooperation essential. Land at this time was being purchased by the Jewish National Fund, and then made available on 49-year renewable leases to prospective groups.

In 1910 the first group to settle in the Jezreel valley, at what was to become Kibbutz Merchavia, consisted of 36 people led by Dr Franz Oppenheimer, a well known agriculturalist/sociologist.¹ Ten field crops were grown, with wheat yields of 760-950 kilogrammes/hectare, poultry was kept, and one of the first dairies in Palestine established, with average milk yields of 1,000 litres per cow per year. Malaria proved a problem for the new settlers, and the group which at this time worked on the basis of wage labour, made a financial loss each year. The settlement broke up in 1915 with Oppenheimer returning to Germany.

In other regions Kibbutzim, at this time termed Kutzva, had been founded, but ideological arguments

among the socialists led to split into different Kibbutz federations. The militant left-wing break away group was led by Meir Ya'ari who came to the settlement at Merchavia². Ya'ari now in his 80s is still 'active' in politics on Merchavia. The new federation was called Kibbutz Artzi (countrywide) and became affiliated to the political party Mapam. The other major federations Ichud and Meuchad have recently remerged to form the United Kibbutz Movement. A descriptive account of the early days on Merchavia can be found in Golda Meir's biography, based on her three years experience there.

People commonly hold that in addition to ideas of Zionist socialism many pioneers of the Kibbutzim were also motivated by the philosophical writings of such as Leo Tolstoy, Martin Buber, and A.D. Gordon,^{3,4,5,6,7}. Those writers were all proponents of simple living—back to the land lifestyles—with their own interpretation of religion and a philosophy akin to many contemporary writers on ecological lifestyles. Gerson, a Kibbutznik pioneer, and himself a disciple of Martin Buber, completely rejects this view and maintains that their influence has been at most marginal; the main influence being that of Marxist social revolution.⁸ This supposition is supported by the work of the Zionist historian, Laqueur, who states that any early influences of this nature quickly faded⁹. Josephthal, a spokeswoman for the federation Ichud and labour party Mapai when questioned on the Kibbutz use of high technology stressed, as reported in the *Jerusalem Post*^{9a} (20th April 1964) that the Kibbutz was not bound by any "back to nature" ideas. Meanwhile in the minutes of the Artzi federation, to which Merchavia is affiliated, "the Marxist—Lenin doctrine" is described as the prime influence¹⁰. Many Kibbutz authors stress that the Kibbutz has not been constructed from a blueprint worked out in advance, and practical solutions are certainly not prescribed on a dogmatic basis. Nonetheless the Kibbutz has its roots in socialist philosophy.

Kibbutz Merchavia

Today there are eight production branches at Merchavia, each branch representing a separate economic unit with its own accounting system. The different branches will be described, noting to what extent they disrupt ecological processes, conserve materials and energy, and can supply satisfaction as a workplace.

Plassim: The Plassim (plastics Merchavia) was founded in 1960 and is Israel's oldest manufacturer of complete plastic piping systems for agriculture, industry, and building. Plassim includes a: R & D Laboratory, and a transport fleet, in addition to administrative and shop floor workers, and employs over 100 people. The premises have expanded from an initial 600, to over 4,500 square metres, and Plassim now generates 70 to 80 per cent of the total Kibbutz income. The factory consists of two units; production and injection.

Production: This produces polyvinyl chloride and polyethylene piping systems from up to ten moulding

machines, with production continuing for 24 hours a day. The raw material stems from petroleum, Plassim purchasing its polymer resins from petro-chemical plants in Israel, Europe, and the U.S.A., according to market prices. Production of plastic is an energy intensive process, and the machinery imported from Italy, Switzerland, and Germany, runs on electricity. This is supplied from a national grid, which uses oil purchased from Egypt and Mexico. Owing to the rising cost of oil a new coal fired power station is being commissioned during 1982 which will use coal purchased from South Africa, U.S.A. and the U.K. Freight and unloading charges will at least equal the price of the coal, according to the *Jerusalem Post* (December 23rd 1981). In addition to maintenance, most of the shop floor work consists of ensuring a steady supply of resin to the mould. Should there be a fault in the system, or a piping system ready for packing and transporting to the store a flashing "emergency light" comes on. The machines generate enough noise to warrant ear plugs on occasions.

Injection: This unit consists of five thermoplastic injection moulding machines, producing hard plastic fittings 16 hours a day. The fifth machine was purchased in 1981 from Germany at a cost in excess of £150,000; it is expected to have a 20 to 30 year pay-back time, and supplies one shop floor work place. The work entails changing the different moulds, trimming up the fittings produced, and some assembly work of the components before packing.

In the present world market situation Plassim is proving a very successful economic enterprise, earning millions of dollars in exports. The technology and innovation are of a high order, and over 50 per cent of the irrigation in Israel has been planned and installed by Plassim's people. Indeed Flavin of the Worldwatch Institute reports a bright future for the plastics industry in as much as metal pipes are more energy intensive in moulding than plastic, and often have a shorter life. Furthermore they tend to be more expensive. By comparison plastics, which overall consume some eight per cent of the world petroleum consumption, are energy and material conservative.¹¹

Not that the plastics industry is free of environmental problems¹². Indeed vinyl chloride, on which the plastics industry is based, is now accepted to be a carcinogen¹³ a fact which the industry has tried to suppress.

Industrialization has been a feature of the Kibbutz movement from its origins. In 1937 factories already supplied on average 19 per cent of their income³. By 1959 the net product of Kibbutz industry exceeded that of its agricultural branches, according to the *Jerusalem Post* of August 16, 1963^{9a}. Today 80 per cent of Kibbutzim have an industry, nearly half of which constitutes metal plastic or rubber factories. Overall Kibbutzim industry produces 6 per cent of the national industrial product¹⁴.

Without question the growing industrialization of the Kibbutzim is leading to a weakening of the original Kibbutz ideology in as much as specialization requires work-place differentiation¹⁵. An associated problem is that of ensuring that the wealth created is used in an

egalitarian way, as Blasi points out¹⁶. Factory managers in Kibbutzim, when asked to describe their priorities in managing plant answered that profits came first, then employment opportunities for the Kibbutz and way down the list the quality of working life and job satisfaction¹⁷. Meanwhile Leviatan has shown from studies within the Kibbutz that there is little difference in work satisfaction between modern farm and factory workers¹⁸.

In much of *Das Capital* Marx appears to argue against both machinery and the process of industrialization. Yet his main concern is that the working classes will suffer most from the "crisis" generated by disequilibria in production and consumption in the industrial process. Such a crisis can be solved through an equitable distribution of the profits, as well as by allowing worker and state ownership, which by increasing and maintaining consumption will thus relieve the burden of material difficulty for all. The Kibbutz industrial system, with its profit sharing and common ideology would thus seem to comply with Marx's strictures.

Although Marx criticises machinery in *The Communist Manifesto* as destroying the charm of the workplace and making the worker an appendage of the machine, he vigorously criticises those "Luddites" who attack the "instruments of production", but not the "bourgeois condition of production." Because industry is not bound by local resources but requires the mass movement of materials in world markets, Marx concludes that it is a basic goal in that it increases the interdependence of all nations, and "draws all, even the most barbarious nations into civilization"¹⁹.

Agriculture: Merchavia farms around 700 hectares of land in the Jezreel Valley, about one half of which is over 4 km from the Kibbutz itself. In the early days a variety of crops including vegetables were grown. Since 1960 the industrial crop of cotton has increased in importance and now presents a large proportion of the income derived from the fields. The agricultural sector employs around 14 people and brings in 10 to 15 per cent of the Kibbutz income. The crops grown in 1981 with some important cultivation practices are given in Table 1.

Kibbutz farming is intensive and utilises the latest techniques: indeed micro-electronics are used to control the drip-feed irrigation system for the cultivation of American Upland (*Acala*) cotton. Plastic pipes purchased from the Plassim are laid at 2 metre intervals, that is every other cotton row, and consequently 5 km of pipes are used per hectare, or 350 km of pipes for just two of Merchavia's cotton fields. The pipes have an average field life of only three years owing to perforation blockage, resulting from slightly dirty water, and because of stretching in the laying out and taking up of the pipes. The pipes are then sold to an electrical fittings factory in Nazareth for "recycling": although flexible plastic when remoulded becomes hard. Water as well as liquid fertilizer is dripped twice a week from angular perforations—made by a laser beam. In that way the water is used efficiently being supplied directly to the crop roots. Nevertheless the cost of the pipes dictates that the soil is maintained with almost 100 per cent available water.

To effect such availability modern devices are employed such as the neutron probe which measures soil moisture at different depths by a small radioactive discharge. In addition aerial infra-red photographs were made of the fields in 1981, that showed uniformity of crop growth as well as diseases not always visible from the ground. The irrigation system can be controlled by a computer, introduced for field 3 in 1981, and manufactured by the Israeli electrical firm Motorola. For 1982, computer cables from fields 3 and 4 have been laid to the Kibbutz campus, to save on transport costs. Theoretically, the computer can be programmed to adjust its irrigation cycle to field sensors measuring soil moisture and fertilizer levels, and record malfunctioning filters and valves on the display board, thus saving on manpower.

Nitrogen fertilizers are manufactured in Israel, and potash is extracted from the dead sea. The crop-dusting was carried out by the national cooperative Chimavair, in which Merchavia has shares. However Chimavair is experiencing serious economic difficulties and may be liquidated. Heavy machinery is needed for the tillage, mostly imported (John Deere, David Brown, Case), and requires considerable capital

TABLE 1. 1981: Agriculture on Kibbutz Merchavia

CROP	AREA (HECTARES)	YIELD	CULTIVATION PRACTICES
Cotton 1. unirrigated	150	1,700Kg/H.	Seed dressing, winter herbicide spray, 6 aerial pesticide sprays (4 in 1980) 2 defoliate sprays, inorganic fertilizer.
Cotton 2. sprinkler irrigation	70	3,400Kg/H.	As above; 7 aerial pesticide sprays. Water from Kibbutz reservoir containing oxidised sewage water of Kibbutz.
Cotton 3. Drip-feed irrigation (Plassim pipes).	80	5,500Kg/H.	As above. 9 aerial pesticide sprays. Organic fertilizer from Kibbutz dairy. Water from Kibbutz shared reservoir.
Cotton 4. Drip-feed irrigation	60	6,300Kg/H.	As above. 7 aerial pesticide sprays. Water from Mekerot, national co-op.
Wheat	220	4,000-5,000Kg/H.(c.f.1910 yields of 760-950Kg/H.)	Seed dressing, Inorganic fertilizer, 2-3 herbicide sprays.
Chick-peas	60	2,000Kg/H	1-2 herbicide sprays, a leguminous crop.
Sorghum	60	4,000Kg/H.	1 herbicide spray
Sunflowers	50	Low/poor quality	None/loss made.

investment each year. In 1981/82 this investment will be around £50,000. The agricultural branch is backed by very good garage/workshop facilities; indeed the image of the modern Kibbutznik farmer is that of a good mechanic who can also use a pocket calculator.

The first settlers of the Kibbutzim were aided by government and bank loans in initiating their agricultural enterprises. Working as a collective enabled large-scale intensive farming, utilizing the technological revolution, possible at an earlier stage than individuals working as smallholders. During the 1950s' when agriculture was still a prominent factor of the economy, the Kibbutzim faced a financial crisis and most were consuming their own capital. The situation was remedied by further loans, industrialization, and the general world economic boom of the early 1960s' ¹⁰.

Agricultural strategy is that of 'maximum production' from the land, and the Kibbutzim now produce some 37 per cent of total Israeli agricultural produce¹⁵, although they comprise a much smaller percentage of Israel's agricultural settlements. Much of agricultural production is geared to exports, a policy which the labour alignment, in its 1981 election manifesto, states should be promoted in order to increase economic growth. On the other hand the idea of 'maximum environmental protection' does not figure prominently in Kibbutz literature. The use of the word 'environment' is rather in terms of, "exploitation by capitalistic forces" as Darin-Drabkin points out. Cohen goes further and shows the Kibbutz involved in a "conquest of nature", "conquest of land", and "conquest of labour"²⁰.

Such a strategy complies again with Marxist directives. Thus one of the measures especially indicated in *The Communist Manifesto* is the "establishment of industrial armies especially for agriculture". Meanwhile Lenin deals with the agrarian question in greater detail. He views man and nature as being separate entities in competition for the means of existence. Thus Lenin states:

The story that primitive man obtained all his requirements as a free gift of nature is a silly fable that would bring forth jeers and ridicule even from first year students. Our age was not

preceded by a Golden Age; and primitive man was absolutely crushed by the burden of existence, by the difficulties of fighting against nature.

(Lenin 1907:55)^{21a}

Accordingly he advocates the world view of scientific materialism:

Both in industry and in agriculture, man can only utilize the forces of nature, if he has learned how they operate, and facilitates this utilization by means of machinery, tools etc...

The old breeds of plants and animals created by natural selection are being superseded by improved breeds created artificial selection... Urban capitalism strives to utilize all the resources of modern science for the development of the technique of agriculture.

(Lenin 1907:55, 42)^{21a}

For Lenin socialism is a progression of capitalism, which in turn was a progression from feudalism and the system of landlord/serfs found in Russia at that time. From such historical determinism arises the idea of 'maximum production' as a progression from 'maximum protection'.

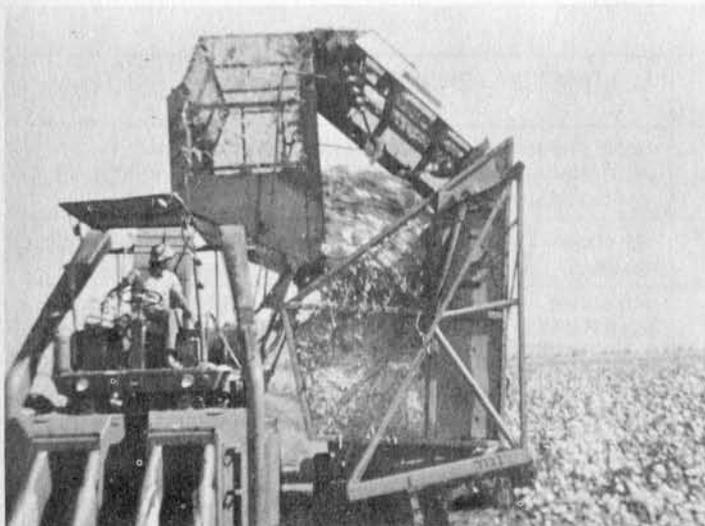
A few decades of capitalist change have done more than whole centuries of preceding history. Monotonous, routine, natural, self-sufficing economy has given way to diversified forms of commercial agriculture: primitive agricultural implements have begun to give way to perfected implements and machines; the immobility of ancient systems of husbandry was undermined by new methods of agriculture.

(Lenin 1899:299)²¹

With his copious use of statistics, Lenin demonstrates that at around the turn of the 20th century, large-scale farming with machinery was giving higher yields and profits. He is therefore in favour of "communal, collective, large-scale production" under the changed social/economic conditions of, "systematically and methodically transplanting urban culture to the rural districts" i.e. the creation of a proletariat from peasantry to relieve "rural idiocy/barbarity" (Lenin 1907: 13 ff)^{21a}.

Dairy: The dairy on Merchavia now consists of nearly 450 Israeli-friesians, which, according to Heiman, have become the single dairy breed in Israel.²² Milk yields on Merchavia are among the highest in Israel, averaging 9,300 litres/cow/year, a nine-fold increase from the cows kept in 1910. The dairy employs around fifteen people and generates five to ten per cent of the Kibbutz income.

Cattle breeding, in common with the rest of Israel, is almost entirely achieved through artificial insemination. The calves are then separated from the cow at birth and placed in individual cubicles; later, when three months old, they are sold to a Moshav where families work cooperatively on the land. The Kibbutz then repurchases the cows when ready to milk. The dairy herd is fed on wheat silage bought from the agricultural branch, and in some years on hay, or cotton seeds derived from the cotton gin, and some grapefruit skins obtained from the juice canning factory. The bulk of the diet consists of concentrates, which are mainly imported. Loew estimates that every ton of imported grain frees one quarter hectare of land and 100 cubic metres of water, allowing the cultivation



The cotton harvest on Kibbutz Merchavia



Newly born calves in isolation pens on Kibbutz Merchavia

of cotton and citrus crops for export, which at present provides a higher income.²³ Nonetheless such a system of buying in feed has its hazards and in 1977, the concentrate mix contained a lethal level of nitrogen and Merchavia's entire herd of 380 cows was killed. All the cow manure is dealt with automatically, chain and scraper removing the dung from the sheds. After separation the fluids and solids are later spread on the fields.

The cows are milked three times a day, in a 28 place rotary herringbone milking parlour. Their average economic milking life is only 2.8 years, after which the cows go for slaughter. For milking the cows are enticed into the parlour by means of a moving electrically charged bar in the exterior pen; milking then takes eight minutes, before they return to their concrete pen and yard. Disease is sometimes present but usually staved off with the administration of antibiotics and vaccines.

The milk is sold to Tnuva, the national cooperative, the price being government controlled. Milk, like other staple Israeli foods, carries a large government subsidy, usually in the region of 100 per cent. Thus the price of milk in the shops is around the production cost and consequently the dairy receives the production cost, plus a government subsidy i.e. profit. So as to maximise profit the milk consumed on Merchavia is purchased in plastic bags from Tnuva.

In general Kibbutzim possess 57 per cent of the total dairy herds in Israel, with an average milk yield of 8,100 litres/cow/year.¹⁵ Among the future developments expected in the dairy industry are the injection of high yield cows with hormones so they produce 100-200 embryos a year for them to be inserted into the uterus of other cows.²⁴ Experiments are also being carried out on a new system, in which, says Kalay,

The cow will enter the milking parlour and a transistor implanted in her body will broadcast her number and body temperature; the milking machines will measure and test the milk for each cow which will then go of computer analysis.

Closed circuit T.V. and video recorders will allow for the continuous checking of cows for heat detection.²⁴

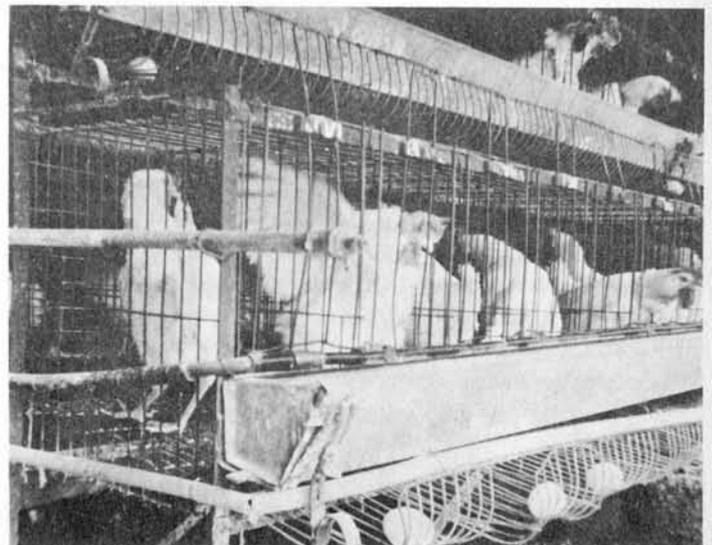
Increasingly therefore the dairy has become a highly industrialized process with the cowshed like a factory floor, the cows the manufacturing machines and raw products imported from outside to be processed into milk. The cow meanwhile never sees land, nor grazes in the traditional sense.

Orchard: The orchard covers nearly 20 hectares and consists of more than 4,000 mature grapefruit, 800 temple, and smaller numbers of lemon, olive and advocado trees. The orchard employs around five regular workers with an additional ten during the picking season. The orchard which primarily produces for export, comprises five per cent of the Kibbutz income. The trees are sprayed two or five times against insects, inorganically fertilized, and irrigated with water supplied by Mekerot, the national supply cooperative.

Poultry: The chickens are the standard Israeli cross between a synthetic red male and a synthetic white female. A policy of "All in-All out" is followed when "all in" they number up to 10,000 and have a one year economic egg laying capacity. The chickens feed on mash from the central feed mill, antibiotics and vaccines; the litter is sold to a private farmer in the district. Merchavia has its own incubators for rearing the new batch, the chickens for these being kept with a cock in a series of indoor enclosures, the rest are maintained in standard batteries. The poultry branch employs five or six people, and provides two per cent of the Kibbutz income.

Most Kibbutzim have now stopped egg production, and Merchavia's poultry branch is being undermined for lack of capital investment.

Printing Press: The printing press was established in 1934, and was one of the first Kibbutzim industries. Some of the original equipment remains and modern equipment including offset litho, photocopy/reduction machines have been added. In the main production consists of small newspapers such as Merchavia's bi-monthly paper and glossy advertisement brochures. The press employs up to ten people and generates two to four per cent of income.



Battery chickens on Kibbutz Merchavia

Greenhouse/Nursery: This is a small enterprise of two to three thousand potted indoor and outdoor plants. Two or three people enjoy regular employment there, with others periodically coming from local Moshavim/Kibbutzim for short training periods in propagation techniques. The nursery makes no significant income.

Bees: Merchavia has over 100 rather neglected hives under the supervision of one person. The honey supplies the Kibbutz breakfast table during the year, this being the only example of a food produced for 'self sufficiency'.

The Need for Skilled Workers

Many of the workplaces within the productive branches require some skill or experience and are usually staffed with regular workers. Some members are involved in planning and giving instructions, while others are expected to follow instructions. Although authority carries prestige, that state is not reflected in economic or democratic differentiation, men work an eight-hour, and women seven-hour, six day week. The children start contributing one or two hours a day from an early age. There is no retirement age, members will often work four or five hours a day, according to their capacity, while in their seventies and older.

Population and Manpower

One of the principal conditions of a stable society is a population in which recruitment equals loss. Israel and the Kibbutz movements are exceptional cases, and cannot be judged fairly under the criterion, as their stated aim is the absorption of immigrants.

Merchavia now has a population of a little under 600 people. This includes the members and their children, who may apply for membership in the year after their compulsory army service. The population is thus close to consisting of 110 nuclear families, with 65 extended family groups. It therefore lies within the boundaries of that "magical number" of 500 for optimal village size.²⁵ A few of the members work or study outside the Kibbutz, such as in regional Kibbutzim enterprises, the political party, Mapam, as university lecturers, students, hospital staff, and policemen. Any salaries for such employment are paid into the Kibbutz. The male members are also required to do a month in the army reserves each year, which reduces the available manpower.

The workforce is supplemented by some 35 regular hired labourers, mainly Arabs from local villages, four convicts on a working remission, and an average of 30-35 migrant labourers, mostly non-Jewish, from affluent countries working as volunteers who on average stay for periods up to four months. Some of the Arabs have worked at Merchavia for up to 25 years and occupy positions of responsibility. Approximately 20 per cent of the actual workforce is of non-Kibbutz origin.

The percentage of the Israeli population living in a Kibbutz has dropped from 7.5 per cent in 1947³ to 3.6 per cent, comprising 120,000 people in 1980;²⁶ this number represents some 30 per cent of the rural

population²⁷. While this appears a small percentage, an equivalent institutional network in Britain would contain a population of 2 million people. Although for many years the birth rate within the Kibbutzim was below the level of replacement, it is now considerably above, with 3.5 children per family being the accepted norm.⁵

Having sufficient numbers and manpower are seen as two recurrent problems within the Kibbutz movement. Thus as many as 50 per cent of children born in Kibbutzim leave the Kibbutz some time after their army service. Moreover, hired labour forms 38 per cent of Kibbutz manpower¹⁵; and in regional Kibbutzim enterprises this proportion rises to 75 per cent.²⁶ On one Kibbutz, a factory was sold because 180 of the factory's 220 workforce constituted hired labour, a state of affairs considered to be a serious negation of Kibbutz ideology. Yet in 1976 Baehr carried out a Kibbutz-based study on volunteers and concluded that they had both beneficial and unanticipated effects.²⁸

In the early days of the Kibbutzim—during 1921—ten hectares were considered the necessary size to support each family unit in a Kibbutz;¹⁰ a figure not so different from that found today, thus Merchavia has seven hectares per family. The optimum size for a Kibbutz was also debated as far back as 1930. Originally 100-200 members, hence 200-300 people was

Fig. 1. Population size and number of Kibbutzim (Kibbutzim founded prior to 1950)

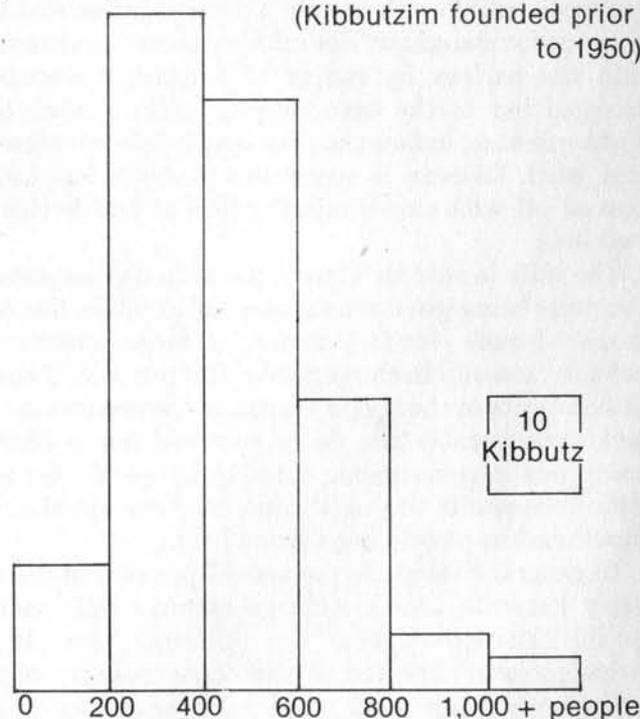
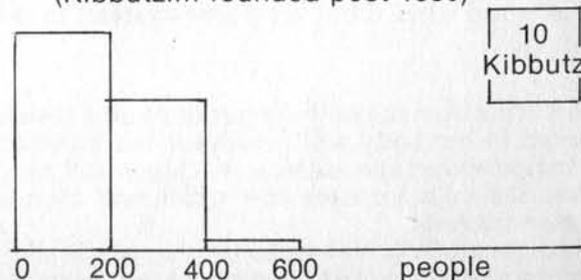


Fig. 2. Population and number of Kibbutzim (Kibbutzim founded post 1950)



recommended as the optimum size. This number was later raised to 160-180 members as a minimum for the efficient functioning of a mixed economy. In 1942 Viteles estimated that a population of 500-600 people then found in some Kibbutzim, was an acceptable figure. In fact the general policy is to establish a new Kibbutz rather than continually to enlarge existing Kibbutzim so as to absorb newcomers. Figures 1 & 2 thus show, although not conclusively that the population size of existing Kibbutzim tend to be self-limiting.

All Kibbutzim are rural. When an attempt to establish an urban kibbutz was made, as at Ramat Gan, a suburb of Tel-Aviv, it proved an economic and social failure. Again such a situation would have been foreseen by both Marx and Lenin. Indeed decentralization was always a prominent feature of Marx's socialist society, and in *The Communist Manifesto* Marx calls for the "gradual abolition of the distinction between town and country by a more equitable distribution of the population over the country". This evening-out was also emphasized by Lenin, although as a means to transplant urban culture to rural areas in order to "relieve the idiocy of rural life." Furthermore while socialist philosophy condemns the making of profit out of wage labour, Lenin, so as to get industry going through capitalism, is in favour of the use of migrant workers. According to him the employment of such labour will help break down social stability and allow progress and development to run their natural course:

We assert the 'migration' of the labourers is not only advantageous from the 'purely economic' point of view to the labourer himself, but generally speaking should be regarded as a progressive phenomenon: public attention should be drawn not towards substituting 'employment at home' for migratory occupations, but on the contrary, towards removing all the obstacles that stand in the way of migration....Unless the population becomes mobile it cannot develop. (Lenin 1899:292-294)

While the volunteers on a Kibbutz do not receive any wages, generally speaking they can be regarded as the products of such a progressive phenomenon.

The Social System

The major differentiation between a socialist and a capitalist society becomes apparent in the distribution of the goods, and in the availability of services produced by that society. The Marxist origins of the Kibbutz are indicated in Marx's statement that:

The emancipation of labour demands the elevation of the means of labour to the common property of society and co-operative regulation of the total labour of society, together with an equitable distribution of the proceeds of labour. (Marx 1875:2)

In this sense the theory of the communists may be summed up in the single sentence: Abolition of private property. (Marx 1848:355)

Private property has been abolished on the Kibbutz, which assumes complete responsibility for all the



Some of the original buildings of Kibbutz Merchavia.

needs of its members. If a Kibbutz folds up the assets or debts become the responsibility of the appropriate Kibbutz movement, and not of the last remaining members. The Kibbutz has thus adopted the motto; "From each according to his ability. To each according to his needs".²⁹ This neologism actually originates in Abbe Morell's *Code de la Nature* of 1755 (Viteles 1967 2: 64) and later appeared in Marx's *Criticism of the Gotha Program* (Marx 1875:7).

The following services are provided in Merchavia: housing, a minimum of a single room for individuals, usually two rooms, kitchenette, and toilet/shower for couples; communal 700 seater air-conditioned dining room serving three meals a day (fresh salads, tinned, frozen and processed foods); separate children accommodation, and schooling for children on the Kibbutz, and in the Kibbutzim regional high school; medical clinic with doctor and four nurses; modern dental clinic; laundry; library; clubhouse; 300 seater cinema; mini-supermarket; swimming pool; holidays; transport facilities; carpenters; cobblers; plumbers and electricians. In Merchavia the infra-structure is presently being increased with better accommodation for young members; with air-conditioning in all couples' rooms; a new children's library/playhouse. An internal telephone network for each house is also being installed.

The Kibbutz movements have a consumption pattern equivalent to the upper middle or professional classes of Israel, a situation which led Prime Minister Begin to proclaim that Kibbutz members were "arrogant millionaires idling in their swimming pools". Normally the social services absorb 50 per cent of the available workforce on a Kibbutz.

The Kibbutz also has its own sewage treatment facilities. Pipes from all the housing bring the waste to a small pond adjacent to the Kibbutz campus. After settling, the fluid is pumped to a large oxidation pond, which is full of turtles, and from there pumped to the Kibbutz irrigation water reservoir. The solids are removed by the municipality, as is the general garbage.

The social system of the Kibbutz has been the focus of nearly all studies on the Kibbutz, as Shur has documented³⁰.

Religion

It is well known that for Marx religion was merely, "the opium of the masses", and an impediment to social progress. The Kibbutzim—with the exception of 13 religious Kibbutzim in a separate federation—have abandoned orthodox Judaism. According to Darin-Drabkin, a Kibbutz author,

It could be maintained that socialism and co-operation form the ideological basis of the commune in modern times, just as religious ideas supplied its basis in antiquity and the middle ages. (Darin-Drabkin 1963:5)

Nonetheless, since Zionism entails an important ideological motivation, the Kibbutzim tends to display a strong attachment to Jewish identity and culture. Thus Bible stories form part of the education curriculum, Bar—and Batmitzvahs take place, and national religious holidays are celebrated, but in Kibbutz fashion. However in no respect can Jewish identity or culture be taken as the control mechanism, or dominant cultural determinant of Kibbutz society.

Kibbutz Democracy

Marx's scientific socialism consists of two inseparable components: first the abolishing of the classes within society and the organising of socialist production with egalitarian consumption; second, the battle against political and bureaucratic absolutism, with the democratisation of the political and social system.

Rosner gives the pre-requisites for direct-democracy to work as:

1. smallscale community,
2. awareness of all members,
3. nonformalised public opinion in operation,
4. reserves of potential cadres for committees,
5. equality between officials³¹.

These are all general features of a Kibbutz, in which participatory democracy has two formal expressions of which the first is a general assembly which takes place usually once a week, for members to debate and vote on issues. Very important or contentious issues may go to a secret ballot for a final decision. In the early days of the Kibbutz movements meetings were lively and well attended, now with most Kibbutzim running smoothly, and the attraction of television, the attendance rate is usually 10 to 30 per cent. The second component consists of numerous committees and a secretariat, which normally involve at least 50 per cent of the Kibbutz members. Democracy is maintained through members of the committees automatically standing down every one or two years. In policy making there has been a shift over the years from the general assembly to the committees.

Although each Kibbutz enjoys a degree of autonomy in determining its internal priorities, the Kibbutz federation to which it is affiliated, intervenes and supervises the overall budget. Norms are laid down for expenditure in each sector, which thus gives some standardization between, and a centralization of, the Kibbutzim²⁹.

A casual visitor will therefore not notice an appreciable difference between the food served on a

rich and poor Kibbutz; the wealth difference is usually reflected in the level of capital investment in the productive sector.

The Family

The Bourgeoisie has torn away from the family its sentimental veil and has reduced the family relation to a mere money matter. (Marx 1848:324)

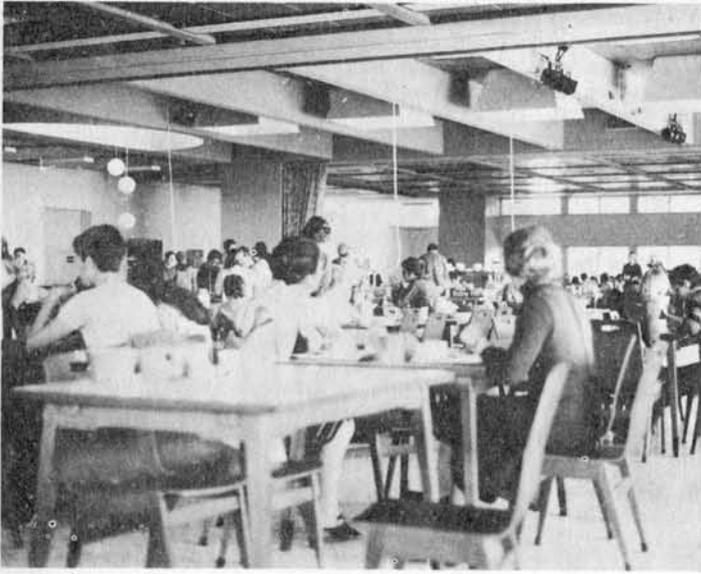
The first condition for the liberation of the wife is to bring the whole female sex back into public industry and this in turn demands the abolition of the monogamous family as the economic unit of society. (Engels 1846. Cited in Gerson 1978³²)

The Kibbutz pioneers were mainly young and unattached and had rejected much of the value system of their upbringing, including close family ties. From the beginning, various measures were introduced to curb any familistic tendencies; thus there was a strict ban on family members working in the same sector, and members were obliged at communal meals and social occasions to take the next vacant seat available. Meanwhile children slept away from the parents in the children's houses and 'couple behaviour' in public was frowned upon.³² According to Spiro such restrictions on behaviour led a number of academics to believe that the Kibbutz was a society in which "the family" had been dispensed with.³³

With the appearance of the second generation on the Kibbutz, many members started changing their social relationships. The nuclear family group started assembling for a tea-snack at 4 pm, the evening meal would also be eaten at home, and the apartment became the centre for entertainment. Recently the United Kibbutz Movement decided that children could now sleep in their parent's house. The Artzi federation, meanwhile, is still debating on the issue. A ballot held in Merchavia in 1981 indicated that 68 per cent of the members wanted children to sleep with their parents. If the vote is carried by the federation it will result in housing complications. With an empty children's house, and overcrowded—by western criteria—apartments.

Today, the Kibbutz represents family units working in economic and social co-operation, and compatible with Marxist principles there are no intra-family economic dependence ties. Indeed Blasi considers that the Kibbutz should more aptly be termed a collective village than a commune.¹⁶ Nonetheless the potential effect of large extended family groups acting as a power block within the democratic system of the Kibbutz is causing some concern. In fact direct democracy must continue to depend on the voluntary identification of family members with the larger collective aims and ideals.

Kibbutz authors such as Gerson still see the family as in a state of transition from that of an institution to that of a voluntary group established for purposes of companionship. Gerson completely rejects the word "natural" concerning the family, stating; "this is not an appropriate philosophical basis for an innovative social movement like the Kibbutz".⁸ Others see the technological society as a means of preventing familistic trends:



The dining room on Kibbutz Merchavia.

The attenuation of the collectivist restraints is partly counterbalanced by a considerable increase in the emphasis on rationalization and specialization of the economic structure of the Kibbutz. This accelerated process of rationalization counteracts the tendency to revert to a non-specialized and small-scale domestic pattern. (Garber-Talmon 1972).

Women are also to be liberated within the Kibbutz through the care of children being taken over by the community and through equal opportunity in work and community status. While the first generation was to achieve this liberation by a radical lifestyle change, the value system would then be transferred to subsequent generations through no sex distinction in education or upbringing.

Complete equality was never perfectly realised by the first generation, but as Tiger and Shepherd indicate, more than one-half of the women worked for a considerable time in a productive branch.³⁴ Today, with first, second and third generation members of the Kibbutz the situation has changed and Tiger and Shepherd have collected considerable statistics from the Kibbutz movements showing that:

1. Sexual division of labour, with males in production branches and females in the services, has reached 80 per cent of the maximum:
2. Women are less active in the general assembly, over-represented in social, educational, and cultural committees, and seriously under-represented in work, policy and security committees.
3. Women have problems sustaining all-female work groups and prefer mixed sex groups or male leadership:
4. Women fall behind in scholarly achievement and are less likely to pursue academic education:
5. Single women are expected to marry, and the main instigators of nuclear family structures are women.
6. All such trends have been voluntarily sought by women against the principles of their social background and ideology.

Tiger and Shepherd have become sociobiologists, and offer a tentative explanation of the data within that framework as does Barash.³⁵ According to Amir, such

conclusions have not been well received by the Kibbutz movement.³⁶ It is surely ironic that an almost model socialist microcosm should provide such strong data for sociobiology, a discipline which has come under fierce attack from the political left.³⁷

Spiro recently revisited the Kibbutz on which he based his arguments that the family was not universal. Nearly 30 years on he met the adults he had observed as children of 18 months to 5 years old in his earlier study. Naturally, he observed the changes as documented by Tiger and Shepherd. In his original notes on those children Spiro had recorded a number of important and significant differences between the sexes in both play and non-play even though no sex distinction was being made at that time by teachers and parents. He therefore concludes:

1. It is unlikely for those sex differences to have been culturally determined i.e. pre-cultural differences between the sexes were apparent.
2. Those childhood sex-differences seem to have anticipated some of the core features of the counter revolution, that is resurgence of the family, and work differentiation, nor did those features appear to be a reaction against the parents. Those findings are incomplete contrast to general opinion within the social sciences (where behavioural differences between the sexes are considered to be acquired through social/cultural patterns. Thus Spiro has had the intellectual patterns, to reverse his earlier beliefs that culture was the only determinant.³⁸ That is not to say that Spiro, or the sociobiologists, believe that the differences are purely genetic, as they could still be experimentally acquired.

In conclusion there is a strong correlation between the principles of scientific socialism as expounded by Marx, and elaborated upon by Lenin, and the functioning of a Kibbutz. The employment of outside wage labour is the most serious practical deviation from the theoretical principles—but that deviation is partly a consequence of Israel's unique security problem and the need for manpower in the military services.

With the exception of the bees and the nursery, which make no significant financial contribution, none of the productive branches in Merchavia can be said to be part of natural ecological processes. All the branches are more or less dependent on a flow of imported materials; and all the branches are heavily dependent on a high energy input, currently obtained from non-renewable resources. With the Plassim being the economic mainstay of the society, the future of Merchavia is clearly linked to the availability of petroleum.

The social system has undergone a number of changes, chiefly the resurgence of the family unit, and the voluntary choice of women not to express their full equality by fulfilling the same social and economic roles as men. The history of the Kibbutz movement has been that of economic growth, in parallel with such growth elsewhere in the industrialised world. The social system must be judged in that context, and can give no indication as to whether it can provide

satisfaction to its members in a non-growth or stable society. The considerable physical infrastructural growth, that has also taken place requires a large expenditure of materials, energy, and workforce to maintain its present condition. It can only be supported by a capital intensive industrial system.

The Kibbutz movement should be aware that the next fifty years will see changes probably as great as the last. It has entered the world industrial system, and unlike its Third World counterparts who have had no financial backing, has been able to compete successfully. The future of the Kibbutz will not be dependent on whether children sleep with their parents, or families eat in the dining room, which at present gives rise to major debates within the movement. The fate of the Kibbutz will be determined by the fate of industrialism; in any event the movement has still to reorganise, as E F Schumacher said, that "Economic growth is purely a quantitative concept and quite meaningless until defined in qualitative terms."

The ecological movement should be aware that a decentralized community of 500 people, egalitarian, voluntary with direct democracy and liberated women, will not be in harmony with its environment, unless it has an appropriate world view. The philosophical basis of the socialism of Marx and Lenin does not provide such a world view; indeed, both socialism and capitalism are merely different expressions of scientific materialism, the very anti-thesis of paradigms from which ecological cultures can arise.

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THE DEATH OF A CULTURE— THE LACANDONS GET RICH

On the walls of the Na-Bolom museum library in San Cristobal Las Casas in southern Mexico hangs a circle of straw hats, each made in a different village. The Indians of Chiapas were traditionally identifiable by the distinctive feathers and ribbons of the hats they made and wore. None of those hats are new though, for in 1950 the Pan-American Highway was opened and within a year the Indians had abandoned making their own and were buying them mass-produced from the north. The yellow circle on the library wall illustrates both the complexity and the fragility of the cultures of this ethnically diverse province, the remotest in Mexico. Until the coming of the Highway San Cristobal was 12 days ride from the nearest port and railway station at Tehuantepec. It is still a relatively quiet city, with its back streets unpaved and its colonial core intact and its market is still the economic and cultural centre of the mountainous state to which Indians come from miles around.

1950 was also the year that Frans and Gertrude Blom—a Danish archaeologist married to a Swiss botanist—settled in San Cristobal Las Casas and bought a derelict house they called Na-Bolom, a pun on Frans' nickname in the Tzotzil language. They set about turning it into a combination of house, museum and anthropological research centre and it has since become famous. The Bloms had been drawn to Chiapas because of certain Indian cultures that had survived almost intact. As it happened they were just in time to record the customs of many before they began to disintegrate, despite their protective efforts. Frans Blom died in 1963 but Gertrude has continued to record the lifestyles of the Indians while trying to reconcile their ancestral ways with modern Mexico and minimize the disruption.

One tribe in particular interested the Bloms—the Lacandons, whom they were the first Europeans to contact. Untouched by the con-

quistadors, before whom they retreated into impenetrable hill jungle, they had maintained not only their language and economy, but also, uniquely, much of the old Maya religion. Their rites were recognizably descended from those of the inhabitants of the great cities of Tukul or Palenque. Only in the last 30 years has contemporary Mexico, driven by the pressures of its expanding population and economy, shattered their stone-age idyll. Though there is no question of genocide on an Amazonian model, the effect on the Lacandon way of life is likely to be as devastating.

The name Las Casas commemorates the 16th century bishop of Victoria who fought to stop the exploitation and oppression of the Amerindians. His high-minded exhortations were, not surprisingly, ignored by the men on the spot, who enslaved those Amerindians who had not hidden themselves away. The Lacandons owed their survival partly to geographical factors—their mountainous jungle offered no mineral wealth to lure the avaricious—and partly to their small numbers, at present some 360. Except for the occasional epidemic of smallpox or 'flu spread by itinerant chicle-gatherers, the Lacandons were left to themselves until the mid 20th century. Their traditional pattern of settlement was based not on villages but clusters of two or three households, belonging to a patriarchal headman and his sons or sons-in-law, who together hunted and made ceremonial food-offerings to their gods. Scattered throughout the jungle, often miles apart, their lifestyle precluded any form of political development but enabled the Lacandons to live easily off the natural abundance of the forest and in apparent harmony with it. Wild turkey, parrot, deer, pheasant, peccaries, honey from wild but stingless bees, catches of crab and fish in the local lakes were supplemented by their cultivation of corn, beans, mangos and pineapples. Work was rigidly segregated on sexual lines, women doing all the housework, men taking care of the hunting, farming and fishing. The Lacandons were usually monogamous, the older men being the acknowledged leaders of each group.

The word Lacandon itself probably comes from the Spanish "los

del Acanton". The Lacandons, however, call themselves the "Hack Winik", the "real people", but Acanton means either stonemason or stone-worshipper, depending on the translator. It is their stone-fetishism that links the modern Lacandons most clearly with the Mayans, for they burn incense in clay bowls with modelled heads almost identical to specimens found in Maya ruins and caves in the Usumacinta valley. The modern Lacandons, though, attribute the building of these small cities to supernatural beings whom they worship—that is, they are unwittingly worshipping their own ancestors. Probably most of the Maya-speaking peoples of the forest, who had abandoned their cities long before the Spanish came, once had similar beliefs and used to burn incense in similar stone bowls or indulge in ritual drunkenness. They were conquered and converted, at least nominally, in the 16th and 17th centuries, only the northern Lacandons escaping by moving deeper into jungle. They are thus the last remnants of the ancient Mayan culture and religion.

The invasion of the Lacandons' jungle began in the late 1940s when thousands of Tzotzil, Chal and Tzeltal Indians entered the area, impelled by Mexico's incipient demographic explosion. (Its population has doubled in the last 25 years and is still increasing very fast.) As newcomers, they indulged in unnecessary burning of the jungle and pollution of the waters; worse, they were followed by crocodile-hunters and chicle-gatherers who cut tracks for their vehicles and airstrips for their aeroplanes. The Lacandons, unable to compete, responded at first by retreating deeper into the forest but by 1970 nearly a third of it had been burnt and they seemed doomed to extinction like so many other primitive peoples. In 1971, partly due to pressure from Gertrude Blom, a presidential decree granted them ownership of 614,321 hectares of land which was declared a national park. In 1975, however, the Lacandons were asked to affix their fingerprints to various contracts giving lumber (and subsequently oil) companies the rights to exploit their lands. The revenues accruing are divided, 70 per cent being taken by the government agency responsible for guiding the

economic development of indigenous groups, the remaining 30 per cent being distributed directly to the Lacandons, so making them the richest tribal group in central America.

Following the official policy of assimilation and acculturation, the Lacandons have been moved from their former isolated homes into three villages, each with its own infirmary, shop and radio. Corrugated metal roofs are replacing traditional thatch and there are even plans to build a small Zocalo—the main plaza every Mexican village or town likes to boast—in each. By becoming concentrated in villages, the Lacandons have become accessible to the outer world. Tourists now come to visit them on their way to see the ruins and the Lacandons obligingly sell them souvenirs. Instead of farming themselves, they now pay their poorer Tzeltal neighbours to till their fields; instead of going fishing, they buy tinned sardines in the local shop.

Initially, the Lacandons seemed to balance old and new quite well. They bought items like steel knives or axes and rubber boots that, like the introduction of basic medical care, could be applied to their existing life-style. Thus traditional medicine co-existed with the new infirmaries. But the glamour of the new has proved too strong for the affluent younger generation. Some men are now cutting their hair and buying Levi jeans, some girls taking to western fashions and make-up—not things anthropologists condemn in themselves but indicative of the breakdown of tradition. Some now own cars as well as cassette-players and drive in on the new roads to San Cristobal to sample the bright lights or visit Na-Bolom. There is a marked difference between the older and younger generations in their attitudes to such changes. Chan K'in, a magnificently patriarchal figure who has emerged as one of the most effective Lacandon leaders in the fight to defend their rights, is pessimistic about the impact of recent developments. His son views this acculturation with enthusiasm rather than distrust. In his generation, Lacandon culture seems likely to lose most of its characteristics.

The process is being accompanied by massive deforestation. The timber companies are making no real efforts to replant after felling and this practice, in an area of steep hills and tropical rainstorms, must

lead inevitably to soil-erosion. As Gertrude Blom points out, the jungle is not virgin forest, the oldest trees dating back less than a thousand years, and it seems likely that the Mayan cities had to be abandoned because of soil exhaustion. Despite the efforts of Na-Bolom, which distributes over 20,000 saplings a year to the Indians, the process of soil degradation seems likely to repeat itself, that is unless the relevant governments take the problem more seriously.

The Lacandons, with their rags to riches story, are better off than most of the indigenous peoples throughout central America, especially those in neighbouring Guatemala. Everywhere Indians who have managed to maintain the integrity of their language, lifestyles and—beneath a transparent veneer of Catholicism—much of their pre-Colombian animism, are being overwhelmed by the sudden impact of North American Culture. Though individual "gringos" may be despised, nearly all the countries of the region are united in their pursuit of the American dream in a Spanish-speaking form. The striving after western culture affects all aspects of the Indians' lives, from their market-customs to their religion. Traditionally, the Indians would walk long distances to their markets not primarily to profit by selling their textiles or vegetables but to exchange them for other produce, if available. If they had sold nothing they were content to return home with their goods. The modernization of Mexico has led to commercialization of those markets.

In Mexico, intent on its oil boom, the non-Spanish speaker is despised by urban bourgeoisie and workers alike; similarly in next door Guatemala, it is government policy to teach only in Spanish, thus ensuring the demise of native languages. Even where lip service is paid to the ideals of protecting ethnic minorities and the environment which supports them, economic and cultural forces are bound to prove too strong. Inevitably age old cultures of the Indians, such as the Lacandons, will be destroyed, and for what?

Nigel Rodgers

Footnote

My thanks are due to the people at Na-Bolom who allowed me to use their library and answered my queries. Part of the information on the Lacandons themselves comes from an article by Didier Boremanse in the *Geographical Magazine*, January 1981.

FIGHTING TO SAVE THE WILDLIFE OF STRANGFORD LOUGH

In Ulster the belief that the wealth of Strangford's unique bird, animal, fish and marine life would suffer a severe blow if a tidal-electric barrage across the Narrows at Killyclief Point were to become a reality makes grim news for naturalists and ecologists. Priceless assets are involved here which once destroyed can never be replaced. So if technology is seen to make its full impact we might find that Strangford Lough has become a type of dodo territory.

This would be a bizarre fate for a region which is recognised as one of the best wildlife reserves in the British Isles, and is also rated in top places as the finest wildfowl refuge of its kind in Western Europe. For these reasons it is clear why associations such as the National Trust, the Ulster Trust for Nature Conservation, the Royal Society for the Protection of Birds and the Ulster Society for the Preservation of the Countryside believe that the overall effects of a tidal power project would bring widespread destruction to the Strangford environment.

Fortunately in its 1981 report on the Strangford barrage the Northern Ireland Economic Council admits that much more detailed biological information collected over a period of time will be required before observers can arrive at final conclusions relating to the full effects of environmental damage. It is expected that the £334 million plus scheme could begin in 1984, and that the first production of electricity would occur in 1989. On this basis the Government's advisory body the Economic Council estimates that the power output would provide a tenth of the energy needs in the Province. Assessors on the Economic Council are aware of how substantial mudflat and shoreline areas right round Strangford would no longer be exposed at low tide if a barrage is built. A permanent loss of such mudflats, shingle and seaweed-covered rocks could therefore be envisaged as robbing the thousands of ducks and brent geese of their winter food supplies. Observers who have watched hosts of these birds feeding within the Newtownards, Greyabbey and Comber areas cannot but doubt that the many

thousands of black, white and grey brents which come there each year from the high Arctic areas of Canada and north-west Greenland would largely disappear.

Before the eel grass had been affected the numbers of brent geese coming to Strangford stood at the 13,000 mark or thereabouts, but this figure then dwindled to a few hundred birds. However, once the eel grass began to recover in the mid-nineteen fifties the geese gradually increased in flock size to reach their present status of some 10,000 to 12,000 specimens. Now, it seems certain that if the mudflats are put permanently under water the majority of brent geese will be eliminated. Also affected would be the feral populations of Canada geese, barnacle and greylag which breed on islands in the lough.

Apart from these species numerous kinds of waders such as the curlew, dunlin, redshank, lapwing, oyster catcher, ringed plover, golden plover, knot, greenshank, heron, turnstone, bar-tailed godwit and black-tailed godwit depend on the mud, sand and seaweed for food such as lugworms, cockles, mussels, sandhoppers, sea snails and various types of marine worms, etc. Notable too are the different duck species including wigeon, pintail, shelduck, mallard, eider, teal, scaup and golden-eye together with the whooper swans from Iceland or Siberia and numbers of mute swans. As many as 210 whooper swans have been observed on the Maltings near Newtownards.

When ornithologists hear the bugle-like calls of the whoopers, the whistling of wigeon, bubbling curlew notes, the guttural sounds of geese, lapwing call notes and the piping of oyster catchers Strangford Lough becomes a place of grandeur. Life abounds there with a richness unique in the United Kingdom, and it serves to illustrate the crucial need to preserve our ever diminishing wildlife habitats. At the head of the lough the mud is estimated to attract 70,000 birds including geese, swans, ducks and waders.

As pointed out by the Economic Council the Strangford Lough region forms one of those all-important conservation areas as defined by the International Waterfowl Research Bureau. Under such conditions estuaries are of major importance if the winter wader population in marine areas numbers

20,000 birds. When taken at this rate Strangford with its 40,000 or more waders is obviously well out in front. Moreover, the region attracts approximately 40 per cent of the world's population of the pale-breasted brent goose.

Any tampering with the inflow of water entering Strangford could be expected to eliminate or drastically affect the various fish species, while also affected would be the 200 or more common seals which frequent the local sandbanks and beaches. In fact, it is acknowledged that the seals would probably disappear, and fish such as the six-foot tope, skate, ray, oyster, plaice and sole which breed in the lough might likewise be extinguished or greatly reduced in numbers. Much depends here on the changes caused by the sluice gates and the turbines of the barrage in hindering water flow and restricting the supply of marine plankton upon which many sea creatures feed.

Dr. P. Boaden, director of Queen's University marine biology station at Portaferry at the mouth of Strangford Lough is certain that the entire balance of nature in the waterway will be at risk if the tidal electric power system goes ahead as planned. He refers to the different currents entering the lough from the tropics in summer, and others coming from the Arctic regions in winter. These warm and cold water flows provide the survival conditions for an unusual display of sea creatures.

The varying temperature levels make possible the growth of small tropical corals and a species of starfish common to the waters of the Arctic. Altogether some 1,500 marine animals are known to exist in the lough, among these we find 20 species of starfish, a small octopus, various sponges, sea anemones and the interesting soft coral known as dead man's fingers. Almost 100 fish species have been recorded from Strangford, and it is believed that a reduced tidal flow caused by the barrage would bring wholesale destruction to most of these animal communities.

What will happen is that many changes will occur involving alterations in water temperature, lower salinity levels, pollution effects, a reduction in the density of sunlight reaching into deeper levels, chemical upsets in water composition and a sharp decrease in the free-floating microscopic organisms which serve as food for small and large fish alike. Also to be considered are the eggs

and young of many sea denizens which form part of the plankton layers at the sea's surface. Tiny plants and animals comprise the plankton population in a balance of nature that could readily be overturned by changes in the current flows entering the lough.

It seems inevitable that such changes resulting from tidal electric power will wipe out Strangford's thriving and ever-expanding oyster farming business. This is because these shellfish require continuous supplies of fresh pollution-free oceanic water from which they filter microscopic organisms. Under such conditions any hint of silting or contamination would destroy the beds which at present are producing more than 70,000 marketable oysters each year. The output in 1985 is expected by Cuan Sea Fisheries to reach one and a half million oysters, with most of these going to the British mainland, and others to the continent.

Fish of another sort as food for summer bird visitors such as the common tern, Arctic tern and Sandwich tern could likewise be very much affected by a barrage system. If stocks of this nature became greatly reduced the terns or sea swallows might possibly disappear from Strangford, for their young ones depend on plentiful supplies of sand eels, fry and smaller fish specimens. Needful again would be sufficient food for the common or harbour seals which eat various types of fish.

Even though winter bird counts on Strangford Lough between 1975 and 1980 have shown that maximum numbers vary somewhat from year to year the loss of mudflats caused by a permanent water cover would not provide enough food for the many thousands of wildfowl which come in any given year to Strangford. From this viewpoint conservationists are unlikely to be swayed by the planning idea that a tidal-electric barrage would blend in well enough with local landscape forms, nor would they on balance care much for its supposed potential as a means of increasing tourism and giving greater recreational value. Anything gained therefore would not compensate for the loss of wildlife habitats which could never be replaced.

Cleeland Bean



Books

Darwin outpaced

THE NEW EVOLUTIONARY TIME-TABLE by Stephen M. Stanley. Basic Books, New York £9.50.

Given that the world appears to operate on reaction-counterreaction, it is perhaps not surprising that the United States should be throwing up the latest, challenging ideas about evolution, while bible-thumping fundamentalist attitudes over 'Creation' still hold sway. Indeed Steven M. Stanley's book is clearly meant to serve a double purpose — to confound for ever the notion of a seven-day miracle conjured by God, with man of necessity the pinnacle of life on earth; and equally, to guide the reader to the new interpretations of evolution. Without question, Stanley, who is professor of paleobiology at Johns Hopkins University, has written an enthralling book that must appeal to biologists and non-scientists alike. What I particularly like is that he answers puzzles that have obviously wracked the minds of biologists for a century or more. No more is it a problem that the fossil record seems to be so perversely inadequate; nor does speciation — that curious process by which new specimens arise — seem such a mystery. Like many convincing theories, the new ideas on evolution are breathtakingly simple.

In Darwin's time, fossils, while they gave some credence to notions of evolution and to the existence in the past of more primitive forms of life, could equally indicate that the earth had undergone a series of cataclysmic events which had wiped out a handful here and there of God's creatures. Darwin himself was somewhat embarrassed by the paucity of the fossil record, realising that the 'missing links' could by their very non-appearance support the idea of a single act of creation. Thus the missing could be deemed missing because they never were. As for speciation, the hallmarks of Darwin's theory were that one species

transformed into another by a slow, inexorable process. Thus the new species was in a sense recognisable as such only when its progenitor had lost its competitive edge and vanished. Speciation for Darwin and his followers was a kind of blurred process, with the entire spectrum of species moving in a unified fashion towards greater efficiency and perfection. Darwin's evolution therefore mirrored in many respects the neo-Platonic idea of the 'Great Chain of Being' in which there were no holes in the scale of creation — angels, if you like, one step up from mankind.

Well, all that has gone, blown away with the fresh ideas of paleobiologists, who far from finding the fossil record inadequate, find it extremely illuminating and full of evidence on the mechanism of evolution for those who care to look. And having been despised for decades by those reductionists who consider that anything bigger than a cell is hardly worth the study, the paleobiologists have now revenged themselves by making the molecular biologists and geneticists have to adapt their ideas on the genetic basis of evolution to the new findings. Like all revolutions in thought, the groundwork was already done, and Stanley gives credit where it is due, singling out for example such great biologists as Ernst Mayr from Harvard, who has been convinced for decades that one place to look for the mechanism of evolution is among a small population that has become isolated geographically from the main body of its species. At the same time Stanley indicates where Darwin went wrong, and he in no way belittles him by so doing. Darwin, of course, was hampered by having to make do with the idea of blending inheritance. The irony is that Mendel sent Darwin the results of his famous experiments indicating particulate inheritance in the pea; but Darwin left the package unopened on his desk.

'Nature does not make jumps', claimed Darwin in *The Origin of Species*, and few disputed the notion. Indeed the new discipline of genetics emerging at the beginning of the 20th century appeared to support Darwin by its demonstration of point mutations. As for those intrepid biologists who suggested quantum leaps in evolution they for the most part had scorn poured upon them.

Darwin himself was well aware that evolution needed time, hence his excitement at Lyell's *Principles of Geology*. But if he had thought about it more he might have come to realise that his kind of

gradualistic evolution could never have taken place within the limited time available — and the age of the earth was then considered to be much shorter than has been demonstrated by modern assessments based on radioactive measurements. The point Stanley makes is that even with the extended time now available for evolution, the process that has led to the emergence of mammals and birds could never have taken place by gradualism alone. Furthermore the fossil record indicates relative immutability of species for thousands of generations, encompassing millions of years, until suddenly the species vanishes and is replaced by entirely new forms — with few missing links. Punctationalism — the notion of sudden, sharp change — has thus come to replace gradualism. And according to the new theories of evolution, species, once born, do not necessarily remain in fine tune with their environment; they can in fact get out of adjustment until their very survival is threatened. The opportunity then exists for a new wave of adaptive radiations of species until a new settling down period is attained.

Places where new environments have become isolated off from neighbouring environments, through volcanism for example, or a pinching off of a lake, are likely places to find examples of a sudden adaptive radiation of species. The Galapagos Islands and Hawaii are classic situations, and Stanley gives evidence of others, less known, but equally compelling for his argument. He has a brief chapter on human evolution, and suggests that a number of different hominids were contemporary and possibly rivals. Neanderthal man may well have been just one side branch of the evolutionary chain, with *Homo sapiens* another. It is quite likely too that modern man had little compunction in wiping out his supposedly less intelligent and more brawny rival. Man thus emerged as a real opportunist and nothing in his present character suggests otherwise.

Sex too, has always been a problem to explain away with the old gradualistic theories of evolution. With punctualism sex takes on a new meaning, since among small populations provided with sudden opportunities to expand their numbers, the sharing and exchange of genes can bring about quick transformations of form. Here modern genetics, with its evidence of regulatory genes that govern the activity of large segments of structural genes,

indicates a possible mechanism by which species can change, while still sharing a substantial proportion of their genetic material with closely related species.

There is clearly much tidying up to be done before the punctuational model has outmoded Darwin's gradualism. Stanley's book certainly makes a convincing start.

P.P. Bunyard

A vital Countryside

NATIONAL PARKS: CONSERVATION OR COSMETICS? Ann and Malcolm MacEwen. George Allen & Unwin. £8.50.

THE ECONOMY OF RURAL COMMUNITIES IN THE NATIONAL PARKS OF ENGLAND AND WALES. Research Report No. 47. Tourism and Recreation Research Unit. Available from Tourism and Recreation Research Unit, Chisholm House, Department of Geography, University of Edinburgh. £8.00 (plus £2.00 postage)

When it became clear that the Second World War would be won by the Allies, people began to dream about and to plan for the new world they would create when hostilities ceased. That new world would be one from which the evils of the old, pre-war world would be banished for ever. There would be homes for all, work for all, decent, civilized standards of care for the young, the old, the weak. There would be education and, in the same spirit, there would be access for everyone to the grandeurs of the British countryside. For too many centuries, the rural Britain for which so many believed they were fighting had been the fenced, defended, exclusive preserve of landowners. Everyone was optimistic, even civil servants — and the wartime civil service was staffed to a large extent by outsiders, rather than the old-time professionals. People really believed that the bad, old ways could be abolished by a few bold legislative strokes. So far as access to the countryside was concerned the legislation was the National Parks and Access to the Countryside Act, 1949. With its authority, ten national parks were designated between 1951 and 1957 in England and Wales — although not in Scotland. Today the parks occupy nine per cent of the total land area of the two countries.

They are in trouble. A full generation after they opened their gates to the first visitors, questions are being asked about the extent to which they have fulfilled the hopes of their founders and about the extent to which they are likely to continue to do so. These two books both deal, then,

with what has become a controversy.

They begin, both of them, with fairly detailed accounts of the history of the "national park" concept. This is necessary, for contemporary problems are rooted in the past. The parks were modelled to some extent on those in the United States, but the comparison could not be carried far. Britain has no "wild" land. Almost all of it has been occupied for centuries, has been farmed, its minerals mined, and where the landscape is open and untended as often as not it is merely neglected, its former inhabitants having departed. The British parks do not, cannot, conform to the accepted international definition of a national park, which requires that the land be unaffected by human activity. Indeed, there has been talk of changing the name, but since the British adopted the term before the IUCN defined it, and since no alternative term seems to even remotely suit, British "national parks" remain "national parks". They are different from those elsewhere in the world, that is all.

They are not unique. Much of the argument about their conservation seems to assume that they have some special ecological importance. They do not, although there are areas of ecological interest within them. They are nothing more than uplands, of a type that is very common in the temperate latitudes. The MacEwens complain that the management national parks has concentrated too closely on their scenic rather than their ecological value — the complaint is implied in their title — but this is to miss the point. They have been designated because they are scenically handsome, extensive and more or less open, and so appear to offer facilities to visitors. They are in the uplands because it is only in the uplands that areas of open land are to be found. Ironically, what is unique scenically in the British landscape is to be found in the farmed lowlands.

This fact demonstrates a weakness in the whole "national park" concept, which the MacEwens describe well. By drawing a line on a map, the impression is given that differences exist in the quality of the landscape to either side of the border. The protection of the park may be achieved at the price of neglecting what is "non-park". This affects most seriously the area immediately bordering parks, to which activities may be directed that otherwise, and perhaps less intrusively, would be sited in the parks themselves.

In turn, this illustrates the central problem. The British parks are places where people live and therefore where people must engage in economic activity. The parks are, and must be, farmed. Being upland, however, their land is often poor and difficult to farm, but it may be suitable for af-

forestation. Britain is notoriously short of forest: if that shortage is to be remedied it is in the uplands that the trees must be planted. At the same time, because of the geology that gives them their character, often the parks contain minerals that may be needed and so must be mined. The Army requires open space in which to train troops, and where else is it to find such a space if the parks are denied to it? The sad fact is that Britain is crowded and that all of its land area is under pressure.

Perhaps improvements could be made. The MacEwens join in the general conservationist assault on the Ministry of Agriculture, Fisheries and Food, which in their view finances the desecration of all that they hold most dear, but they also point out that the parks have suffered and continue to suffer from too many authorities whose responsibilities overlap and amongst whom communication is primitive to say the least. The park administrators proper are under-financed and under-powered, and while the optimism of the 1940s allowed the Act to be passed it did not go so far as to demand that the land in the parks be taken into public ownership. Unlike the American parks, most of the land in the British parks is owned privately.

The Edinburgh Unit does not differ seriously in its conclusions, but its approach is made from another angle. It is concerned with that other objective of park policy: the enhancement of living standards for people who reside in the parks. There, very clearly, the dream has not come true. Economically the parks are not different from other remote rural areas and they have suffered seriously from depopulation. Being remote, they have not benefitted from the move of population out of the cities that has been evident in recent years. Life in them is hard and employment prospects are few.

No one suggests seriously that we forget the entire operation and abandon our national parks — although such a suggestion could be supported, at least as a long term objective. More immediately, agricultural support might be modified in ways the EEC has always intended, so it is used to support incomes in the more difficult farming areas, rather than to attempt to make farms profitable by changing radically the farming methods that are used. More encouragement — which means money — might be given to establish industries to provide employment within the parks, in ways that do not detract from the scenic value. Better facilities for visitors, especially on farms, would be appropriate. Eventually, though, the change that must come will affect the entire British countryside, not only the

parks. All of us must learn to appreciate the value of our rural landscapes. Today it is fashionable to berate the farmer and forester for the philistinism that is supposed to inform them. Real progress will come only when town-based conservationists acquire a genuine understanding of and sympathy for those who must earn a living in the countryside, so that a rural-urban partnership can be forged.

Both of these books make a valuable contribution to the debate and I recommend them warmly.

Michael Allaby

Damning Evidence

MAJOR DAMS—A SECOND LOOK, eds. L.T. Sharma and Ravi Sharma. Gandhi Peace Foundation, 223 Deen Dayal Upadhyaya Marg, New Delhi 110002, India. 12.50 rupees.

It could be said that largescale hydroelectric dams are to the Third World what nuclear power stations are to the West. The subject of bitter controversy, they have both become central to the debate over the direction development and industrialisation is taking us. Nor does the similarity end there—for the electricity boards promoting dams have shown themselves as adept at political chicanery as the West's own nuclear lobby. Opponents of dams, like opponents of nuclear power stations, are branded as anti-deluvian troublemakers. The disastrous environmental and social consequences of so many hydroelectric schemes, like those of nuclear power stations, are brushed aside or dismissed as 'pitfalls' which can easily be avoided with a little judicious planning. And, just as with the case for the claimed 'economic' benefits of nuclear energy, those facts which do not support the building of dams are either suppressed or substituted by more 'suitable' figures, conjured up it often seems from nowhere.

In short, both Third World and Western electricity generating boards would seem to be beset by the same 'fortress mentality'—a mentality which, at times, reaches absurd, even puerile, levels. Thus, in order to disrupt a public meeting of opponents to its Silent Valley hydroelectric scheme, India's Kerala State electricity board not only obtained a ban on public speaking but also switched off all the power to the State capital, Trivandrum, on the night of the meeting.

Yet, however puerile such attempts at gagging opposition might seem, the 'fortress mentality' behind them appears to be the only logical explanation for the Third World's

continuing commitment to build yet more large-scale dams. How else, after all, is it possible to reconcile that commitment with the record of almost unmitigated social and ecological disaster which has accompanied the building of large-scale dams in the tropics?

It is the Indian side of that record which is the subject of *Major Dams—A Second Look*. The book arose out of a seminar, organised by the Totgar's Cooperative Sale Society, to consider the implications of damming the Rivers Kali, Bedti, Aghanashini and Sharavati in North Kanara District, Karnataka State. That scheme, involving seven major dams, is taken as a case study for the book, with additional material from other Indian examples being used to give the broader picture.

There are more than 1,500 dams in India classified as large and, almost without exception, they have been dogged by a familiar catalogue of problems. Deforestation of catchment areas has brought erosion and the consequent silting up of reservoirs with the siltation rate frequently being between three and ten times that predicted. The reduced flow of rivers has led to the encroachment of sea water in lower reaches and, hence, to salinisation of good agricultural land. Earthquakes and flash floods have become more frequent and the resettlement of those whose villages have been flooded has rarely proved a social success. Inevitably, too, there have been increases in the incidence of waterborne diseases. Indeed, as Vijay Paranjpye points out in his paper, "It is about time the initial enthusiasm and euphoria gets mellowed and we pause and ponder about the justification of large dams."

Already the first stages of the North Kanara District hydroelectric scheme have brought heady problems for the engineers and planners building the dams. Thus the rock bed on which the Kali Stage 1 dam is being built has been found to be severely fractured, costs have doubled and few expect the final price-tag to be less than three times that estimated. Those who have been resettled have been given hilly, unirrigated land in exchange for their plots in the now flooded, but previously irrigated, lowlands. Worse still, the land designed for resettlement was stripped bare of all trees before it was handed over to the peasant settlers. Today, the clearfelled land has succumbed to the weed, *Eupatorium glandulosum*, which is throttling all regrowth, whilst still other areas have been eroded beyond recovery. Indeed, according to Dr. Madhav Gadgil of the Bangalore-based Indian Institute of Sciences, by 1979 the resettlement land was already 'a desert unfit for cultivation for all time.'

Although, cost-benefit analyses are required before the construction of a dam, their sole purpose is, according to Vijay Paranjpye, "to get the approval of the Planning Commission and obtain the necessary financial sanction." No account is taken in the cost-benefit analyses of the value of any timber submerged nor of the agricultural land which is flooded; and, in the case of the Bedti dam, "estimates of compensation and rehabilitation costs given by the Mysore Power Corporation to the Planning Commission for scrutiny were so grossly wrong and misleading that one wonders about the very intentions of the corporation." After recalculating the figures submitted by the Mysore Power Corporation—and taking into account those 'costs' the Corporation had ignored—Paranjpye concludes that "even if the most obvious and direct costs of the project are taken into account, the project is non-viable." Such 'fudging' of the figures would seem to be fairly widespread; recalculating the costs of the Bhima Project in Maharashtra, for example, brought the cost-benefit ratio down from 1:6.29 to as low as 1:0.46. It is difficult to explain such vast differences in the figures through the sort of acceptable mistakes that might be made in any complicated calculation, and one is forced to conclude that the reason for them is somewhat more sinister.

Major Dams—A Second Look provides a highly valuable overview of the problems that have been encountered by large-scale dams and brings the current direction of development sharply into question. If I have one criticism of the book, it is that it is apallingly referenced—particularly annoying in this instance as many of the references quoted are well worth following up. Nonetheless this is a small criticism—and one that can easily be rectified at the second printing the book so richly deserves.

Nicholas Hildyard.

City under the Microscope

THE ECOLOGY OF A CITY AND ITS PEOPLE. The case of Hong Kong, by Stephen Boyden, Sheelagh Millar, Ken Newcombe and Beverley O'Neill. Australian National University Press.

Hong Kong, a modern city-state, is a city of paradoxes and a potent symbol of the precariousness of modern industrial societies. Less than one hundred and thirty years ago Hong Kong was a sparse and scattered community of a few

hundred farming and fishing people: in 1980, by contrast, it housed a population of over 5 million. The life expectancy of the population is now similar to that of modern European city-dwellers and 90 per cent of its households have television sets - yet in the homes of half the population the amount of free space per head is less than 2 square metres.

This extraordinary book looks at Hong Kong through the multi-faceted lens of urban ecology, which is itself still undergoing rapid evolution. The idea of carrying out an ecological study of Hong Kong emerged ten years ago, at a conference then organised by the Commonwealth Human Ecology Council, and in late 1974 the Hong Kong Human Ecology Programme was adopted by UNESCO as the first urban ecology pilot project within its Man and the Biosphere Programme. A particular attraction was the fact that Hong Kong is a discrete economic, geographical, demographic and political entity, with excellent records available on inputs, throughout and outputs of people, materials and energy.

In fact, the main quibble with the book's approach stems from the fact that it took six years from the completion of the field work to get the book out - and much of the statistical information used dates from 1971, since the Colony's population has increased by more than 25 per cent. That said, however, this book is required reading - and it is a pleasure to read, being almost entirely free of unnecessary jargon.

The 'economic miracle' achieved in Hong Kong, under an alien government and a laissez-faire economic policy, has involved the ever-increasing use of machines powered by exosomatic energy, ever-increasing levels of environmental pollution, and a rapid displacement of natural systems by concrete. The extraordinary thing, given the emphasis on living in harmony with nature in the culture of the Chinese who make up more than 98 per cent of the Colony's population, is that no attempt has been made to preserve substantial areas of parkland within the city - and the most vociferous conservationists have come from the very small European minority. The explanation offered for this particular paradox is that the Chinese idea of harmony with nature has more to do with adapting to conditions which are outside human control than with nature conservation as understood in the West.

The facts and figures given for Hong Kong's 'metabolism' are quite remarkable: the total consumption of oxygen each day is estimated at 27,000 tonnes, only 3,000 of which are used by people, the rest being

consumed by machines. As for gaseous outputs, some 26,500 tonnes of carbon dioxide, 208 tonnes of carbon monoxide, 110 tonnes of nitrogen oxides and 29 tonnes of hydrocarbons were being emitted every day during the 1970s. Well over a million tonnes of fresh water went into system every day, and over 6,000 tonnes of human and industrial sewage solids ended up in the harbour over the same period.

The authors distinguish four main phases in the development of human society: the primeval, early farming, early urban and modern industrial phases. They point out that while hominids have been around for at least 80,000 generations and *Homo sapiens* for more than 10,000, the Industrial Revolution happened less than 6 generations ago. The environmental and resource constraints identified in their study suggest the need for a transition to a fifth phase, involving the evolution of a 'multi-focal' society, which they equate with the decentralised society painted in *A Blueprint for Survival*. Altogether, a fascinating book and a pioneering attempt to apply ecological principles to the analysis of urban systems.

John Elkington.

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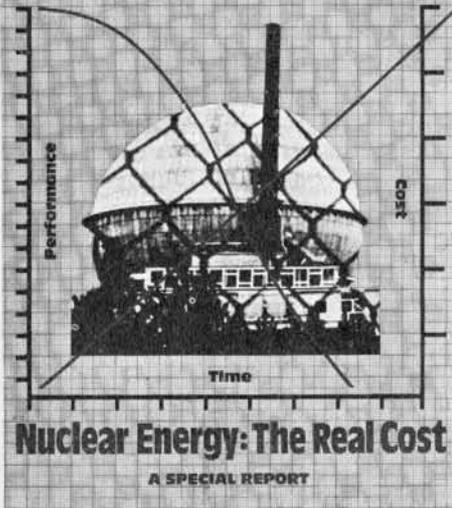
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After Summer

After summer's easy fruits were coldly blown away,
Anxiety sired ritual out of reason.
Our terrors and desires we named as gods
And called on them to join us as we stalked
The stealthy flesh which hunted us,
Who rivalled wolf and boar in strength and cunning.
The dark copse force young growth to seek the light
And gave us long straight staves of ash and thorn.
Bryony choked the nut-wood giving natures healing twist
For incantations of sweet roots to fight our wounds.
Oak and sycamore glowed sacrificial red.
By fires of thanks and fires of need,
Robed in our food's hides,
We out-stared frost with pride.

Now, the pride of summer quashed in barn and silo,
The butcher safely tests his hooks and knives.
Cattle, fat on processed feed,
Born trapped, bred irresolute, castrated, dehorned,
Accept the captive bolt.
For pale men from the north have rubbed away
The splendour of all the great uncertainties but one.
Shrunk by science, the earth is our arena.
We watch, detached, the facts decay
Under the ointment of amusement.
We pray for things to come to pass,
Whose coming is ensured by chemists' skill,
Still kneeling to the established corpse.

Henry Israel



Professor J.W. Jeffery writes:

I would not normally wish to comment on a review of a publication for which I was at any rate partly responsible, but Dr. Jones' three pages in *Atom* 306, April 1982 on *Nuclear Energy: the Real Costs*¹ is not so much a review as an attempted refutation. He himself says at the end of his 'review' that he has 'sought to point out' that Sir Kelvin Spencer's committee have presented 'an incomplete and misleading analysis which, regrettably, is of little value to anyone wishing to have a better understanding of the nuclear costs question', and that 'sufficient has been said (by Dr Jones) to show that these (calculations) cannot be regarded as reliable and the conclusions based on them therefore fall'.

Since most of the calculations criticised by DR Jones derive from my paper in *Energy Policy*² (the draft of which was familiar to him, although it had not been published when he wrote the 'review') I hope you will allow me to comment on some of the points he makes.

Everyone would agree that the future demand for electricity is a major factor in any decision on the future of nuclear power. As a factor to be considered I would put it second only to the dangerous character of nuclear technology (both intrinsically and as leading to the proliferation of nuclear weapons). However, the *CSENE Report*¹ was primarily concerned with the economics of nuclear power in the period up to the end of the century, and the Conclusion 11.5 - that electricity conservation should 'reduce by at least a factor of two the electricity generating requirements in this country' is consistent with a doubling of the actual end use of electricity for its essential purposes. The

In response to the *CSENE Report*, Dr P.M.S. Jones, of the UKEA wrote a lengthy review which appeared in *Atom* p. 89 April 1982. Professor Jeffery, who acted as a consultant for CSENE and whose, addition to the *CSENE Report* appeared in *The Ecologist* p. 80 March/April 1982 has now replied to Dr Jones's review in the form of a letter to *Atom*. *Atom* will be publishing that letter in the near future. Meanwhile we also produce here a copy of the letter together with a further comment by Dr Jones and a few final remarks by Professor Jeffery. With the Sizewell B public inquiry imminent we believe it of the utmost importance that the public should have as much perception as possible of the vital issues at stake. The economic argument, as we pointed out in the *CSENE Report*, is just one of a whole series of contentious issues.

possibilities are exemplified month after month in *Energy Manager*. An example from the April 1982 issue is NE1 Parsons Heaton works in Newcastle. New lighting and controls are estimated to have reduced the lighting consumption on a yearly basis from 473,700 kWh to 118,400 kWh - a saving of 75 per cent with an increase in illuminance of from 100 -300 per cent. The efficiency of electric motors is admitted to be very poor in general and will allow improvements of the order of 50 per cent. As the wasteful use of electrical resistance heating is phased out, the capacity will be available for new uses.

It is not necessary to postulate a halving of electricity production (even with a doubling of end-use consumption). The lower end of the CEBG's latest forecasts is sufficient to sustain the CSENE analysis. Since these CEBG forecasts have been coming down rapidly and steadily for at least the last 5 years (see my article in *The Ecologist*³) and show no sign of slowing up, let alone levelling off, the lower bound this year is likely to be the upper bound next.

Dr. Jones agrees with the results of calculations on inflation corrected capital costs with 5 per cent interest rate, which show Magnox electricity dearer than coal, but claims that the result 'says nothing about whether investment in coal as opposed to Magnox would have proved cheaper, it offers no guidance on future investment and it says nothing about national resource costs'. This sweeping judgement makes nonsense of the CEBG's evidence to the Select Committee on Energy (Report on the New Nuclear Power Programme - Vol II, p.56) where the economics of nuclear power were based on an NEC calculation which produced figures for future stations at constant prices and 5 per cent interest rate, in exactly the same way as we have done for

past stations. It is difficult to see how our calculations can be without significance unless the CEBG's calculations are also useless a guide to future investment.

Providing the assumptions are clearly stated (and compression in the *CSENE Report* may make it necessary to refer to the *Energy Policy* paper²) the method is valid within its limits equally for past and future calculations.

Dr. Jones complains that the figures for the NEC turnround from -£25/kW pa to +£31/kW pa require coal costs to remain constant, not just to 1986/7 but for the whole lifetime of the station. This is true, but he knows that this was just an illustrative example, which kept the far more unreasonable nuclear costs the same as for the CEBG's calculations. When a realistic NEC calculation was attempted (Figure 5 in the paper²) the -£25/kW pa produced by CEBG's assumptions turned round to +£88/kW pa, although this case did include a 2 per cent pa increase in coal costs from 1986/7 to the end of the century.

This trivial example of the 'errors and misconceptions' in the *CSENE Report*'s 'set of assumptions alternative to those of the CEBG' is given full treatment, while the main alternative is not mentioned. The most significant CEBG assumption was that coal costs would increase in real terms by 36 per cent between 1980 and 1986/7, and it made this assumption at the same time as the 'understanding' with NCB was entered into which, in present circumstances practically guarantees that there would be zero real increase in coal prices for the next five years. I believe Dr Jones does not dispute that a large increase in coal prices over the construction period (or an even larger increase following commissioning - see Figure 3 of my paper²) is required, in order that the NEC

calculation should produce a clear negative result which would enable the CEBG to claim that building a nuclear power station is 'economic on energy cost savings alone'. As things are, that claim clearly fails, and I would have expected Dr Jones to acknowledge this fact, rather than quibble about an illustrative result which is fully explained in the paper from which it was taken.

I am equally puzzled by Dr Jones criticism of my nuclear fuel costs. No one knows better than I do that there is considerable uncertainty about my fuel cost figures, due to lack of specific information. I have been trying for the past year to get information which would enable me to refine the calculations. BNFL refer me to CEBG who originally took a collective decision (May 1981) not to 'answer your detailed numerical questions at this stage', but have recently promised to reply to my latest request for information. I am doubtful as to whether the answer will be other than 'elliptical' but one can only wait and hope!

I tried Dr Jones in March 1981, but he replied, in relation to nuclear fuel costs, 'I have no access to the details of current CEBG commercial arrangements, nor do I see a need for such access'. How he can know what CEBG is paying for uranium ore or separative work unless he has since acquired the information he saw no need for in March 1981, I am unable to understand. If he has acquired the information I wish he would let me have it.

CEBG is certainly not 'in the market' (if the expression has any meaning in the nuclear context), but has long term contracts for both uranium ore and separative work. For uranium the Monopolies and Mergers Commission Report (MMC p.173, 7.58) says that purchase is 'by means of long term contract of between five and ten years' duration, negotiated many years in advance'. The details of the long term contracts were censored from the Report. However, uranium costs are a small part of fuel costs, and large variations in price have little effect (see my paper², p.92, Note 39).

The separative work is more important. 'Until 1978 the CEBG obtained enriched material from the UKAEA's diffusion plant at Capenhurst . . . The Board has told us that it proposes to discontinue the use of this facility as soon as possible in view of its high production costs and the Board's present stock levels' (MMC p.175, 7.75). 'Two contracts have been placed (with URENCO) for 5,950 tonnes separative work for the period 1980 - 1994' (MMC p.177, 7.77). CEBG 'has negotiated a contract for 1,000 tonnes separative

enrichment work in the USSR over the period 1980 - 90' (MMC p.178, 7.82). Some information on pricing is given (MMC p.177, 7.79 - 7.82) from which it appears that the 1981 URENCO price was more than 5 per cent above that of the US enrichment plants and rising relative to them. However, it is expected that the US diffusion price (which is effectively the 'world market' price) will rise faster than the URENCO centrifuge price in the long run. If the US price gets 'very substantially' above the URENCO price (which is escalated 'on the basis of defined indices which can be checked against external information') URENCO can review its prices upwards.

CEBG's policy is to hold 8 months supply of enriched material. It estimates that on 31st March 1982 it will hold £70m of stock, equivalent to 2 years supply. It is attempting to reschedule deliveries from both URENCO and USSR (MMC p.178, 7.83).

I presume that Dr Jones has been working on the US enrichment prices, and when he sends me his figures and calculations, as I have sent him mine, I will see whether they justify altering my results. In view of the above quotations I do not think this is likely, and we shall have to depend on CEBG producing some figures of actual costs before it is worth making any changes.

On coal fuel costs, I have given some of the arguments in my paper² (p.78, Note 7) and expanded on them (especially in relation on coal subsidies and the effect on coal prices of building unnecessary and expensive nuclear stations) in the article in *The Ecologist*³.

On French claims, the *CSENE Report* was referring to 'unofficial but well-informed sources'. French official figures are totally uncheckable and completely undeserving of credence. Even the British government is apparently not clear exactly how much subsidy is involved in bolstering French nuclear power; but Mr Howell at the Select Committee on Energy Hearing on Pricing Policy (28.1.81, p.83) agreed that a £1.4 billion capital write-off and interest charges suspended until 1985, or 'broadly similar things' had been done in France. But he still trusted, as Dr Jones apparently does, their projections from an undisclosed base for future costs.

Finally, on the question of construction overruns, our modest 30 per cent is said to be really over 50 per cent because CEBG includes 17.5 per cent allowance in its estimates. There are two things to be said on this. First, the actual tender prices for Drax B and Heysham II were 9 per cent and 25 per cent respectively above the estimated costs of the

previous year (MMC p.80, 5.60). So the 17.5 per cent 'allowance' is likely to be taken up before construction starts. Second, the 17.5 per cent is only on construction costs (and is an acknowledged underestimate -MMC p.83, 5.67) whereas our 30 per cent was on construction costs plus interest during construction (IDC). Any time overrun has a large effect on IDC. Perhaps the cost overrun figures for the nuclear stations under construction will put this estimated future cost overrun of 30 - 50 per cent into perspective. With constant prices and interest at 5 per cent, the total cost overruns (construction + IDC) are as follows:- Dungeness B -230 per cent; Hartlepool - 201 per cent; Heysham I - 85 per cent. These are based on figures of March 1980 when it was estimated that the first reactor in each case would be completed in June 1981, March 1982 and December 1981 respectively (MMC p. 335, Appendix 25). The estimates then were said to be under review and the overruns have obviously increased.

I hope that those who may have been put off by Dr Jones 'review' will now think it worth while to study the three documents cited above.

1. A Special Report by the Committee for the Study of the Economics of Nuclear Electricity (*CSENE*), 1982, The Ecologist, Worthywale Manor, Camelford, Cornwall.
2. The Real Cost of Nuclear Electricity in the UK, J.W. Jeffery, *Energy Policy*, 10, No. 2, June 1982, p.76 - 100.
3. The Nuclear Economic Fraud, J.W. Jeffery, *The Ecologist* March/April, 1982.

Dr Jones comments:

Professor Jeffery, who had acted as a consultant to Sir Kelvin Spencer's *CSENE* (see review, page 89, *Atom*, April, 1982) has spent a great deal of time and effort in trying to understand and interpret the published material on nuclear and fossil fuelled electricity generation costs. The results of his work have appeared in the papers of *Energy Policy* to which he refers, and a comment on these from the CEBG is expected to appear in the September issue of that journal.

The Statement of Case for the Sizewell Inquiry, published on May 13th, 1982, provides the latest costings based on detailed analysis, and once again demonstrates the sizeable economic advantage that nuclear power offers (see box) against a wide range of alternative views of the economic and energy future. On one such scenario construction of Sizewell 'B' will save some £M500 to

Table 11.3* - Comparative Net Effective Costs (£/kWpa, March 1982).

	No New Nuclear Background	Medium Nuclear Background	High Nuclear Background
Sizewell 'B' PWR	- 93	- 69	- 43
AGR Station	- 55	- 27	- 10
Coal Fired Station	10	14	22

* From CEGB "Statement of Case", Vol. 1 page 56. The numbers relate to scenario C (1 per cent p.a. growth of GDP). A negative NEC implies that fossil fuel savings are worth more than the capital, operating and fuel costs of the station considered, and it is economic to construct Sizewell 'B' to replace fossil fired plant with a positive annual Net Avoidable Cost.

£M1000 in 1982 money over its lifetime.

In the light of the availability of this later document, detailed comments on Professor Jeffery's paper would be superfluous. He and I have very different views on the attractiveness of electricity, on feasible conservation levels, on the likely behaviour of coal prices in the absence of nuclear

competition; as well as on the distinction between "sweeping judgement" and fact and on what constitutes "just an illustrative example" as opposed to a central conclusion (CSENE, summary point 8, page 5). However, I can agree with Professor Jeffery on the value of looking at all considered arguments.

Professor Jeffery replies:

Dr Jones wisely takes refuge in generalisations and quotations from the CEGB's Statement of Case (S. of C.) As I have not yet been able to study the latter in detail, I can only say that the economic sections appear to be little more than a version of the 1980 CEGB Memorandum to the House of Commons Select Committee on Energy (HCSCE) updated to March 1982 prices (RPI inflator 1.243 from March 1980). As such it is subject to the same criticisms as before. In addition, instead of making the best guess of what is going to happen in the next 25 years, the PWR life time has now been upped to 35 years (assuming the reactor vessel does not have a catastrophic distribution, or the steam generating plant does not vibrate or corrode to pieces before then!)

There are some peculiar variations. Water Marshall's *tour de force* has brought down the nominal real capital cost of a PWR (allegedly without making it more dangerous) by 11 per cent, when the AGR real costs were rising by 11 per cent and coal-fired by 9 per cent. The PWR capital cost is now supposedly 20 per cent less than that of an AGR.

But in general the new S. of C. figures given in Dr Jones' table above are no more understandable or useful for decision making than the corresponding ones in 1980.

The one piece evidence which would be relatively easy to understand as a starting point, and which I have been trying to get for two years from the CEGB without

success, is understandably not mentioned in the Statement of Case. This is the detailed cost of electricity on settling down after commissioning of a new station, in terms of today's costs and prices. I estimated these as best as I could in my paper, and the results will not be much affected even by Walter Marshall's new figures.

Even this simplest form of comparison is not easy, since assumptions have to be made regarding overruns on construction. But the major difficulty is that CEGB does not know what its nuclear fuel costs are, because a large part of the outlay will occur in the future. The processing plant for AGR and PWR fuel (THORP) is not yet even designed in detail, let alone costed. On May 12th 1982, BNFL stated that "at this time the design work (on THORP) is continuing and will do so for some time yet, and cost analysis of the design therefore also continues." This is the meaning of the last sentence of para. 27, p.241 of the CEGB statement of Case, "In providing this information (on the reprocessing and waste disposal costs of the fuel cycle) BNFL has indicated that at this stage it is preliminary in nature."

Such is the reality behind the apparent certainty of the figures for nuclear power costs. Nevertheless, estimates must eventually be made but with every assumption clearly explained so that alternative possibilities can be considered. At present the data for an informed evaluation is not even available to the CEGB. Far more information is required, including contract prices

before any reasonable conclusions on economic grounds can be made. Since no-one says the new station is required on grounds of need the decisions should be deferred until the necessary information is available.

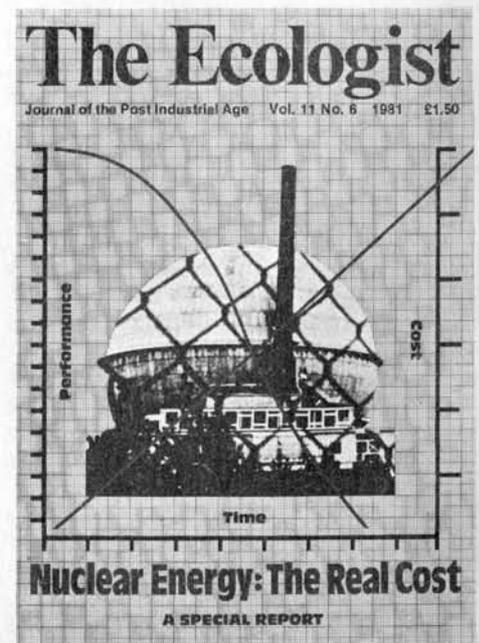
On Dr Jones' general comments, I wonder in what way his views on the attractiveness of electricity differ from mine. I think that electricity is a very valuable (and expensive) high quality form of energy, which is essential for many functions and desirable for others. It think enough of it should be produced to satisfy the efficient performance of these functions. I doubt whether Dr. Jones is so attracted to electricity that he would want it used inefficiently!

Whether my paper contains 'sweeping judgements' or facts I leave to its readers to decide.*

I do however believe, *pace* Dr. Jones, that CSENE Summary, point 8, p.5 is a central conclusion, although I realise on re-reading it that compression has led to an error in assumption (c). The section on Nuclear Fuel Costs starting on p. 87 of my paper gives the details, but the assumed increase in nuclear fuel costs from 1980 to 1986/7 is 22 per cent, mainly due to an expected (not "more than double" as stated) doubling of reprocessing costs, (calculations based on a 10 per cent increase are also given in my paper).

Footnote

* Copies of 'The Real Costs of Nuclear Electricity in the U.K.' can be obtained for 50p (packing and postage) from the author, Crystallography Dept, Birkbeck College, Malet Street, London WC1E 7HX.



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