The Ecologist

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Did the peanut cause the Sahel tragedy?

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Editorial

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Editorial

The Riots: Reaping the Bitter Harvest

Some five years ago, at a conference held by the Gulbenkian Institute, the then official monitor of the government's urban aid programme, A.H. Halsey, scathingly dismissed the notion that Britain's cities might by heading for an urban crisis as "yet another example of an idea drifting casually across the Atlantic, soggy on arrival and of dubious utility". Today, Halsey must be kicking himself. The riots that have swept Brixton, Moss Side and Toxteth have exposed the true depths of the crisis gripping our inner cities, revealing a bitter and divided society that is disastrously at odds with itself. Indeed any illusion we might have harboured about Britain's long-term social stability must surely have been shattered in those few nights of violence: each petrol bomb became an appalling reminder of the extent to which we have slid down the path towards social disintegration, each CS gas cannister a symbol of the ultimate impotence of the authorities to meet the challenge of the crisis.

Perhaps predictably the response of politicians on both sides of the House of Commons has been to reach for the cheque book. For his part, Mr Michael Foot called upon the government to pump some £2 billion into the inner cities; meanwhile the government itself drew up plans to boost its spending on inner city programmes and expand its youth training schemes. But can such schemes really solve the problems that led to the riots? Since Sir Harold Wilson first initiated the Community Development Fund in the early seventies, millions of pounds have been poured into the inner cities in one programme after another; by 1975, the dockland of Liverpool alone had received some £15 million in grants (more than £200 a head); and, from 1977 to 1979, the total amount of money spent on urban aid leapt from £30 million a year to £179 million. Yet for every penny spent, the problems of the inner cities seem to have increased exponentially. Since the beginning of the urban aid programme, the exodus of industry from the inner cities has continued unabated, we still face a housing shortage, the numbers of those living on the poverty line has actually increased, the crime rate has risen dramatically, the number of one-parent families has burgeoned and unemployment rates in the inner city areas have shot through the roof. In Toxteth, for example, 37 per cent of adults are unemployed (the rate amongst young blacks runs at 47 per cent) and, with five hundred people chasing each unskilled vacancy on Merseyside, the prospects of the unemployment rate falling in the immediate future seems slim. What then has gone wrong? Is it that we have spent too little on the inner cities? Or are the urban aid programmes themselves to blame for the current crisis? Are the riots in fact nothing more than the bitter and inevitable harvest of twenty-five years of inept social planning?

What shocked many people the most about the riots was the seeming connivance (or at least acquiescence) of parents and other adults in the rioting of the young. Whilst few of them actually partook in the violence, it was clear that they both allowed their children onto the streets and, in some cases, actually encouraged them (one boy telling a reporter from *The Times,* "My Mum asked me to get her a wall clock"). Essentially the riots were a vivid reminder of just how far the forces of social disintegration have run in inner city areas — and the call by Mr William Whitelaw, the Home Secretary, for families to exercise greater control over their children only demonstrated how out of touch with the reality politicians have become. As *The Sunday Times* put it: "Many people wondered where Mr Whitelaw had been all these years . . . British children are not what they were. They are according to statistics, much more prone to indulge in alcohol, sex and crime than ever before — at least in the records of the twentieth century. But then this also applies to adults. British families are not what they were. The divorce rate has increased by 400 per cent over the past 20 years (and is now the highest in Europe; one in every four marriages will end in divorce). More mothers go out to work (for example, in 1979 one in four mothers was working or looking for work by the time her baby was eight months old, compared with one in eleven in 1971). The number of unmarried mothers increased by 44 per cent in the first five years of the Seventies. One in every ten British children now belongs to a one parent family."

The statistics show clearly, then, that the grip of social disequilibrium is rapidly become a bearhug. In part the figures can be explained by the general tenor of life in a mass industrial society, the encroachment of the market economy and the gradual erosion of traditional family responsibilities by the welfare state. But by far the greatest portion of the blame must surely rest on the planners and politicians who have gutted and rearranged our cities in one of the most disastrous social experiments in history. Bowing more to the pressure of economic forces than to the requirements of society, they have systematically destroyed the very social bonds that foster both the family and the community. In the new towns, those bonds have been shattered with sudden violence: in the blighted inner city, they have suffered a slower death, atrophying with each redevelopment programme. Either way the effect has been disastrous.

To take the 'new towns' first. In his book, *The Politics of Planning,* F. Gladstone describes in some detail the social problems in a housing estate just outside Sheffield. "Wybourne has almost no facilities.

There are two or three shops and schools but little else. There is a lot of open space but it is not arranged in such a way that people can use it. The large worn verges between the houses and the road are a no man's land for which neither tenants nor council want to take responsibility. Relations do not develop there because there is no place for them to develop, no corner shops for example. People complain that they do not know their neighbours even after thirty years . . ." Elsewhere Gladstone reports that neighbours are actually afraid of each other and comments, "In a deep way, the combination of the industrial and political situation seems to have decultured people."

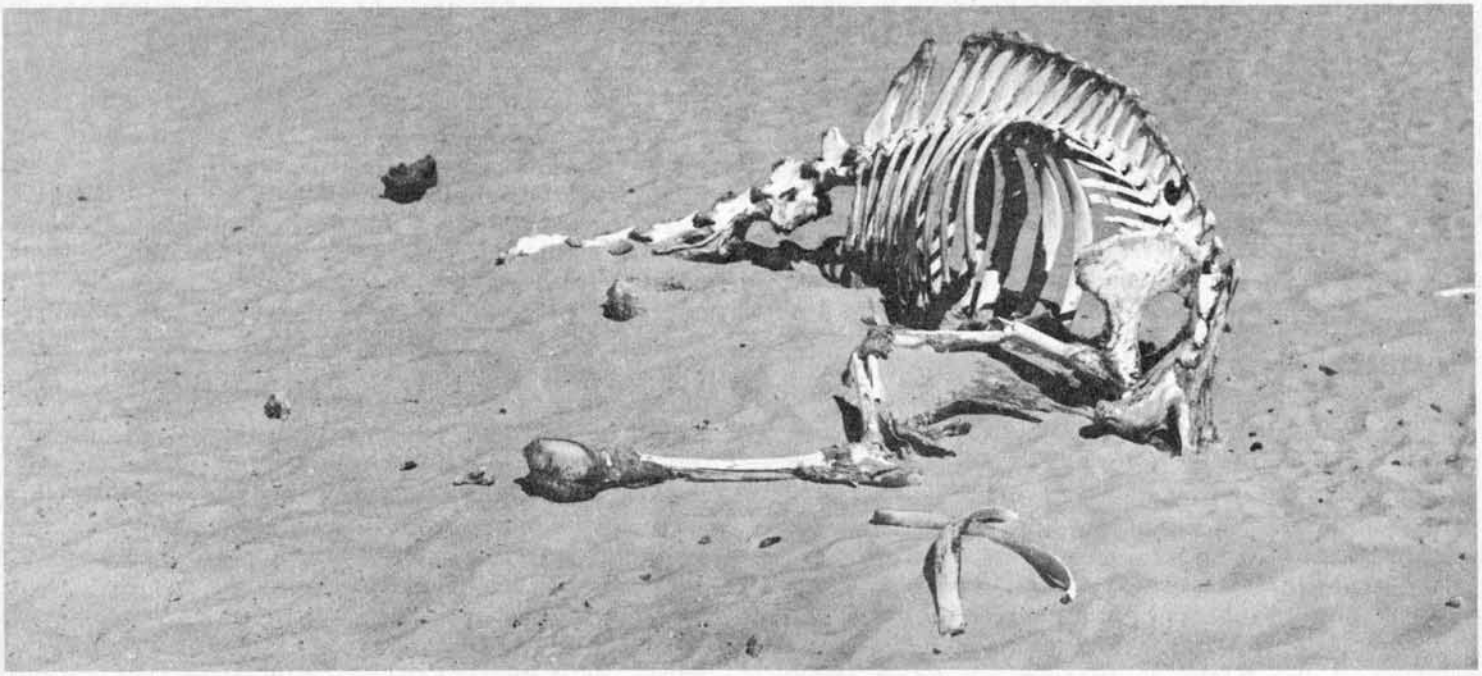
That is a truly horrifying condition of society but it is one that we have brought upon ourselves. In designing the 'new towns', scant attention has been paid to anything but the most trivial social considerations: hours of wrangling take place over the most suitable site for the local but stop, whilst plans that one can predict will be social disasters are passed without a murmur. By dividing up new developments entirely on the basis of different activities (work being confined to the industrial estate, play to the playground, sleeping and eating to the housing estate, shopping to the shopping centre, growing old to the old peoples' home, being rich to one area, being poor to another), the planners have succeeded in fragmenting the social relations which would, under other circumstances, tie a community together. Indeed it is only when the whole spectrum of classes, ages, occupations and activities are concentrated into one localised area that the tight mesh of relationships which form the basis of a community can develop. Disect the community, and like a disected body, it eventually dies to be replaced by a series of disjointed, fluid and highly unstable groupings — in reality no more than the network of friends and acquaintances surrounding any one individual.

That same process has occurred — though for different reasons — in the areas worst hit by the riots. As *The Economist* points out in one of the most perceptive articles to follow the riots, the redevelopment of both Toxteth and Brixton not only destroyed many traditional sources of unemployment — the workshops, cornershops and small industries which had previously formed the mainstay of the local economy (one estimate suggests that over 3000 such jobs may have been lost through clearance schemes in Lambeth alone) — but, in doing so, it shattered the community both by depriving it of its natural leaders and by breaking up the economic and social ties which bound it together. The ultimate effect was to create a ghetto for the disadvantaged, for as redevelopment proceeded so the businessmen, home owners and shopkeepers moved out, stripping the community of the very social 'layer' which provided its core, and leaving behind the poorer residents 'surviving on tail-end leases among the boarded-up houses, decaying shops and workshops which (once) gave them their jobs and sense of security.' And in removing those whose activities fermented the social relations that once made for community, the planners also destroyed the community's capacity to 'police itself'. As *The Economist* puts it: "City communities — like rural villages — maintain a measure of law and order through an unofficial network of vigilance; local figures of authority, the publican, the shopkeeper, parents, housewives chatting on the doorstep, recognised people 'occupying' the street. By calming a quarrel, cuffing a miscreant, witnessing everything that happens, they are the true policemen of any close community . . . It was this secondary control which broke down in the (riot) cities." Not surprisingly, perhaps, *The Economist* concludes: "It was the collapse of the community authority, and the environment which supports it, which was the 'cause' of the riots. Occupied, lived-in, worked-in property is defensible space. Only those who feel some stake in a community will wish to save it."

That stricture applies as much to life in the 'new towns' as it does to Brixton and Toxteth for, as we have seen, the 'new towns' too lack that grid of social relations which make for community control. Under such conditions, the temptation is for individuals — robbed of the security of a traditional community — to seek solace in cult groups and to look for scapegoats for their own sense of alienation. Therein lies a partial explanation for the antagonism shown by the residents of Brixton and Toxteth to the police. It is certainly an explanation for the growth of the strong skinhead following in such extreme right-wing movements as the National Front: the flags, uniforms, the feeling of common purpose in a single all-embracing ideology bring as much a sense of identity to the individual as membership to a warrior cult in a tribal society. Yet there is a critical difference. In a tribal society, the cult-group is not the individual's sole source of identity nor is it set wholly apart from the network of social relations that give the society its structure. Not so in a disintegrated society. There the group is subject to none of the social constraints of community for the community is fragmented to the point where it can no longer exert such constraints. Instead the group must be controlled by outside authority — and the stage is set for potential conflict. Witness the riots.

In destroying the community, we have done more than simply condemn thousands of citizens to alienation. We have made conflict inevitable. Indeed, as Erin Pizzey, the veteran campaigner on behalf of battered women, put it in a letter to *The Times*, "I'm astonished that people are *surprised* by what happened in Liverpool. What did they expect? If family life is eroded, then society naturally breaks down." Just how to put society back together remains one of the most intractable problems facing us today. But one thing is certain: it won't be achieved by yet more development programmes.

Nicholas Hildyard



Peasants, Peanuts, Profits, and Pastoralists

by

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The Nomads of Niger suffered untold hardship during the 1973 Sahel Drought. Many blamed them for overgrazing the area. But who were the real overgrazers? The Nomads? Or the peanut producers in the South who pushed them into the desert fringes? And were ambitious development plans the root cause of the Sahel tragedy?

The 1968-74 Sahel drought and famine had a devastating impact on the lives of Niger's farmers and herders. According to FAO estimates, the production of the major staple crops, millet and sorghum, was down 50% in 1973-74 as compared with the 1969-70 average, (FAO, 1976). The same source estimates cattle losses, caused by a combination of lack of water and lack of food, at 39% of the total Nigerien herd between 1970 and 1974. In addition, 10% of the goats and sheep are thought to have been lost.

While the human deaths have not been apparently estimated on a country by country basis, the effects of the drought on Niger's people can be roughly gauged by a few statistics. The incidence of measles, for example, rose from 2,886 cases in 1971 to 29,000 in 1972, and had reached more than 35,000 in 1973, (Sheets and Morris, 1974). Because of the late arrival of measles vaccination equipment and serums from overseas donors, many thousands died from this disease throughout the Sahel, including Niger. (1)

Beneath the statistics, of course, lie thousands of individual and family tragedies. Particularly hard hit were the nomads of Niger, thousands of whom became refugees, wandering through the arid landscape with their families and belongings until they came to a refugee station or town. One description of such a trek will perhaps give an idea of what life became for those forced to leave their homes and traditional occupations.

The Trek of Sidi Mohammed

Sidi Mohammed, a Nigerien herder took his family of ten, including his mother, brother, Sidi's wife who had recently given birth, and six children, including the infant, and began heading south. They took with them two camels and three donkeys. They left their home after their herds had died, their destination, a town where food was supposedly available. His wife died on the way, the infant son, without his mother's milk "wasted away to skin and bones". He too would die. Sidi desperately tried to give away his two youngest daughters since he could not feed them, but no one was able to take them on. When they arrived in Maradi, almost at the border with Nigeria, and a major peanut and staple crop region, they discovered there was no food to be had. They sold their animals and the sons went begging. The family finally took up residence in a refugee camp, hoping the rain would come next year and somehow they could go back north and begin again.(2)

This article first appeared in the August 1980 edition of *African Environment*, P.O. Box 3370, Dakar, Senegal.

After 1974, the rains were once more sufficient. However, the area's reprieve from drought appears to have been a short one. The rains failed again in 1976 in some countries of the Sahel, and in much of the region again in 1977. The Director of the FAO, Eduard Saouma warned of a new drought situation (*Le Monde Diplomatique,* October, 1977).

Several months previous to this warning, the Foreign Minister of Niger had appealed for 200,000 tons of food and $2.7 million to fight rodents, birds and insects which were attacking the crops, (*New York Times,* February 11, 1976). The donor countries disagreed with this estimate and thought it should be lower, but some aid experts believed an oversupply would be necessary in order to be sure that the poor distribution system would be able to provision the remote areas of Niger, (*New York Times,* February 10, 1976).

A Double Tragedy

The recurring drought and the numerous social and economic problems which it entails may lead to a double tragedy. On the one hand, the latest drought, if it becomes serious enough, may set in motion again the emigration of herders from their pasture lands, making refugees of many at great cost to the Niger government. At the same time, the drought and the social dislocations which it causes will hamper and perhaps even set backwards the momentum of the Sahel Development Program, one of the world's most ambitious and heavily-financed aid programs. The Sahel Development Program is designed to provide food, self-sufficiency, and some measure of environmental reconstruction by the year 2,000. (3)

Despite the enormous resources being made available through the Sahel Development Program — an initial commitment of $10 billion came out of the 1977 Ottawa, Canada meetings — projects developed will not be likely to succeed unless they are based upon firm understanding of past processes that have led to the region's high vulnerability to drought. It is the thesis of this essay that the severe human suffering brought on by the drought in Niger is the result of a series of economic and social processes in which the herders — the main victims of the drought — found themselves grazing their animals on regions too close to the desert fringe. The nomads' unfortunate behavior was a consequence of a series of events in which the farming populations of the more southerly part of Niger pressured the nomads for control over land resources. Finally, the entire set of destructive processes was a result of the international economic and political structure which has influenced Niger's development policies.

The Dilemma of Dependance

While it is true in a general sense that all nations in the modern world are dependent upon others for raw materials, manufactured goods, food, and other products, the dependency of the poor countries on the wealthy, industrialized nations had created special circumstances which call for special analysis. (4)

Of particular importance in the analysis of dependency, are the phenomena of lack of diversity in dependent nations' output, high levels of foreign investment in productive sectors, dependence on the ups and downs of the capitalist business cycle, inability to maintain a balanced posititon in the midst of competitive rivalries among the wealthy nations, and, in many cases, a continuation of colonial social structures in the dependent countries. A few facts about each of these elements of dependence in the case of Niger will provide a backdrop for an analysis of the internal processes that have led to ecological degredation and drought vulnerability in that country.

First it is the lack of diversity in dependent economies. Niger is a prime example of this conditon; in 1964, 68% of the country's total exports were provided by peanuts or peanut products, and in 1970, the figure remained at 65%. (5)

An important corrollary of the high dependency on a single export was that that same export was not readily available for local consumption despite its potential use as a high-protein element in the diet (FAO, 1965). In addition, the high dependency on a single crop was compounded through the historical ties developed through the French colonial period: the FAO noted in 1965 that the Sahelian countries as a whole were dependent for more than 83% of all their main exports on just three markets — the USA, Great Britain and the European Economic Community (FAO, 1965).

The combination of not having much variety in things to sell, and not much choice in where to sell it, sets up a contradictory situation. On the one hand, Niger would be extremely vulnerable to any large (and perhaps even small) declines in the world price for its product, having little if anything to fall back on. This is a classic problem of single-product economies and one of the telling features of dependency. On the other hand, if the outside market countries try to solve this problem by offering a stable, high subsidized price, there is a constant danger of stimulating overproduction and ecological damage as the aritificial price attracts too many producers of the crop. It will be seen in Niger just how devastating this process can be. And even "guaranteed" prices have a way of being phased out, as will also be seen.

Declining Terms of Trade

Even with rich-country price supports, however, the effects of this dependency on a limited market produce another contradiction, the dependent country is pushed toward higher outputs of its one or two exportable crops both by the price supports and by the fact that even these supports are not sufficient to overcome the more rapidly increasing costs of goods imported from the wealthier countries. This phenomenon is usually referred to as "declining terms of trade". It can be more easily understood by taking an amount of production in a given year and comparing in a later year how much more or less production is required to purchase the same amount of imported goods. In Niger, for example, to purchase 100 units of imports in 1961, it was necessary to produce 100 units of peanuts or cotton. By 1970, 130-135 units of

peanuts or cotton were necessary to purchase the same 100 units of imports. (Comité Information Sahel, 1975.). Thus, the "declining terms of trade" fostered a need for increased output just to maintain the same buying power in international markets.

Another aspect of dependency is the high proportion of foreign funds in the investment sector. In Niger, between 1960 and 1970, 72% of investments were from foreign sources (Samir Amin, 1973). This figure suggests that foreign interest groups would be pointing investments towards what they saw as more profitable rather than necessarily as part of a balanced development plan.

Boom and Bust Economies

A major area in which dependency manifests itself is in the cyclical nature of the production process in capitalist economies. The recurrent boom and bust phenomenon of capitalism is familiar to most people in the industrialized capitalist world, but its implications for underdeveloped, dependent economies are far less understood. While little detailed work has been done so far, a few general points can be suggested.

First, the expansionary side of the business cycle is a period in which investments are encouraged, and thus a period in which production is stimulated. This means that materials, such as peanuts or peanut oil may be in increased demand in the industrial economies. Whatever means are necessary for their production may be offered, in the form of private investment, foreign aid, loans, or some combination of these. This boom period is also one in which the tendency to offer a guaranteed price in a single-crop economy would be highest, in order to maintain supplies of a necessary material.

By contrast, the recession phase of the cycle in the industrial capitalist world may be characterized by retrenchment of foreign aid, wavering of the commitment to price supports for overseas products, and a contracting market for many of these products. The effects of this retrenchment, severe enough on the poorest groups in the industrialized countries, is even more striking in dependent countries because their greater basic poverty and their lack of diversity of production renders them particularly vulnerable to even a single price change.

Effects of Business Cycle

The recent effects of the business cycle on Sahelian countries have been particularly strong owing to the nature of post-World War II international economic development. Two processes have dovetailed to create demands on the Sahelian economies for increased production of agricultural products.

First, is the fact that the post-World War II upswing in the business cycle has been particularly long. From 1949 to about 1968, there was a nearly uninterrupted boom-period. In the Sahel, this lengthy expansionary period coincided with the last few years of colonial rule and the first few years of independence. This boom period helped to determine the economic policies of the French in stimulating ever greater production of peanuts and attempting to establish a meat export industry.

Pawns in International Feuds: Soya Beans vs Vegetable Oils

The phenomenon of dependency has yet another aspect. The dependent country may become party to rivalries between the industrialized countries as a kind of "reserve" to be used for solving special problems which one industrialized country is having vis-à-vis another.

Of particular importance in the case of the Sahel countries during the transition to independence was the situation of the world market in vegetable oils, of which peanuts were a major element, and the relations between France and the United States regarding these oils.

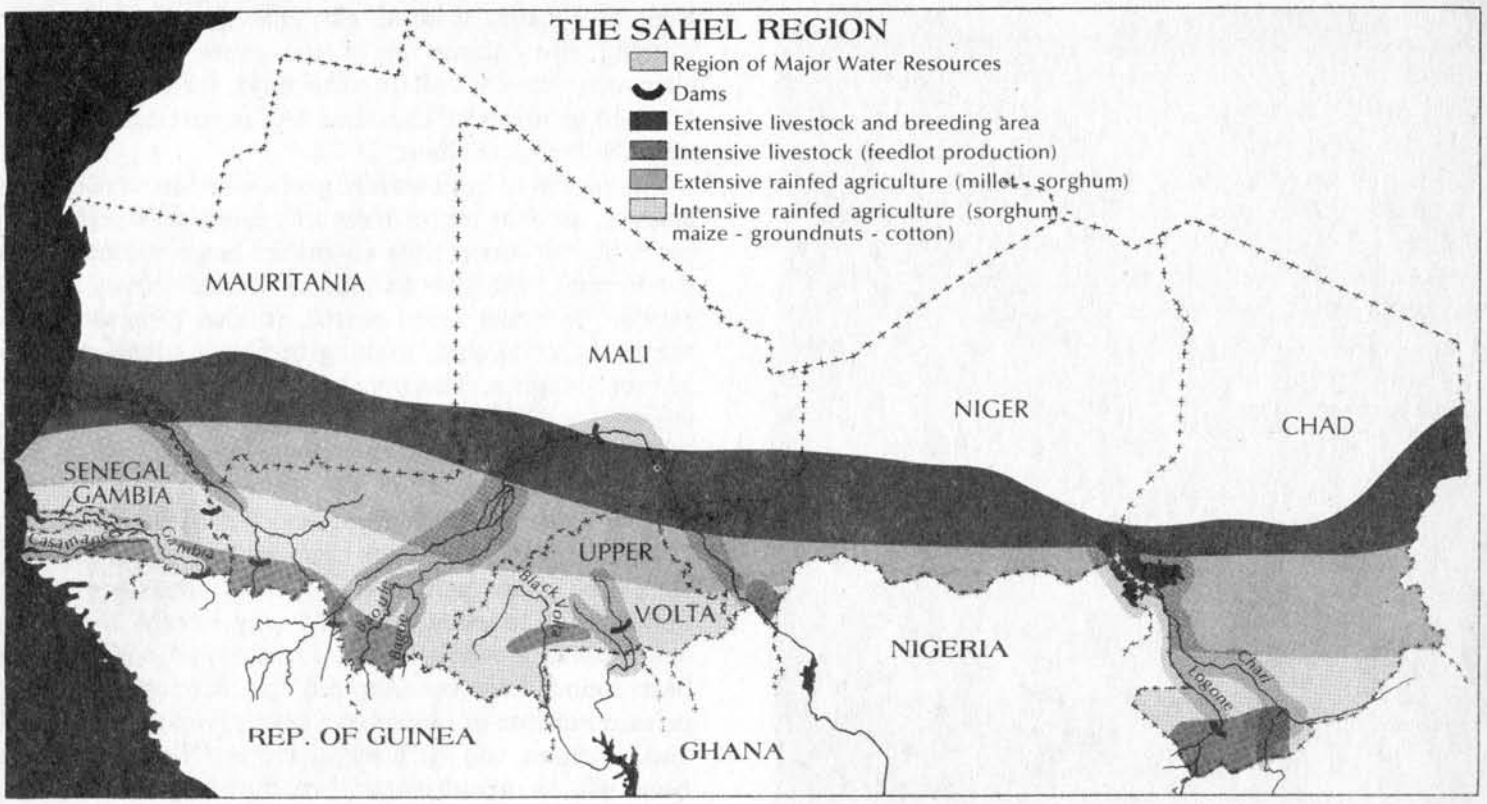
In 1957, geographer A.B. Mountjoy wrote a brief article on the world vegetable oil situation. He noted several features of that situation which related to West Africa, including especially the Sahelian countries.

Mountjoy noted first of all, that the peanut is a particularly desirable oil-producing plant. "An acre of groundnuts produces 260lbs. of vegetable fat, one of soyabeans 150lbs. of vegetable fat, whereas the average cow yields only 46 pounds of butterfat per acre." (1957). (6)

In addition to the desirability of the groundnut on productivity grounds, there was a particular market problem in that "the world's greatest consuming area of vegetable oils, Western Europe, produces them only in very limited quantity" (Mountjoy, 1957). And to this was added the additional problem that several of the major producers such as China, India, and the United States had internal markets large enough to absorb their own output of groundnut oil. Thus Mountjoy concluded:

> "The tropical and equatorial possessions in Africa of the great industrial powers, Britain, France, and Belgium offer the greatest opportunities for the expansion of export oil crops. It is clear that already Africa is replacing Asia as the main surplus vegetable oil area." (Mountjoy, 1957). (7)

Mountjoy wrote as well of the potential for increased acreage in peanut cultivation in the Sahelian region of West Africa, but the attractions of the Sahel's peanut regions in general was further complicated — indeed heightened — by the post World War II economic relations between the United States and France in the matter of vegetable oils. Soyabean exports to Europe are among the greatest success stories of American agriculture in the last 30 years. In 1949, U.S. soyabean exports were 47,000 tons; by 1973, they had reached nearly 5 million tons of processed beans and another 13 million tons that are crushed in U.S. owned mills established in Europe. (Susan George, 1977). The story of this enormous expansion of soyabean exports to Europe is one of aggressive marketing, pressure at international economic meetings, the use of Food for Peace shipments to introduce soya products cheaply to consumers who were accustomed to olive oil, as well as the general economic growth of Western Europe which took place faster than the countries could develop their



own supplies. (See Susan George, 1977, for an account of some of this history.)

The massive take-over of the European vegetable oils market by U.S. concerns did not come entirely without resistance, however. The speculations of Mountjoy noted above, indicate that there was some thinking going on about how the European countries could find more controllable sources for at least a part of this production. Of all these countries, France was in a position to put up the greatest resistance because of the alternative sources offered by the Sahelian area. As one French researcher summed up the situation in 1974: "Soya beans produced in the United States, and peanuts produced in the underdeveloped countries are in competition with each other on the world market." (Marloie, 1974).

A double contradiction emerged from this four-way competition of peanuts, soyabeans, France, and the United States. On the one hand, the Sahelian countries most dependent on peanut exports, Senegal, Mali and Niger, found their markets severely limited by the massive and aggressive U.S. campaign to dominate the vegetable oils market with soyabeans. Yet, at the same time, France put to work much scientific research and foreign "aid" work in Senegal and Niger, the countries where it had the greatest post-independence influence, to expand the production of peanuts. It was ultimately a losing battle: by 1971, France imported 1,307,947 tons of soya, of which 773,544 tons came from the U.S. as opposed to only 318,332 tons of peanuts (Marloie, 1974). Nonetheless, this losing battle was fought not only in the fields of France (where production was increased particularly after the onset of the 1968 Sahel drought), but also in Niger. In their drive to compete with the U.S., French governmental and commercial interests brought about the extension of peanut production into areas where it had previously been considered uneconomical because of high transportation costs. In particular, a major expansion was undertaken in Niger. With the support of the local Nigerian elite, partly created by the colonial administration, a series of development policies were carried out which in combination played a major role in bringing about Niger's high vulnerability to the drought of 1968-74.

Niger

Niger is a large country, twice the size of France, with a small population of 3.8 million in 1968. Most of the northern part of the country still lies within the desert zone, with the central part devoted to pasture-desert transition which grades into the Northern Sahel. Rainfall increases towards the south, creating along the southern border with Africa's most populous nation, Nigeria, a narrow strip in which peanuts can be grown. For centuries the farming communities of southern Niger have interacted with the pastoralists to the north, producing millet and sorghum in return for animal products, including fertilization of the fields by the herds which move south in the dry season. In some cases, farmers have even developed herds themselves, and "lent" them out to the herders during the rainy season when the herds move north to escape the tse-tse fly and the farmers are busy tending their crops. It is in this southern agricultural region that we must first focus our attention.

Peanut Production in Niger

Unlike other Sahelian countries such as Senegal, Niger does not have a century-long association with the peanut. Owing to the great distances from Niger to the main transportation routes to Europe, the French only began developing commercial production of peanuts after the first World War (Péhaut, 1970).

The Sahel Drought turned thousands of Nigeriens into refugees. Starvation and lack of water killed very nearly half of the country's cattle.

In the 1930s there was a small expansion of the area under cultivation, and then, following the second World War, the boom began. Peanuts, which had occupied 73,000 ha, in 1934, spread to more than 142,000 by 1954, and had reached 349,000 ha, by 1961 (Péhaut, 1970; Raynaut, 1975). In 1968, on the eve of the famine, the area planted in peanuts hit the highest mark ever, at 432,000 ha. (Derriennic, 1977). The tremendous speed with which the peanut culture has spread has not resulted from a sudden discovery of ways to make its cultivation ecologically beneficial, however.

Ecological Problems of the Peanut

Despite its adaptability to relatively dry climates and sandy soils such as characterize much of southern Niger, the peanut is not a very hardy plant unless the growing conditions fall within a certain limited range. Peanuts do not grow well with less than 500 mm (20 inches) of rainfall during the growing season although theoretically they can survive on 350 mm. (14 inches). (Péhaut, 1970).

Of great importance, is the timing of the rain which must correspond closely to the growing cycle of the plant if production of nuts is to be good. For example, there must be a solid rain 20 mm. in one day, or 25-35 mm in 2-3 days during the first few days after planting. (Péhaut, 1970). Similarly at other points in the growth of the plant, rainfall coming even a few days "late" can adversely affect the eventual harvest. Close to harvest-time too much rainfall can also be damaging by causing the taking on of too much of the acidic elements from the soil into the plant, which has mostly stopped growing by this time and is putting its intake into the fruits. (Péhaut, 1970).

The region of Southern Niger is close to the 500 mm isohyet, so that many areas of peanut production are particularly susceptible to rather large variations in production from year to year as rainfall varies. As the rainfall becomes more scarce, it also becomes more erratic in its timing, making further undependability in crop outputs. The result of these climatic circumstances is that peanut harvests in Niger show an extremely varied pattern with many good years and many bad years.

How have the cultivators adapted to this problem? If peanut production were their sole means of support, each bad year would mean total disaster to the majority of farmers who live only barely above the subsistence level as it is. A traditional solution has been found, however. Around the farming villages, a certain number of fields have been given over to millet and sorghum, the main staple crops. Other areas have been left as uncultivated brushlands providing essential fallow areas that act as ecological "green zones" between villages. It is in these fallow zones that, during the 1950s and 1960s, peanut cultivation was undertaken (Péhaut, 1970), motivated by the desire of the farmers to maintain their staple crops while expanding the production of the cash crop. Of great significance for the coming of the drought is that these fallow zones had previously been kept unused just for "periods of insecurity" (Péhaut, 1970). The peanut cultivation, while not competing directly with staple crops (which were maintained in their previous plots) did lead to a major lessening of "reserve " lands which could be exploited in difficult times. Finally, peanut plant residue, while higher in protein content than local subsistence crops such as sorghum, offers only about one-third the total dry matter yield, or total food provision (van Raay and de Leeuw, 1974). Thus, the expansion of peanut production over large areas would render more precarious the dry-season pasture availability of food for nomadic herders and their cattle.

Technology, Expansion, Incentives

But how and why did peanut cultivation spread so rapidly in a region where it may not have been most suited at least when viewed in a long-term ecological framework? Reasons deriving from the structure of the international capitalist economies were offered above, but in addition there were several technical factors at work.

First, the peanut was the easiest cash crop to introduce. In neighboring Senegal and in Nigeria to the south, many years of production and research had given techniques for planting, storing, marketing, etc. As transportation routes into West Africa's interior began to improve, it was logical to push the peanut in as well. In fact, there were two great surges of peanut production in Niger.

One occurred between 1954 and 1957 and was mainly a result of a rapid expansion of the amount of land under peanuts: in 1954, 142,000 ha., in 1957, 304,000 ha. This remarkable increase in land under peanuts was achieved by two mechanisms. First, there was a government campaign to encourage production — often accompanied by promises of increased income, sometimes made tangible in the form of "gifts". These were offered by the enterprises that were promoting the government campaign (Péhaut, 1970). The gifts, which included commodities such as Kola and cloth, bound the producers to companies through local commerical networks. Seeds, tools, and other production costs would be "advanced" along with the gifts and had to be repaid by the farmers at harvest time. (Péhaut, 1970). In addition, price supports for peanuts were established by the (still colonial) government in France, precisely in order to encourage peanut cultivation.

Second, the research in Senegal achieved new varieties of peanut seeds which held out hope for even greater expansion making the peanut appear to be an investment with a future — and local chiefs, traders and village elites saw the possibilities along with the French. The research — most of which went on at the Bambey Station in Senegal — led to the development of many new varieties, some with greater drought resistence, some with greater rainfall tolerance, some with shorter growing cycles, etc. The introduction of these seeds, starting around 1961, just after Niger's official independence from France, brought on a second wave of increase in peanut production. Very few hectares were added between 1961 and 1967, but production increased from 130,000 to 290,000 tons (Péhaut, 1970). This "green revolution" in the Niger peanut economy was one of the most statistically dramatic in the world — until the drought hit.

Discontent

Not everyone was pleased with the development of peanut production in Niger. It appears that many local authorities were concerned with the possible effects on subsistence production. Thus, the Governor of Niger wrote in 1954 to the regional commander in Maradi, one of the main peanut regions:

> "Cultivation of peanuts has now reached a level which should not be surpassed: despite the profitable price paid to the producers, its extension to the detriment of subsistence crops, is dangerous. I order that not a single hectare of millet or other subsistence crop should be improperly cultivated due to the attraction of peanut production, and request that you invite all the district chiefs to spare no efforts in the coming months to battle this tendency".

Despite his injunction, just 12 years later the amount of peanuts produced in Maradi had tripled and 12 new market centres for peanut trade had been opened there. (Raynaut, 1975).

An American commentator noted in 1966 that "the rapidity with which the peanuts have assumed so important a place in Niger's economy has alarmed the authorities" and went on to state that "the government is re-organizing the local peanut market, discouraging expansion of that crop, and favoring substitute or supplementary agricultural sources of cash income." (Thompson, *in* Carter, 1966). (8).

But this "reorganization" of markets mainly shifted control from French companies to Nigerien middlemen and government officials who benefited from the production of an export commodity. As for the discouraging of the expansion of peanuts, though it is true that the overall area planted in peanuts did not increase much after the surge of 1954-57, (it did go up by some 50,000 ha. more by 1968) some individual localities did witness expansion in land area. In Magaria district, for example, the number of hectares planted in peanuts increased from 82,000 in 1958 to 110,000 in 1961, to 146,000 in 1966 (Collins, 1976). In three regions, moving from West to East, the per cent of land devoted to peanuts was 13.8% in Dosso, 43.8% in Maradi, and 64.1% in Tessaoua (Péhaut, 1970). Of equal significance, peanuts came to be an indispensable part of many farmers' incomes. Data from Maradi in 1957-61 indicated that a quarter of farmers received more than 35% of their incomes from peanuts. Another quarter received more than 20%, while the remaining half of the farmers depended on peanut harvest for 50-80% of their incomes! (Péhaut, 1970). Along with this increased dependency came a long-term deterioration in living standards. Despite the short-term appeal of peanut-growing created by high prices, farmers found their work-load increasing as well. One French observer has calculated that one hectare of peanut cultivation requires 480 hours of work as against 375 hours for a hectare of millet. (Derriennic, 1977). Furthermore, the dependency on outside markets for staple foods resulted in a loss through terms of trade. In Senegal this has been estimated as follows: in 1913, 110 kilograms of peanuts would buy 118 kg. of rice, while by 1968, the same amount of peanuts would purchase only 34 kg. of rice. (Derriennic, 1977).

Thus, a combination of factors compelled the continuing increase in area and harvest of peanuts — a kind of treadmill in which producers became ever more dependent, worked harder, and needed to produce even more peanuts. More importantly, with the development of seeds for shorter growing cycles, peanut cultivation in the 1960s began to spread north of its previous boundaries, into regions which brought peanut farmers into direct competition with pastoralists. More will be said of this phenomenon later.

The Fertilizer Problem

As has been noted above, the expansion of production in the 1960s was due largely to increased yields brought about by the spread of improved varieties of seeds. These seeds were intended — at least according to the research experiments — to be accompanied by larger doses of fertilizer than were traditionally used by farmers in the region. The need for specific types of fertilizers to protect the soil has been known, if not practiced, for a long time. As one soil expert has commented with regard to Africa generally:

> "...it was clear forty or fifty years ago that both increased pressure of population, and the inclus-

ion of cotton, groundnuts, or other crops for export in small-scale cultivators' rotations would sooner or later cause fallow periods to become too short as cropping periods, too long for maintenance of fertility by means of natural fallows alone, and that there was definite need of experimentation with alternative methods." (Vine, *in* Moss, ed, 1968).

It is estimated that after three years of growing peanuts, a minimum fallow period of *six years* is needed. An appropriately long fallow period is of great importance in the re-generation of soils. Particularly, the fallow period allows for phosphorous, potassium magnesium and other important elements to accumulate in the topsoil. It also provides for the building-up of humus and the addition of nitrogen: and weed growth is more easily suppressed. (Vine, *in* Moss). Without fertilizers, the only recourse for the peasant whose land is exhausted is to acquire new land and repeat the process over again. Some additional figures will further indicate what the groundnut does to the soil if no fertilizers are being used. For the Casamance area of Senegal, for example, it has been estimated that after only two successive years of peanut growing, there is a loss of thirty per cent of the soil's organic matter and sixty per cent of the colloidal humus.(9) In two successive years of peanut planting the second year's yield will be from twenty to forty per cent lower than the first (Ossewaarde, 1956, p. 88).

Another study from Senegal showed that a harvest of 1,000 kilos of peanuts takes from the ground:

Nitrogen — 70 kilos	Magnesium — 12 kilos
Phosphates — 10 kilos	Lime — 18 kilos
Potash — 28 kilos	(Fouquet, 1951)

As the organic matter diminishes, the soil's capacity to retain water is lessened and there is more susceptibility to drought. Without reserves of moisture, the soil dries out and the harmattan, or desert wind, can blow it away. This is much less of a problem when millet is planted. After harvesting, the stems and roots of millet are left in the ground, acting as a protection against erosion. But the ground on which peanuts are harvested is left completely bare. The shells which are underground are harvested by uprooting. The soil is loosened and the wind can carry away the finest and most important elements. (Comite Information Sahel, 1975);

As the fallow period is shortened — in the case of Niger, as the fallow areas between the villages are put into use next to the millet and sorghum fields — the need for fertilizer increases. In addition, the improved seed varieties for the most part are highly fertilizer sensitive, and get their best results under very specific dosages as determined by the tests on the experiment stations.

During the great production upsurge of the 1960s in Niger, however, it is reported that fertilizer was used on only 1.4% of the planted areas (Péhaut 1970). In fact, then the effects of the improved seeds were felt mostly because of a series of years with very good rainfall patterns rather than because of a rational use of the new technology (Péhaut, 1970). And the more long-term effects of failure to introduce fertilizer along with the more highly-productive seeds is likely to have been yet another degree of degradation of the soils.

But why didn't the farmers utilize that fertilizer? There are several interconnected reasons. First, the production benefits were not clearly and dramatically evident to farmers. Second, the fertilizer distribution was poorly organized and fraught with "abuses", the result being that farmers were not able to keep up with the costs. (Péhaut, 1970). (10)

Finally, fertilizer had to compete with a whole new set of technical inputs including ploughs, animal traction equipment, etc., all of which were being pushed on the farmers who found themselves going ever further into debt to finance an agricultural technology which one critic has stated was primarily suited to European farmers anyway and not beneficial to farmers in Niger. (Péhaut, 1970)

As an indicator of the difficulties which farmers were having, it may be noted that in 1967, 30% of loans to farmers had been defaulted while in Zinder region as of March 31, 1968 — just on the eve of the famine — more than 50% of all debts for new technology remained unpaid (Péhaut, 1970). Thus, a combination of poverty, government corruption, eager European agricultural implements salespeople, and new seeds, combined to drive farmers into debt and prevent the development of fertilizer usage that would help maintain the soils. A USAID — sponsored study in the Zinder region concluded that by 1970, only 26% of farmers had "ever" used fertilizer, and in 1973-4, no fertilizer was being used on staple crop production. The report cited "pricing constraints" as the problem.(Charlick, n.d.).

By 1972, in the region of Maradi, the prefect — a local government official — was charging publicity that: "the fallow periods are shrinking and so the soil is no longer able to regain its potential fertility. In certain zones such as Serkin Yama, the soils can be considered totally depleted." (Quoted in Derriennic, 1977).

Price Policy and Production Increases

There is yet another element in the nexus of development policies in Niger preceding the onset of the drought. During the 1950s, the French government maintained an artificially high guaranteed price for peanuts which was a major stimulant to the rapid expansion of lands under cash crop cultivation in the 1950s as well as the introduction of high-yielding seeds in the 1960s.

The guaranteed French price shielded Niger's government, enterprises, and small producers against shifts in the world market price. It lasted up until 1965, when Niger, along with 17 other African nations, joined the European Common Market with "Associate" status. The terms of this agreement included a gradual lifting of the French guaranteed price which was to be made easier through a year-by-year device of setting a "target cost price". France would pay the difference between this target cost price and the actual world price, but the target cost price was to be reduced each year until it came into agreement with the world market price (IMF, 1970). Nonetheless, the actual price paid to peanut producers — that is the farmers — dropped by 22% between 1967, and 1969 (Amin, 1973).

This drop in prices to the actual producers occurred just as the drought was beginning. The associate status with the European Common Market thus brought with it a severe financial burden to an already heavily indebted peasantry whose farming methods had been stimulated by artificial and unmaintainable international pricing devices and who now faced the prospects of a decline in prices, declining soil fertilit and drought, all at the same time. (11).

Pushing the Nomads North — The Real Meaning of "Overgrazing"

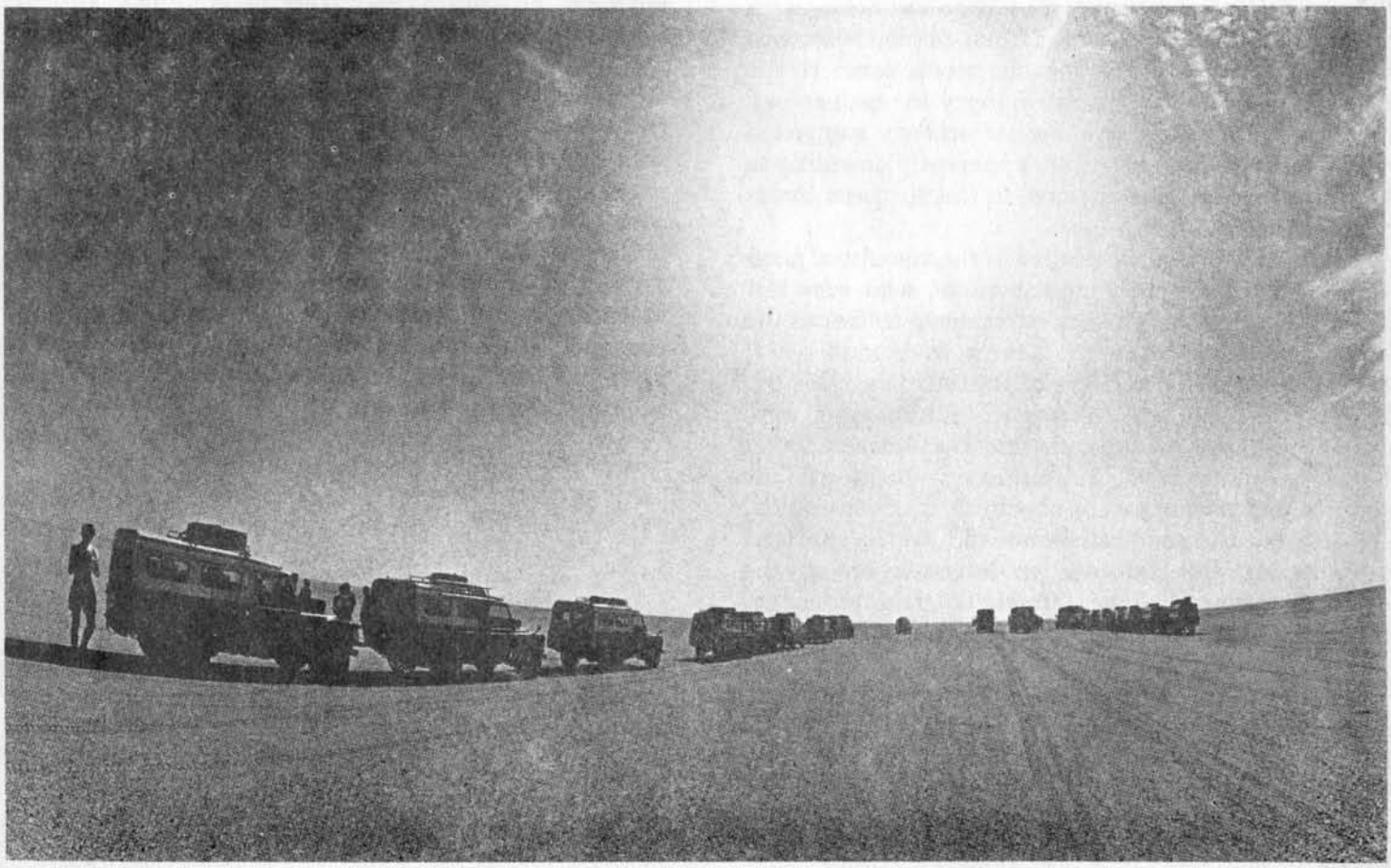
Despite all the ravages visited upon the agricultural zone of Niger by the expanding peanut culture, it was the pastoral peoples to the north on the edge of the desert — the "true Sahelians" — who suffered the most from the drought. But even here, the effects of the peanut were at work.

The region as a whole had already suffered historical processes that placed the nomadic societies in a difficult economic position. The formerly lucrative salt, slave, and gold trade had been wrecked by the new trading relationships established on the West African coast by European shippers.

In 1850, a German geographer, Heinrich Barth, had witnessed the drama that marked the annual departure of the salt caravans overland from Agades, in what is now northern Niger, to the south. He saw "a whole nation in motion, going on its great errand of supplying the wants of other tribes and bartering for what they stood in need of themselves. All the drums were beating, and one string of camels after the other marched up in martial order, led on by the most experienced or steadfast among the followers of each chief." (quoted in de Gramont, 1975).

By the end of the first World War, however, the trade in salt had become insignificant; the desert traffic was being replaced by salt imported through ocean ports. (Suret-Canale, 1971). More recently, roads extended the effects of the modest railway network so that hardly a caravan existed by the 1960s (Caldwell, 1975). This decline is evidenced dramatically by the loss in trading values to the nomads. At the beginning of the 20th Century, a camel laden with salt from Amadror could be converted into 15-20 loads of millet; by 1945-50, the same salt brought only 6-10 loads of millet. By 1974, the salt was worth but 2 loads of millet in a good year, but often would bring only an equal weight. Overall, this amounts to a 95% drop in the terms of trade for the nomads. Similarly, over the past 30 years, the value of a milk-cow in Ader region of Niger has declined from 10 sacks of millet to 4 or 5. (Bernus, 1974, citing Bontë, 1968).

Thus, the decline of the caravans brought on a general impoverishment of the nomads. In particular, however, it greatly reduced their capacity to survive periods of bad weather. This came about because the nomads lost their main source of acquiring valuables that could be stored — goods such as gold and jewels. With the decline of the caravan trade, and the decreasing capacity of the nomadic societies to gain valuables, they resorted more and more to increasing herd sizes as the only means of "saving" for the future against bad times. (Swift, 1973, *in* Dalby).



Christian Aid

A convoy of trucks brings supplies to the drought-stricken Sahel. Ten billion dollars have now been committed to a new development programme in the area. But was development responsible for the disaster in the first place?

The long distance trade of the nomads was not the only set of interzonal interrelations, however. Many forms of cooperation and trade developed at the points where farmers and herdspeople came in contact. In much of West Africa, the former lend out their animals either to transhumant or fully nomadic herdspeople for part of the year and have them returned during the rainy season. In other arrangements, herds will be brought near a farming area for part of the year in order to fertilize the soil with their dung, with the herdspeople receiving payment in the form of cash, trade goods, or agricultural products for the use of their animals in this fashion. Milk and other animal products may also enter into the exchange.(12)

Now, the trade and contact zones have not been stable throughout recent history. During the last several decades, Fulani pastoralists have been moving slowly from Northern Nigeria into Southern Niger and spreading along the southern edges of the Sahel zone. These movements have taken place in a gradual, orderly fashion, season by season, with the herdspeople making one dry season pasturage into a wet season stay over, and moving slightly to the north — towards the desert fringe — during the succeeding dry season (Diarra, *in* Monod, 1975). As long as the agricultural zone spread only as rapidly as the nomads, and as long as the nomads were effectively in control of this speed, the delicate system of exchanges and ecologically balanced contacts could be preserved.

But, as has been noted above, in the 1950s and 1960s, there was a tremendous surge in lands opened up to peanut production. First, the village reserves where the nomads had traditionally kept their cattle while awaiting their introduction onto the fields, were made into cash cropping zones. Then, in the 1960s,with the development of newer peanut seeds, zones to the north were opened by farmers hungry for cash to pay their taxes. These farmers were effectively supported by government administrators apparently unwilling to carry out the legal restrictions on the northern limits to cultivation. (13).

The result was a sharp decline in the amount of pasturage available to the Fulani herders, who were not able to readjust their pasture-movements as fast as the peanut "pioneers" came in. (Diarra, *in* Monod, 1975; cf. Dankoussou). The effects of this sudden upsetting of the ecological and economic interchanges were many. First, the herdspeople and the farmers found themselves involved in numerous conflicts as pastures and peanuts were now in direct competition. Not only did the pastoralists not receive the pastures they needed, but farmers no longer received the fertilizing services of the animals (Diarra, *in* Monod, 1975).

Simultaneously, the continuing expansion of peanut production in areas farther to the south became also more ecologically harmful as the herds no longer could move into these zones, being blocked by the politically more powerful cultivators on the northern edges of the peanut zone. Thus, even while chemical fertilizer use was not increasing because people did not have sufficient resources to purchase it, so also was the number of animals coming to the areas declining, so that previous natural sources of fertilizer were no longer available. One French observer noted in 1971 that the cultivated zone of a certain agricultural village had increased far in excess of the numbers of animal available for fertilizing the soil. The local farmers well understood that this was related to the drop in yields on their farms (Raynaut, 1975, *in* Copans).

Related to these physical and ecological movements was a series of vast social changes, particularly among the northern most herding groups. Former vassals and slave groups of these Tuareg herders moved into the agricultural zones, in some cases claiming their freedom from traditional overlords, and at the same time contributing to the eventual ecological overburdening of the land. (Bernus, 1974).

Finally, the pressure on the nomads to move north too rapidly meant that more and more herds were converging on the same watering places and the same pastures. While a number of nomads found it possible to become settled agriculturalists, many were forced out to the northern edge of the Sahel where they and their herds became the victims of the "overgrazing" noted by so many commentators.

It would be more accurate to say that the peanut and the profit system which was pushing it north were the real "over-grazers", not the nomads. A French technical advisor described the effects of this social and environmental process right up to the eve and through the famine of 1968-74 for a small group of pastoralists in Western Niger. The Alkasseybaten are a small tribe of 130 persons, inhabiting a zone along and to the north of the peanut belt of Niger bordering with Upper Volta. While some changes in the ecological relationships of this group, the neighboring agriculturalists, and pastoralists, can be traced to social and political developments in the 1930s, it was around 1956 that the most significant development began. In that year, the Alkasseybaten found it necessary to maintain their herds all year in a region which had previously been used only for rainy season pasturage, even while farming in the same area was being extended. The result was a process of overgrazing which showed up in a measurable form in the decline in amount of milk produced by the herd. Increasing economic pressures on the Alkasseybaten forced a selling of more and more animals with the size of the herd dropping as follows:

1956	1,500
1962	1,100
1968	700
1972	63

It is significant in this drop in herd size that, while the drought beginning in 1968 had a major destructive effect, large scale losses had begun even before the drought, attesting to the effects of the overgrazing forced by factors outside the nomads' control. Furthermore, when the drought hit, these regions of herding on the fringes of the agricultural zone suffered even more than areas farther to the north. (14).

Overproducing Animals

But the spread of nomads into regions for which they

had not planned an adaptation, like the peanut cultivation itself, was not an isolated process. Still other outside interventions, particularly in the post World War II period, came to make the situation even worse.

In particular, there was the development of vastly increased herd sizes as a result of vaccinations and animal health programs. The figures in Table 1, while only rough estimates of the actual numbers of animals in Niger, give an idea of the scope of the increase in herds just during the period when land available for pasture was being taken over by peanuts.

It can be seen from these figures that the period in which the major expansion of peanut cultivation took place, was also a period of major expansion of herds. More production was thus occurring on less and less of an available resource base.

But why the large increase in herd size? One important part of the answer lies in the export market to Nigeria and the Ivory Coast, and to other large population centers in the south of West Africa — those regions which cannot produce their own livestock because of the presence of the tsetse fly.

The increase in herd sizes was thus stimulated by the goal of increasing market sales in the south. In 1937, for example, a total of 317,000 cattle, sheep and goats were delivered from the entire Sahel region to the Guinea Gulf territories. (Thompson and Adloff, 1958). By 1970 Niger alone was exporting 170,000 head just of cattle (I.M.F., 1970). All these exports were "on the hoof" which had the advantage of low expense, but the disadvantage that cattle which have trekked several hundred miles tend to be low in weight and tough to eat. During the 1950s there came French-sponsored attempts to develop fresh meat shipping facilities, and in 1955, 500 tons of fresh meat were brought to the south by plane from Niger, Upper Volta and Mali (Thompson and Adloff, 1958). Similarly, in Chad a refrigerated slaughter house was opened at Farcha in 1958, with 10,000 cattle being slaughtered there by 1968. The frozen meat was largely exported to Brazzaville (Rayna and Bouquet *in* Caldwell, 1975).

In Niger itself the evolution of export-oriented livestock industries includes the establishment before 1966 of a tannery at Zinder, controlled by the French private capital, another tannery at Maradi in the late 1960s, and the creation of a refrigerated meat abattoir at Niamey specifically to facilitate increased meat exports to the Ivory Coast. (Keita, 1974). These developments were followed by the establishment of several experimental ranches, including in particular one at Ekrafane, 300 km. north of Niamey, financed by the West European FAC (Fonds d'Aide et de Coopération) which was begun in 1964 and began operations in 1968. This ranch closed off an area of 110,000 ha. to traditional herders, disrupting traditional lines of transhumance. The traditional herders were kept out by a combination of fences and guards (Keita, 1974).

The attitude of the Nigerien government towards this process is indicated in a statement by Hamani Diori, President from 1960-1974: "When France, in order to achieve her policy of price stabilization, wishes to import meat, Niger, with 3 million head of cattle, will be ready to furnish the French market with low-priced beef", (Quoted *in* Keita, 1974).

Table 1: NUMBERS OF LIVESTOCK, NIGER

	1938	1961	1966	1970
Cattle	760,000	3,500,000	4,100,000	4,500,000
Sheep/Goats	2,700,000	6,800,000	7,950,000	9,000,000
Camels	50,000	350,000	360,000	n.a.
Donkeys	160,000	300,000	315,000	n.a.

Sources: 1939, British Intelligence, p.388-385. 1961. F.A.O.; 1965, I.M.F., p. 423. 1970. Samir Amin, p. 134. 1961 figures for camels and donkeys actually 1960, Thompson in Carter, 1966, p. 195.

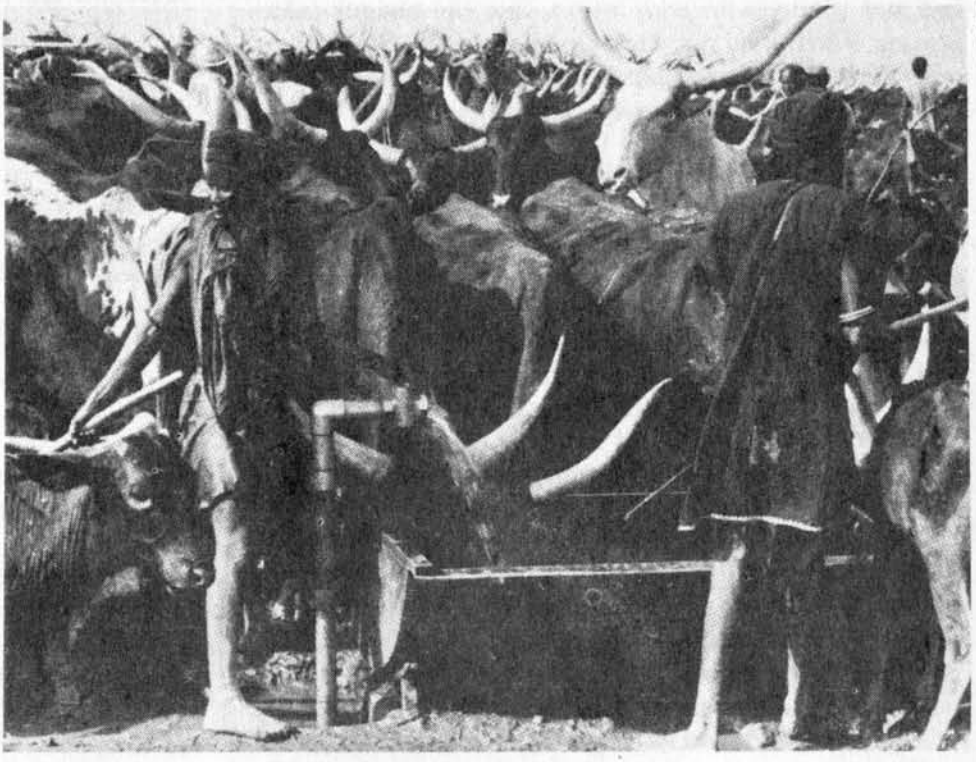
The drive to develop an expanded commercialized meat industry did not stop with the establishment of new marketing and production facilities alone. An entire system of science and technology was brought in from Europe — primarily France — in the service of this enterprise. Between 1947 and 1957, more that 5 billion francs (C.F.A.) were invested in livestock (Thompson and Adloff, 1958) and the veterinary service, first established at Bamako, Mali in 1922, had by 1957 nearly 1,000 personnel in laboratories and in the field throughout the Sahel region (ibid). Programmes included immunization, crossbreeding with bulls and rams imported from France, and, perhaps most importantly for the purposes of this study, the construction of wells and watering points along the nomadic trek routes, providing animals and herdspeople with more water, but not usually more pasture. (15).

The pace of these well-digging programmes was quite rapid. From 1949-1954, for example, F.E.R.D.E.S. (Fonds d'Equipement Rural et de Développement Economique et Social) dug more than 600 wells in Mauritania, Mali, Upper Volta, and Niger (Thompson and Adloff, 1958). By 1955, 50 wells had been dug in the Ferlo desert region of Senegal, helping to open the region both to pastoralists in larger numbers and also to cultivators "who unfortunately are already beginning to dispute the reclaimed land with the nomads" (Thompson and Adloff, 1958). Another organization, the Travaux d'Hydraulique Pâturage, put in over 500 more wells in the Sahelian region as a whole (Rayna and Bouquet, *in* Caldwell, 1975).

An additional 170 wells were bored in Northeastern Nigeria during the period 1958-1962, in a region somewhat resembling that of Southern Niger. During the drought years of 1972-73, most of the herdspeople in the region sent their cattle off to the shoreline of Lake Chad. The wells were not providing sufficient water, but the receding lakeshore had left a temporary and unplanned pasture which helped many of these herders through the drought. (James, 1973).

Early on, however, it was recognized by some observers that the wells were not merely increasing the size of the herds and stimulating conflicts between nomads and settled farmers. The nomads, who were being driven by the expanding peanut cultivation, were gathering in greater numbers along the trek

Hundreds of wells have been dug throughout the Sahel to supply water for cattle. But the wells have been a constant source of friction between nomadic groups and settled farmers. And by permitting an increase in the size of herds, the wells have brought about both the destruction of vegetation and soil erosion.



FAO

routes, where the wells were providing water. But this very increase in herd density "led to a destruction of vegetation along the trek routes and has thus contributed to soil erosion" as was noted by two writers as early as 1958 (16) (Thompson and Adloff, 1958). (16)

Similarly, an F.A.O. report noted in 1961 that:

> "concurrently with the increase in animal numbers, there has been an expansion in the cultivated areas. This is seen on one of the regular grazing routes toward the central delta of the Niger River along the Senegal River, Lake Maggi, the area around the Office du Niger, the Mopti region in Mali and the borders of Lake Chad. Land has been cleared for cultivation and this has intensified the age-old friction between herders and cultivators." (F.A.O., 1962).

At about the same time, anthropologist and Fulani specialist Marguerite Dupire reported from Niger that "the localization of creameries on one single route in the sector of Meiganga so rapidly caused the exhaustion of pastures that it became necessary to consider turning the nomads towards less frequented pastures creating a new route equally well provided with creameries." (Dupire, 1962).

A few years later, a French expert noted that many of the well-sites in the region north of Tahoua in Niger were taking on two, three and even four times the numbers of animals for which they had been designed, attributing the overuse to government, financial, and administrative failures in part. He also noted, however, that the social and political process by which slaves were leaving their Tuareg overlords played a role in the problem. As slaves left to join in the agricultural expansion farther south, their traditional activity of tending the herds became less and less taken care of. A virtual labor shortage was created thus in just the section of the labor force most crucial to proper "herd management" — the herding workers themselves. The wells seemed at first a labor-saving device since they allowed herds to get water more quickly and with less time and work needed to follow them to several dispersed sites.

Undaunted by criticisms, the well-diggers went on with their work, supported and encouraged by the highest organs of Western business and governments. In 1965, the Common Market initiated a program to increase livestock supplies in Niger.

The program included vaccination against rinderpest, veterinary services, a cattle ranch, and well-drilling. From 1968-1970, this program was financed by the Niger Government (I.M.F.,1970), and as late as 1970, the I.M.F. could proclaim that in Niger "Growth of the livestock population has been hindered by insufficient watering points and pumping equipment in the dry season, improper use of pastures, and epidemics" (I.M.F., 1970).

That "Improper use of pasture" might be related to an oversupply of watering points and an overly-expanding livestock and peanut production system does not enter into the I.M.F.'s thinking. But this seems to be just the point. The wells, the veterinary services, the slaughterhouses, the increased herd sizes, are all related to the beginnings of a development plan for commercialized livestock production in the Sahel. At the same time, however, the pastoral regions were being subjected to rapid encroachments by herds-people who were being pushed by the peanut culture into ever more marginal regions. These processes were working together to bring about what might be called the *maximization* of ecological damage, all for the sake of profits to the colonial economy, international businesses, and the commercial African elites. The "overgrazing" of the nomads, such a common phrase in reports on the Sahel famine, can be seen from the example of Niger, to be part of a national and international production system which gave them no other alternatives and then provided them with the necessary technology for environmental destruction.

Footnotes

(1) The apparently accepted estimate of 100,000 total deaths for Mauritania, Senegal, Upper Volta, Mali, Niger, and Chad is based on an extrapolation from an onsite study by a team of doctors from the Center for Disease Control in Atlanta, Georgia. The doctors estimated a total of 44,160 deaths among the nomadic population of Mauritania which in turn was estimated to be altogether 960,000. Continuing the estimates with a figure of half of all Sahelian nomads being in Mauritania, and considering a further estimate that nomads make up about 15% of the total Sahelian population, the doctors were able to calculate a famine-caused death estimate of 100,000, (Greene, 1975). Demographer John C. Caldwell considers a figure of 250,000 to be possible if on the high side (Caldwell, 1975).

(2) U.S. Senate Hearings, March 1974. An account of the conditions in the Niger refugee camp of Lazaret, near Niamey is given by Sawadogo, 1974. A moving informal account of the catastrophe which befell the Tuareg nomads of Mali and Niger has been provided by Thurston Clarke, 1978.

(3) For a summary of the Sahel Development Program, see OECD — Club of the Sahel, 1977. An ethusiastic summary of the aid group's bureaucratic and technical structure is given in Shear and Clark, 1977. A critique of the Club's approach and of several specific projects and their effects will appear in Franke and Chasin, 1979, in press.

(4) Dependency theory has come to include a wide and often divergent range of perspectives. Perhaps the most thorough introduction can be found in Samir Amin, 1976.

(5) Ball, 1978, p. 281; cf. Hodder, 1969, p. 452. Pehaut, 1970, p. 13, gives a figure of 63%.

(6) These figures do not necessarily hold for today, but they were undoubtedly of relevance in decision-making at the time.

(7) It is interesting in this article, written just three years before the independence of many countries in the area, that mountjoy continued to refer to them as "possessions", particularly since the article is oriented towards the future uses to which their lands might be put.

(8) This same observer was perhaps a bit too taken with the likely efficacy of the government measures, declaring that "the famines which have decimated Niger's population twice during the first half of the twentieth century are now a phenomenon of the past".

(9) DeWilde, 1967, Vol. I, p. 16. The effects of peanut production on soils in Nigeria have been described in Svandize, 1968, pp. 311-328.

(10) The corruption of the Niger government elite was so well-known and so widespread that students in the country referred to the President's wife, Madame Diori, as "l'Autrichienne", after Marie Antoinette of "let-them-eat-cake" fame. (Higgott and Fuglestad, 1975). The subject of corruption in Niger under the Diori regime has bred two Nigerien novels and one play, authorized for publication under the current government. See Ousmane, 1977, Oumarou, 1977 and Keita, 1974.

(11) See also Samir Amin's telling comments on the irrational Common Market-financed transportation system for the peanuts via the more expensive route to Coutenou rather than making use of Nigeria's close-by railway system. As Amin noted, this system "has succeeded in making Niger's groundnuts, even at a rock-bottom price to the producers, unprofitable." This system is a holdover of the colonial period when France did not want to "lose" continuing revenues to a British rival. (Amin, 1973, cf. Péhaut, 1970)

(12) Anthropologists distinguish several types of nomads. Some are full nomads, living entirely from their herds. Others spend part of the year grazing their herds in drier areas, while returning during the rainy season to areas where they practice mixed farming and livestock-rearing. These herders are known as "transhumants" because of their mixed life-style. Finally, some herders are primarily farmers who also own animals.

(13) Edmond Bernus gives a detailed account of the government program to limit agriculture to approximately latitude 15°10' north, and the system of fines for herdspeople whose animals destroyed cropfields to the south of this border. He affirms that a series of years with good rainfall aided in the spread north of the peanut culture which the government regulations were not able to stop. (Bernus, 1974a, & Bernus, 1974b).

(14) This process is described by H. Barral in a mimeographed report quoted at length by Derriennic, 1977. A somewhat more abstract theroetical formulation of the processes described above in terms of social oppositions is given in Derriennic, 1977.

(15) The expansion of Livestock services and the increase in herd sizes does not imply, however, that epidemic disease had been brought under control. As Gallais notes after a summary of the situation in 1972, "In short, veterinary activities, in spite of substantial results, are far from achieving mastery over the epidemic and endemic diseases which make African herding a game of chance," (Gallais, 1972a).

(16) It should be noted, however, that this section is not intended to imply that herders trek great distances in the absence of the wells; only that they were generally more dispersed. In fact, each group in the past would follow a well-planned path to a region where they would move slight distances as required during the dry season, and then return, again along their traditionally determined trek-route (Bernus, 1974b).

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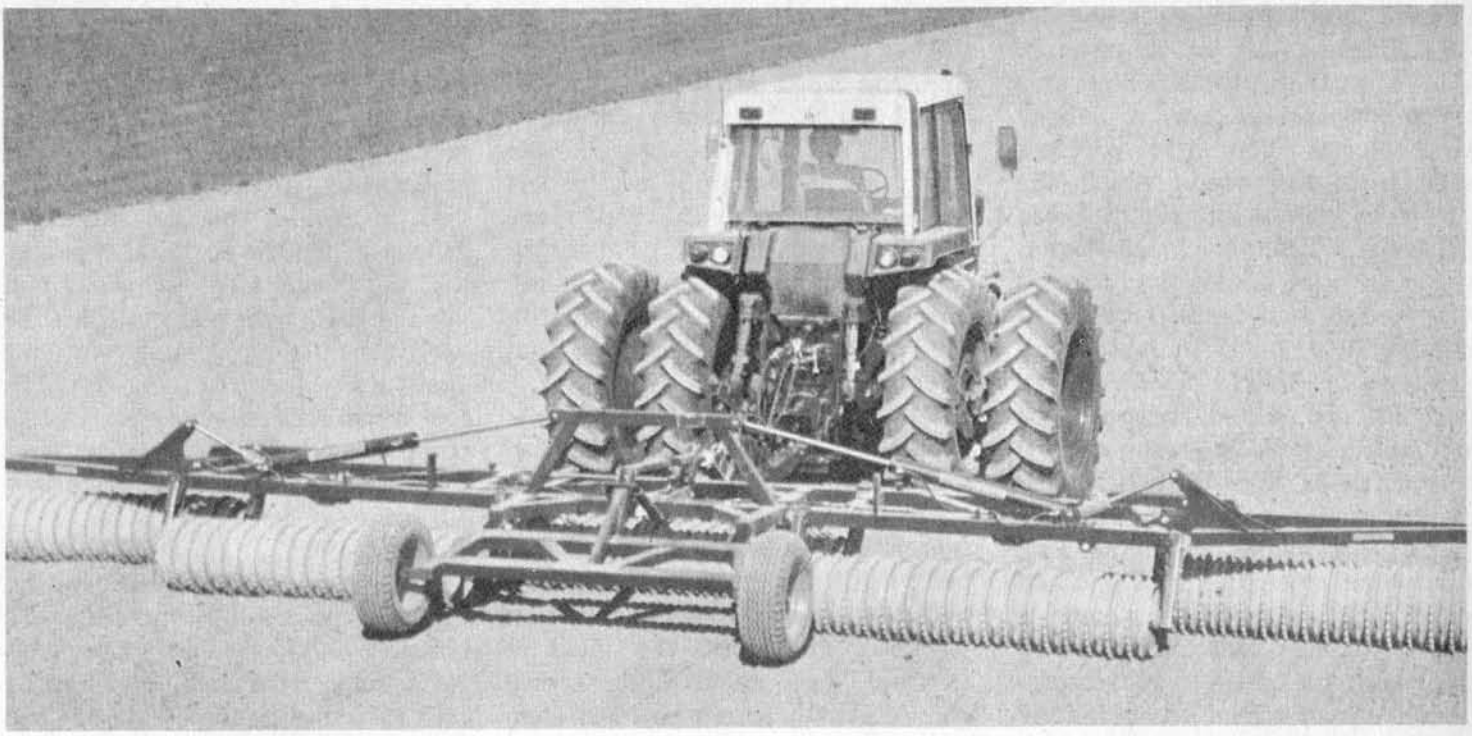

The Quality of Plant Foods

by
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How do modern farming practices, particularly the use of large quantities of chemical fertilizers, effect the quality of the food we eat?

To define the quality of plant foods or, for that matter, the quality of the foods that we take from animals, is not as simple as some might think. Today people use external criteria such as the shape, size, and appearance of foodstuffs. This way of looking at foods has led to some very dramatic changes in, for example the apple growing business.

The Common Market has decided that top quality apples must have a diameter of 54 or 55 millimetres. This decision means that only four varieties of apples will be grade A quality; the remainder will be either too small or too big. During the next 20 years farmers and apple producers will thus plant trees only producing grade A quality, with the result that the consumer will have just four varieties of apples in the stores to choose from. In the United States, where I used to live, everybody knows red, green, and yellow apples; they are Red Delicious, Grannie Smiths and Golden Delicious. In time these will be the only apples which consumers know and consequently shopkeepers will also restrict themselves to these varieties.

Several years ago Professor Schuphan in Germany suggested the use of three different systems to determine quality; one an external one (shape, size, appearance), another the quality which made produce usable for processing, and the third an internal physiological quality. However, from work at our Institute, we would add two more parameters — usefulness for production (thus enabling us to use fewer inputs in the growing system) and, fifth, the social costs involved in the production of certain foodstuffs. Nevertheless, unless one takes everything into consideration it is nigh impossible to determine quality.

Thus we have tried to distinguish the produce of various systems, but have always come to a point where we had to give up and say that with just one measurement, we cannot determine quality. Quality is not just one thing; it is not even just the sum of several things; and in order to determine quality it is necessary to follow a holistic approach.

The Influence of Fertilizing Practice

The history of wheat production in Germany provides a good example of the problems that can be caused by the headlong pursuit of higher yields. In the 1950s, in order to get greater yields people started to use a

different seed dressing employing insecticides against known diseases — later on they supplemented this use in order to cut down on labour requirements. The first problem came from the weeds which the herbicides did not kill; their growth increased. Different, additional herbicides were consequently called for and used. In order still further to increase the yield, increased applications of chemical fertilizer were used but this suited the weeds as well as the wheat and weed growth was increased. This, in turn, called for additional herbicides and for specific herbicides. Problems with mildew and take-all ensued and had to be coped with. The outcome is that in the main wheat area in Germany the farmer had to spend some 1,000 German marks, which is £250 per hectare, for the chemicals which enable him to cope with his production problem. Just to prevent aphid attacks on wheat, farmers now *have* to spray three times a year.

We should therefore consider what mineral fertilizers are doing, what herbicides are doing and what other pesticides are doing as the result of our drive to produce more and more — to produce even bigger quantities.

Effect on Food Quality

Undoubtedly yields can be increased by increasing the application of fertilizer. But, if you obtain maximum yield, your quality parameters are all diminished. At our Swiss Federal Research Station we showed that it is possible with increasing application of fertilizer to increase the yield of apples but at the expense of quality; like the colour of the pulp, red skin, taste, storage quality and texture, all of which are diminished. The result is at maximum yield the quality is poor. With optimum quality the yield comes about half way down the scale. It is important to keep this in mind. If you ask a farmer to produce very good quality apples, you will have to persuade the consumer to pay more for them.

Wine production is the same. You can increase the yield of wine grapes by increased nitrogen application but what you increase is the acid at the expense of the sugar. If you consult the index of ripeness you will see that, for a grape to be really ripe, the index should be over 60. But if you push up the yield of 150 litres per 100 square metres of vineyard, the grapes produced are not quite ripe and above this yield there is no chance at all of the grapes ripening. Maximising yield not only affects such quality parameters as texture but prevents the fruit from ripening properly.

Biologically Grown versus Conventionally Grown Crops.

Petterson at the Biodynamic Research Station in Sweden compared biodynamically grown potatoes with potatoes grown by conventional methods. He found the yield in October was much higher with conventionally grown potatoes than with those grown by biodynamic methods, when the fresh weight yield was approximately 15 per cent lower. But when he took losses owing to grading and storage into account he found 30 per cent losses in one case and 12½ per cent in the other. Thus by the end of the storage period Petterson obtained 26 tons of conventionally grown potatoes compared with 30 tons of the biodynamically grown crop. Arburg at the University of Vienna repeated Petterson's experiments and obtained similar results. A large Swiss supermarket chain now refuses to sell vegetables or fruit from farmers where production exceeds a certain quantity per hectare because of all the findings that excess production results in heavy losses during storage. High yields also interfere with processing.

Conventionally grown crops suffer far higher storage losses than those grown biodynamically.

It was found that the storage loss resulted from perspiratory activity coupled with high enzyme activity, the conventionally produced crop losing 55 per cent more weight, of which 16 per cent was due to respiratory activity, than the biologically produced crop. One aspect of storability is resistance to fungal growth. A special test fungus was tried, its growth on raw material being depressed in the case of biologically grown foodstuffs but high in that of the conventionally grown. When the material was cooked the fungal yield increased and was as high with the biological as with the conventional. In our Institute we are studying different test organisms and trying to isolate components produced by the plant for self-defence.

Inner Quality

Other data indicating the contrast between vegetables grown with compost and vegetables grown with NPK come from Schuphan and relate to 'inner quality'. The critical fact is that the concentration of nitrate in such vegetables is only half that of vegetables grown with NPK. There are other differences. With compost, protein, ascorbic acid, and total sugar are all increased along with some trace minerals, especially iron. The increase in nitrate in vegetables grown with chemicals creates a problem for the plant. The plant takes up the extra nitrate and puts it into the cell which then has a high osmotic pressure. The plant can then only do one thing, put water into the plant and by this dilution resolve its physiological problem. As the result of increasing its uptake of nutrients, the plant cannot ripen at all; an inability which relates to the plant's low storage quality. If you pick a plant which is not properly ripe, it will not store. If you let it ripen properly it will store much better. Large amounts of fertilizer such as nitrogen are quickly absorbed by the plant which cannot say 'No', and the whole selective ability of the roots is disturbed by the thrust of the nitrogen. Thus the yield in a compost grown plant is 24 per cent lower but its dry matter is 23 per cent higher. If a farmer produced vegetables with 24 per cent lower yield but with 23 per cent higher dry matter the consumer might be prepared to pay something more because what he actually wants to pay for is the dry matter and not the water.

Nitrate

Nitrate is of great interest to our Institute and we are working with the government on the problem. By adding compost you also add material which contains lignin. Some old data and some coming more recently from Flagen in Germany show that by putting lignin-containing components in the soil you obtain a product which functions like a switch. With a certain level of nitrate in the soil it turns denitrification off and, unless the plant takes up the nitrate, no more is produced in the soil. If the level of nitrate in the soil drops below a certain level then it again operates like a switch and more nitrate is produced in the soil and made available to the plant. The result is that at any given time there is not more than about 10 ppm nitrate in the soil or in the water contained in the soil. In contrast, sterilization of the soil, as it is done in greenhouses by some growers, increases the nitrate content from the normal base of 50 kilos per hectare to 450 kilos per hectare. Just steaming the soil will do this. If in addition you slowly steam your potting soil you may increase the nitrate to 900 kilos per hectare and you have reached a situation equivalent to the use of chemical fertilizers. Now we do not allow our growers to sterilize the soil except for certain crops where we do not anticipate a nitrate problem, the procedure being mainly intended as a measure of weed control.

Seepage of nitrate into drainage water can bring about a similar problem. By measuring up nitrogen at a depth of a metre, researchers have found that fields farmed organically yield suprisingly different results from fields farmed conventionally. Thus biological methods with undersowing gave values for nitrate one hundred times lower when contrasted with conventional chemical weed control methods.

Fertilizers tend to change grassland. Such a change will also occur when using either raw manure or raw slurry. Again yield can be increased only by a decline in the concentration of dry matter which again is always accompanied by an increase of nitrate and a decline of

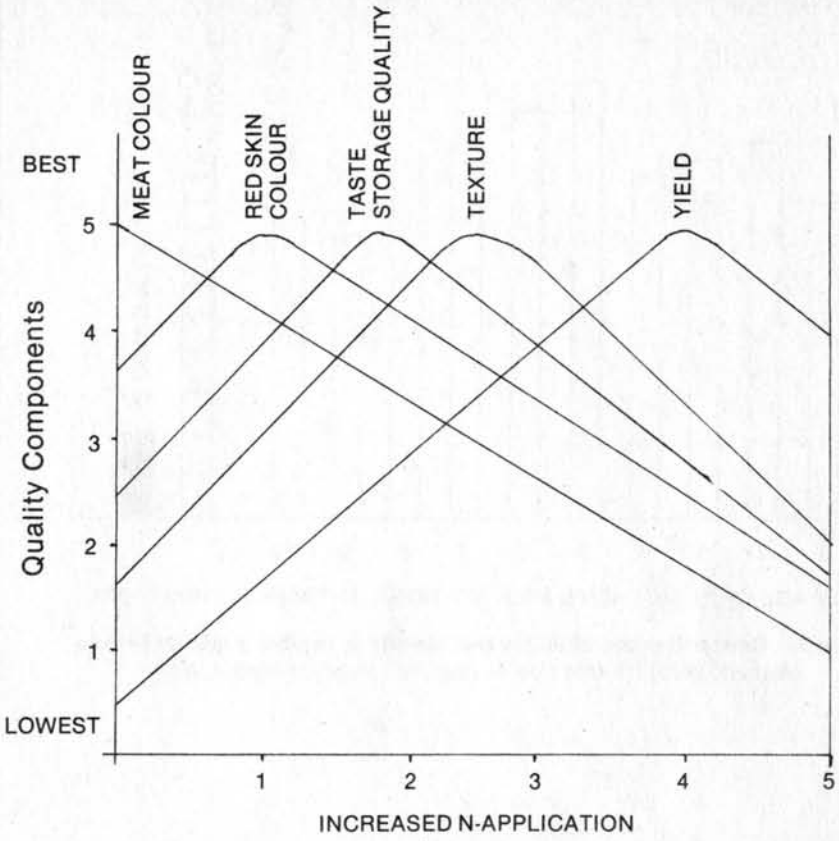

Figure I Quality of apples with increase N-application (Stoll, 1969)

TABLE I

	CONVENTIONAL	BIO-DYNAMIC
Yield, October, Kg/Ha	38200	34200
Grading and storage losses %	30.2	12.5
Weight of the remaining tubers, April	26600	30000
Crude protein, % of dry substance	10.4	7.7
Pure protein, % of crude protein	61.0	65.0
EEA-Index, total	58.4	62.8

Yield and quality of potatoes grown under conventional and biological/organic systems. (Petterson, 1976)

Vitamin C. This we have demonstrated over and over again with vegetables. As to grassland treated in this way, there is a tremendous change in the number of species of grasses followed by changes, not in the number of legumes but in the classes which flourish. All this is reflected in the hay made from this kind of grassland, the potash content is lower and the manganese, magnesium and zinc is higher. This may be connected with the problems of fertility in animals.

Animal Fertility

In one study carried out in Germany Aehnelt compared two insemination stations; at station A they mainly used compost as a fertilizer whilst at station B they used mineral fertilizers. In station B they had less land so that whenever they took the bulls off, they had to put fertilizer on the grass to get it growing quickly again. They looked for 70 per cent movement in the ejaculate. In station A they found 75 and 74 per cent four days after taking the samples in the winter and summer respectively. In station B in winter the result was just under 70, but in summer it dropped drastically and it was in summer that they put fertilizer on the pasture. However they had to buy hay for winter feed-

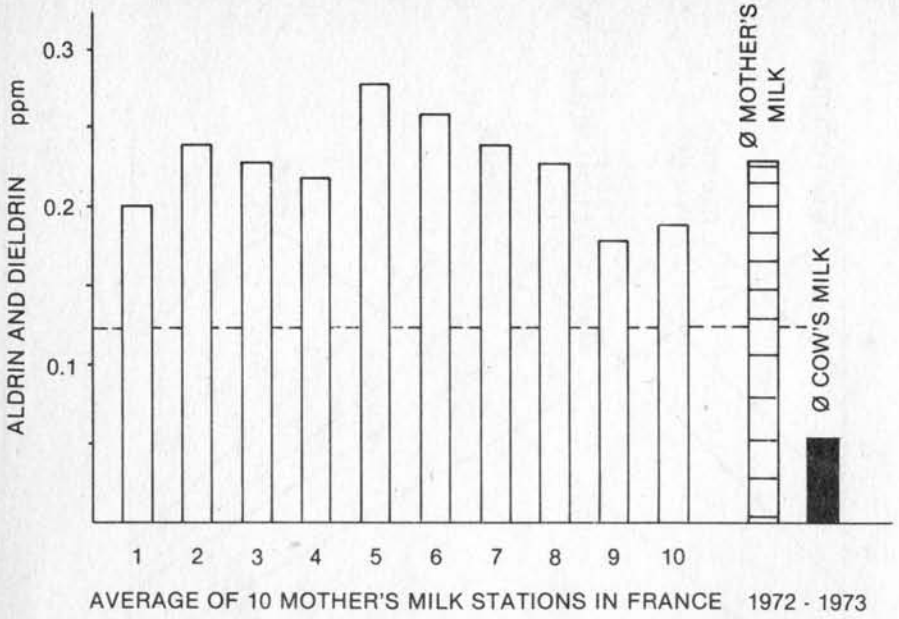

Figure 5. Concentrations of aldrin and dieldrin in mother's milk in France (Aubert, 1975) *(Dotted line = max. tol. level for foodstuffs)*

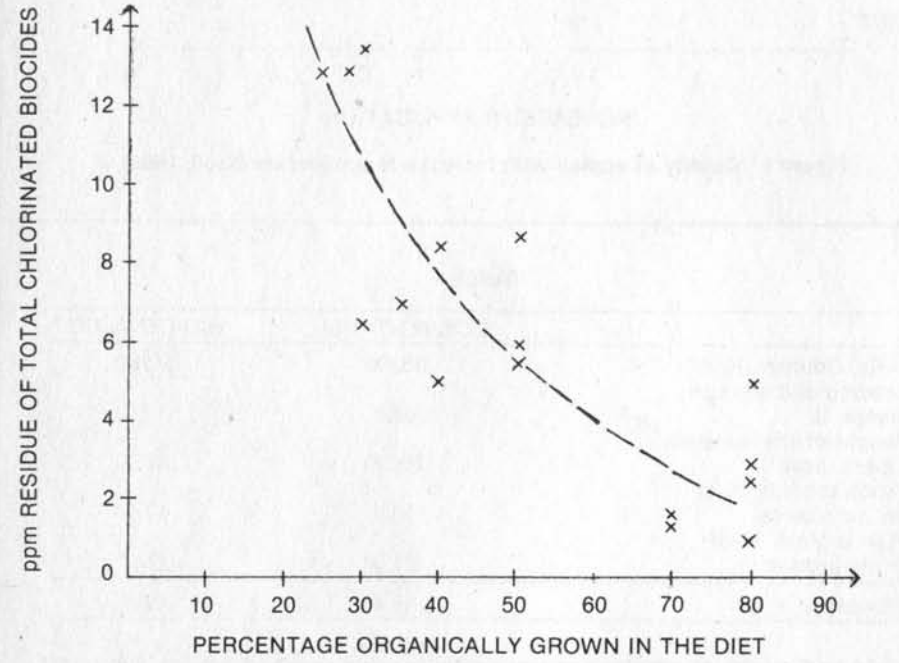

Figure 6. Chlorinated biocides and derivatives in mother's milk in France (Aubert, 1975), in correlation to the percentage of organically grown food in the diet

ing; this came from different areas and therefore the problem was not so acute.

Aehnelt and Hahn in the Veterinary College in Hanover experimented with rabbits using carrots from different systems — from a high NPK system and from a biodynamic system. They found a tremendous difference in fertility between rabbits fed on carrots from NPK systems and rabbits fed on carrots from the biodynamic system — the fertility rate of the latter being twice that of the former.

In 1975 Professor Gottschewski at the Max Schelling Institute in Freiburg carried out tests on rabbits using much larger numbers. He had groups of 40, 32 and 31. He used either pelleted feed with vitamins added, fresh conventional or fresh organically grown materials. The number of animals alive after weaning in the case of pelleted feeds was fifty per cent; the same ratio applied in the case of animals receiving fresh conventional food; but those fed organically grown food had a much higher ratio — 75 per cent being alive at weaning. This result indicates the difference in fertility and in the vigour of the young. I feel that we have here something which we can measure: something we can demonstrate with a chemical measure, with biological measures and with a microbiological measure.

Biocides in Milk

Figure 2 shows that cow's milk registers .05 ppm of aldrin + dieldrin whilst mothers milk is up to .25. The dotted line is considered by the WHO to be the safety level for foods put on sale. Cow's milk is below but mother's milk is above. I do not want to say you should not feed mother's milk, what I want to demonstrate is that we have substances coming into our cells and our body — which are stored in our body fat and which might then be reactivated and transported — as in this instance into mother's milk. Studies carried out in Switzerland since those of Aubert show that the situation has improved slightly with regard to chlorinated biocide but not with regard to polychlorinated biphenyls (PCBs). In the Swiss study the researchers took women from Italy, Yugoslavia and from many other countries and found high levels of chlorinated biocide emanating from agricultural slurry and low levels of industrial biocide — the fully chlorinated biphenyls. In industrial countries the levels of chlorinated biocides derived from agriculture tended to be lower, but there was a considerable increase in PCBs. So we are presented with a further problem caused not by agriculture, but by something else.

Two Swiss Government laboratories checked foodstuffs in the market in the area where I live where we have 5 organic growers who come into the city to a farmer's market. During 1978 the government carried out checks over the course of the year. They took samples of vegetables and food every week, distinguishing what was imported, what was grown in Switzerland and what was biological. The figures were surprising. They checked for 32 pesticides. That is probabl all that our analytical methods allow us to check. There is no analytical method of testing for most of the pesticides, particularly for herbicides. Checking for those 32 did not find any in vegetables grown organically; but they found one example of a phosphorus containing

pesticide in apples and pears. The pesticide, should not have been used by the farmer and he was fined 1,000 francs. With vegetables grown by conventional methods 20 to 25 per cent showed residues but very few above the accepted tolerance level. With apples and fruit the proportion was much higher — 55 per cent had some residue. I am trying to indicate that although chemicals may be dispersed all round the globe it may be possible for biological farmers to produce crops with less than the average or even with none at all.

To sum up, I have indicated that there are differences that can be measured. However, most of our evidence is drawn from experiments conducted under the same soil conditions, the same climatic conditions and the same management. It is much more difficult to take a carrot from Oxford, another from Wales and a third from Scotland and to compare them with regard to some nutrient, distinguishing the one grown organically from that grown conventionally. We do not believe that this is, as yet, possible.

Acknowledgement
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A New Look at Contraception

by
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Translated from the French by Elizabeth Mapstone

Modern contraception offers a technological solution to the problem of overpopulation. But what are the side-effects of the technology? And isn't the problem more cultural than technological?

A study undertaken by the French National Institute for Demographic Studies[1] shows that, in France, 27.6 per cent of women between the ages of 20 and 44 use the Pill, and that peak use (38 per cent) is between the ages of 20 and 24. The coil is used by 8.7 per cent of women, while only 11 per cent use the "gentle" methods of contraception, such as condom, diaphragm or the rhythm method.

When it comes to so-called "modern" contraception, France is in the lead. In the United States for example, 22 per cent of married women in the 20-44 age group use the Pill. No doubt the attitude of the French authorities has had its influence. On the one hand, practically no research at all has been funded in France to study the harmful side-effects of contraceptives; on the other, there have been many studies to find out why women resist using oral contraceptives or the coil. The hundreds of scientific studies on the adverse effects of these two types of contraception, carried out mostly in the United States, have only been made available in France in dribs and drabs, and with serious omissions. Even doctors are very badly informed on the subject. General opinion is that the Pill is not used widely enough.

Why, then, do women hesitate to use the Pill? A SOFRES survey in 1976 showed that 76 per cent of those who spurned its use did so because they believed "it could have bad effects on the health of the user", whilst 54 percent believed "it could have bad effects on the health of future babies". Should we reject these views, as being entirely without foundation?

Inevitable Uncertainty

In the entire history of medicine, there has never existed any active drug which has not had some undesirable side effect. It is not unusual for subtle, even microscopic, effects of a drug to show up twenty or thirty years after its first appearance on the market, and even then, a conscientious researcher is needed to suggest a potential danger before it is found. We know that drugs only reach their target in a roundabout way, and that they always involve broad areas of the metabolism; some changes in metabolism will always remain inaccessible to investigation. Thus it is clear that distrust of or belief in a drug are only partially a matter of knowledge: there is always a margin of uncertainty, so that people opt "for" or "against" for other motives.

The desire to be free of the continual worry of an unwanted pregnancy has naturally led people to look for the answer in new products on the market. But would the millions of people who have lent themselves to this venture have done so if they had been told of the risks they were running?

Original Doubts

The decision to develop the Pill raised in the minds of some European researchers doubts analagous to those of certain advanced physicists as to the wisdom of developing nuclear fission. I can remember the arguments about this in the Faculty of Medicine in Turin in the early fifties. Several professors, both men and women, maintained that to take this path would be to break the essential link between technology and science (they meant by "science" the integration of knowledge and benefit to humanity); I, in company with the other young assistants in the Institute of Histology and Embryology, was strongly *in favour* of this research, and insisted that knowledge was good in itself and did not necessarily lead to abuse. The studies in the late sixties and seventies on the harmful effects of oral contraceptives showed that fears as to physiological effects were well-founded; and the unbridled use of the Pill has more than justified any mistrust that was felt as to the ability of society as a whole to use knowledge with wisdom, though here cultural differences were very marked. The fact that the use of oral contraceptives is now slowing down in countries such as Great Britain and the United States, while in France it is on the increase, should make us reflect on the quality of information made available to the French public.

The Pill: its Side-Effects

We have a mass of medical literature on the side-effects of the Pill. From these studies it is clear that as a contraceptive it is very efficient, but that it is involved (to a greater or lesser degree, depending on quality and dosage) in the pathogenesis

of various diseases, especially where there is already a predisposition. Heading the list of disorders are thrombosis and embolisms, hypertension, diabetes, jaundice, pathology of the breasts, general lessening of resistance to infection (venereal or other), and possibly some tumours. In adolescents, use of the pill can lead to an imbalance of physical development, to amenorrhea (absence of menstruation) and sterility. A possible link between exogenous steroids and certain abnormalities in the newborn is now under discussion.

The U.S. Food and Drug Administration regularly publishes reports which re-examine oral contraceptives as a whole[2,3,4]. Relative risks of different diseases and causes of death are shown. Death by myocardial infarctus in the age group 30-39, for example, occurs in 5.4 per cent per 100,000 of women who have used oral contraceptives and in 1.9 per 100,000 of those who have never used it; the gap between users and non-users is much greater (54.7 against 11.7) for women between 40 and 44. Risk of cerebral haemorrhage is also greatly increased[4,5,6,7].

Most importantly, the F.D.A. reports draw attention to the studies by Janerich[8], which have established a link between incorrect use of oral contraceptives and certain skeletal deformities of babies conceived while the Pill was being taken or while the mother was being treated with similar drugs. Other studies have shown a link between hormonal changes in women who have stopped taking the Pill and chromosomal abnormalities in the foetus — although the evidence for this varies greatly and the subject is still open to considerable controversy. Nonetheless, the F.D.A. officially recommends that women who wish to become pregnant should wait at least three months after stopping the Pill before they conceive.

A joint study by the Faculties of Medicine of Boston University and of Harvard examined more than 50,000 pregnancies[9,10]. They found that the risk of producing a baby with abnormalities of the heart is more than doubled if it has been exposed *in utero* to exogenous female hormones during the first weeks of gestation (frequency 18.2/1000 versus 7.8/1000). This is bound to have a devastating effect on the population as a whole for, according to Dr Nora of Colorado University, 10 per cent of all pregnancies in the United States are accompanied in their first weeks by taking of the Pill, either because treatment was started before the woman knew she was pregnant, or because she used it irregularly. In France, where the use of the Pill is more widespread, this percentage is likely to be higher.

As to the possible connection between absorption of oestrogens and cancer, the F.D.A. refers to the study by Herbst *et al.* on vaginal carcinoma: this research uncovered the unexpected and extremely important fact that cancer in young women between the ages of 15 and 22 was linked with absorption by their mothers of oestrogens during the first weeks of pregnancy.

In mammals which have been given female sex hormones over a prolonged period, cancer may develop in the breast, the cervix, the vagina, and a non-cancerous tumour in the liver. One must not conclude that oral contraceptives are a cause of cancer in women; but it is thought they can have this effect where there is a pre-disposing factor. For example, oral contraception increases the incidence of breast cancer in women who already have non-cancerous disorders of the breast[3,4,11,12].

Dr Doll of the Department of Medicine at Oxford, where a team has been studying this subject for more than ten years, confirms that oral contraceptives play a more or less marked role in development of the disorders we have just mentioned. It is easy to see a possible link between such disorders (for example, diseases of the liver or ovaries, circulatory disorders, genital infections) and difficulties of pregnancy. Use of the Pill would here have an indirect pathogenic effect on the foetus. Several studies also suggest that stopping the Pill followed by an endocrine deficit or imbalance, but it is not yet clear how long this phenomenon lasts and under what conditions it is reversible. All these factors interfere with the normal progress of pregnancy, and may result in small abnormalities in the new-born which are not immediately apparent, but which may even affect the central nervous system, and only show up later when the child does not function properly.

The Coil and its Dangers

Let us now take a look at intra-uterine devices. IUD (Intra-Uterine Device) — more commonly known as "the coil" — is the term given to various metal or plastic objects which are installed in the uterus to prevent implantation of the egg. Until 1977, the F.D.A. was only able to examine drugs and nothing else, and so all kinds of devices were manufactured in the United States and given to women to use without any interference from the federal government. From the U.S. they spread thoughout the world. Since then, federal legislation has been changed, though local anomalies still do arise.

The coils are an experiment, an enormous affair of trial and error, and every woman who uses one is a guinea-pig. We do not know how they work. The most likely explanation is that they produce (when all goes well) a small inflammation in the uterus which either prevents the egg from implanting itself in the uterine wall, or interferes with the performance of the sperm within the uterine area. The effect of the coil is self-evident when inflammation spreads and blocks the fallopian tubes.

We do not have valid statistics on the frequency of unfortunate side-effects, and such statistics as are available are so disparate and unreliable that the F.D.A. refuses to publish them. Its instructions on use of the coil are assembled in the Federal Register of May 1977[13].

The most usual side-effects are intermenstrual bleeding, hypermenorrhea, cramps, and above all, infection. Fainting may occur during insertion of the coil. The frequency of undesirable side-effects is shown indirectly by the rate of removal of the coil during the first year, which varies according to model and specialist, but which is probably in the region of 30 to 40 per cent. The efficiency of the coil is not great, for various authorities report a failure rate in the region of 5 per

A British poster aimed at encouraging men to take more responsibility in preventing unwanted pregnancies. "Many men take it as a matter of course that women should take care of the problem of contraception . . . But love involves two people and so should contraception."

cent — that is, out of every hundred women using the coil in a given year, about five will become pregnant. There is then an extremely high probability that the pregnancy will be septic and/or extra-uterine. Half of all these pregnancies end in miscarriage. It is unnecessary to point out that infection and other complications of pregnancy are serious clinical problems which may even endanger the life of the patient. Furthermore, infection of the genital passages frequently leads to sterility. Infection, which may be caused either by insertion of the coil or by its continuing existence within the uterus, is not confined to the reproductive system: infection may spread from the uterus to other parts of the body, the example most often described being chronic bacterial endocarditis.

Hospitalisation due to use of the coil, according to the U.S. Public Health Service Center for Disease Control and the F.D.A., is for the following disorders in order of importance: 1) infection, 2) abnormal pregnancy, 3) perforation of the uterine wall. Perhaps I should add here that the category "infection" means mainly acute inflammation of the fallopian tubes, peritonitis, and septicaemia; and that frequently it is only possible to control such infection by removal of the affected organs.

The uterus is designed to protect and defend the developing unborn child: everything in its anatomical and physiological make-up is designed with this end in view. It is hidden away in a well-protected part of the body, and under normal conditions is not open to the outside world, unlike the vagina. The cervix is a naturally impassable barrier, keeping out microbes and resistant to most attempts at penetration by a foreign body. On the other hand, the uterine cavity does communicate with the peritoneum via the Fallopian tubes. The entrance of the cervix may not be crossed even by sperm except during the ovulation period, when it opens to sperm, but sperm alone. Now it is into this protected place that one must penetrate to deposit the foreign body, leaving two threads of nylon to dangle through the cervical entrance so as to be able to remove the object some time in the future (an operation often attended with considerable difficulty). Clearly the protective barrier of the cervix is compromised, perhaps for ever.

The history of the coil is a good example of what can happen to one of the most noble of human professions when it submits to the pressure of interests which have nothing whatever to do with public health.I should like to ask a simple question: is it the function of Medicine to create illness?

Medical students in Paris who might like to get an objective picture of the harmful side-effects of the coil will not find anything in the card index of the Faculty of Medicine central library to help them. (There is one card on oral contraceptives, though the report it refers to has disappeared from the shelf: there are now approximately 2,000 scientific studies and 150 reports on this subject.) On the other hand, in the bookshops across the road they will find various commercial brochures on IUDS, most of which are devoid of any scientific value.

What can we do?

If the contraceptive techniques now in fashion are not as good as we thought, what can we do? My answer would be that it is possible to prevent unwanted pregnancies by unspectacular methods, but that this requires knowledge of sexual physiology, respect for one's partner, and care. The method would vary depending on the time of the cycle and how the partners approach each other when they wish to make love. For example, using the safe period, supplemented on occasion with the condom, will be just as efficient as the Pill. (Naturally, it would help if we could find a condom in the chemist which did not make one think of Michelin tyres! We don't need a supersonic jet to get from Rue du Bac to the Bois de Boulogne; and if we choose to go by bicycle, a modern stream-lined one is better than great-grandfather's jalopy). The method I have just suggested is the easiest, and is based on the monthly menstrual

cycle. The rhythm method is more refined and more precise, and takes account of the rise in body temperature following ovulation and during the entire post-ovulation period, as well as the appearance of specific vaginal secretions which mark the moment of ovulation and are easily recognized.[14]

It will be objected that this gentle approach needs careful, well-informed people with an eye for detail. But oral contraceptives also require care, and neglect can lead to conception while on the Pill, which must be avoided. The coil, unless used with quite exceptional circumspection, can have disastrous consequences. Why not make an effort to give people information about those methods which are the least risk to their health?

The usual objection to using the safe period method is that few women have regular menstrual cycle. While making an epidemiological study in the Grenelle Quartier of Paris, we found that 22 per cent of the female population aged 35 had irregular cycles. The cause was often attributable to drugs which interfere with hormone balance, or to psychological difficulties (male and female) which prevented the full flowering of sexuality.

Out of Touch with Nature

This problem is much more widespread than it appears at first when one is focussing attention on contraceptive techniques alone. In this context, normal physiology depends on the harmonious integration of sexuality into an individual's life, and into the life of the couple. The more rudimentary and neurotic the feeling function, the more it is separated from its human context and reduced just to the genital. "Sexuality has not been liberated, it has just been de-sublimated," wrote Herbert Marcuse.

In our society of technologists and marketing men, people have lost their sense of being part of Nature, feeling disconnected with what goes on inside them, and no longer feel in charge of their physiology. It is impossible to suppose that sexuality and the ability to feel pleasure are unaffected; their roots reach beyond the experience of the individual into biology and reproduction.

So why do I *believe* that we shall never find the perfect contraceptive? Because it is an attempt to overcome the body, which will continue implacably, at all levels, to try to maintain the very best conditions for conception. Any attempt to prevent conception — especially if it operates at a cellular level — is bound to have repercussions on the normal functioning of the reproductive system. When it comes to "gentle" methods of contraception, the repercussions are practically nil.

Responsibility

Too little account has been taken of the physiological integrity of the female body. A practical consequence of this fundamental lack of respect is that many men take it as a matter of course that women should take care of the problem of contraception, as though it is their sole responsibility. But love involves two people, and so should contraception. I should think it perfectly normal for men to assume their rightful responsibility in this area. It is a n atter of human dignity, or rather, of humanity.

While trying to answer the question "what can we do?", I find myself writing about the cultural aspects of the problem as well as the biological ones. This is enevitable. All scientific knowledge has its implications, whether we look at it from an ethical or a social standpoint. We are asked for irrefutable proof that the Pill is harmful: why are we not also asked for proof that it is harmless? But in either case, science can only give a partial answer.

A New Approach

In my view, prudence is the best counsellor: the "big guns" in the contraception arsenal should only be brought in on rare occasions, and with circumspection. I believe it would be in the public interest if public authorities could be persuaded to change tack, and try to:

1. Provide funds for improving "gentle" contraceptive techniques.
2. Inform the general public about the various choices available, and as to the correct use of the technique chosen.
3. Take account that "taking the drama out of sex" has actually had the result of debasing sexuality. Educate young people — especially boys — to a sense of responsibility and respect towards their partners.
4. *Try to prevent young women reaching adulthood with their physiological or pyschological integrity already undermined by chemical or surgical interference.*
5. Make it obligatory to give warnings to all users of the "heavy" contraceptives, as is already the case in the U.S. and many other countries.

The views I have outlined above stem from an attitude to technological progress which, unfortunately, does not fit in with the dominant approach today. It seems to me it is a question of whether we let "the great machine roll on and crush us", or whether we are clever enough to adapt technology to the needs of society and of the individual.

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Thermodynamics or Ecodynamics?

by Edward Goldsmith

Scientists and philosophers — many of them sympathetic to the ecological movement — have seized on the Second Law of Thermodynamics and hailed it as the key to unravelling the secrets of the universe. But can the behaviour of the natural world really be understood through a law originally formulated to explain the workings of a steam engine?

Entropy by Jeremy Rifkin and Ted Howard has been hailed as a new landmark in the study of what the Club of Rome calls the Predicament of Man. Rufus Miles of Princeton University describes it as "earth shaking in its implications" and compares Rifkin to Copernicus and Darwin. Hazel Henderson assures us that Rifkin and Howard "have written the epitaph of economics" and that their book provides a "major reconceptualisation which will help to shape the public debate of the 1980s." I am afraid I can agree with none of these views.

This is not to say that this book does not have qualities. I think that it does state very succinctly and very clearly just how industrial man is destroying the planet on which he lives. It also tells us that there is no technological way out — as government experts still insist there is. The only solution to our problems is to phase out industrial society itself and phase in a new low-energy society — a thesis that is well known to many of our readers since it was first properly formulated in the pages of this magazine in our *Blueprint for Survival* in January 1972.

It is for a different reason, however, that this book is considered so important. It tries to explain what is happening to our society and it does so in a language that will impress many people — that of thermodynamics, which our scientists — the priests of industrialism — and in particular our physicists — the high priests — have ritually sanctified. Their thesis is that the fate of our economic system is sealed by virtue of the fact that economic behaviour violates that most holy of all principles — the second law of Thermodynamics, or the Entropy Law.

This is of course primarily the thesis of Nicholas Georgescu Roegen whose papers we have published in *The Ecologist* since 1971[1], not so much because I or any of my colleagues were sold on the Entropy thesis, but because Georgescu Roegen is one of the first economists to have shown that economic behaviour must be governed by the laws that govern other forms of behaviour on this planet and not just by those very narrow ones that our economists have formulated. I part company with Georgescu and Rifkin when they include the Entropy Law in the former category, still more when they tell us, as most scientists do today, that it is the most fundamental of all such laws.

Before I defend my position, let me first try to explain what is the Entropy Law.

The Entropy Law

The term 'entropy' was coined by Rudolph Clausius in 1868. He observed that within a closed receptacle, heat differences tended to even out. The evening-out continued until total heat-uniformity was obtained. This uniformity could thus be regarded as a position of 'equilibrium' — at least from the thermodynamic point of view, and he referred to it as 'entropy'.

As Rifkin points out, however, the concept itself is much older. Sadi Carnot, a French engineer, first made use of it forty-one years earlier. In trying to understand the workings of a steam engine, he realised that it was exploiting the heat difference between that part of the system which was hot and that which was cold. It was this difference in temperature that enabled the system "to do work". This difference, however, tended to even out, and as this happened, so the system's ability to do work was correspondingly reduced.

In such conditions, energy is said to have been dissipated — which means that it has degraded to a more homogeneous state — one that is identified with equilibrium or what Clausius called 'entropy'.

This, in essence, is the entropy law, and it would be quite acceptable if it were applied strictly to the field of thermodynamics. The trouble, however, is that its use has been extended to apply to fields of behaviour that are very distant from thermodynamics, and which would appear to most sensible people to be governed by very different laws from those that govern the behaviour of hot air in a closed receptacle or of steam in the boiler of a locomotive.

The Entropy Cult

What has happened to the entropy law is what happened to many other scientific theories. It has become the object of a cult and taken to provide a key

with which to unravel the secrets of the universe.

The same thing has occurred to Shannon and Weaver's Information Theory which was perfectly all right so long as it was applied to the field of communications for which it was designed, but which has only served to confuse everybody after it was hailed as a great scientific discovery that would, among other things, provide a means of measuring biospheric complexity or organisation.

Why does the Entropy Law not apply to the Real World?

How then do we know that the entropy law does not apply to behaviour within the biosphere?

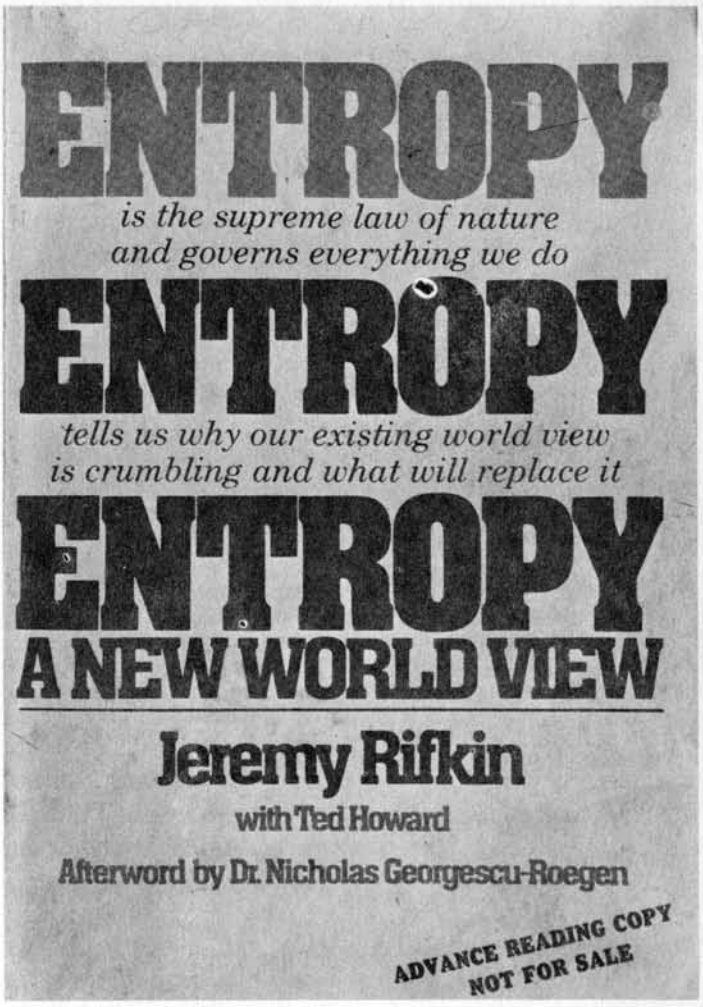
Well to begin with it is easy to see that it doesn't. Life probably began on this planet three thousand million years ago and since then — that is until the beginning of the historical era a mere ten thousand years ago — it has not ceased to develop both in complexity, diversity and stability.[2] In other words it has behaved over, what most sensible people would regard as a sufficient sample of time, *in a manner that is diametrically opposed to that in which it should have behaved had it been governed by the Entropy Law.*

This is a source of great embarrassment to our scientists. "How is it possible to understand life" writes Brillouin[3] "when the whole world is ruled by such a rule as the second principle of thermodynamics which points towards death and annihilation?" Indeed, either we are all mad and there has not been such a thing as evolution, and the biosphere with its myriad forms of life is an illusion or else the entropy law does not apply to the behaviour of living things — only to that of hot air in a closed receptacle or steam in a locomotive.

Some of the most thoughtful philosophers of biology seem to realise this. Thus as Arthur Koestler[4] writes "the Second Law applies only in the special case of so-called 'closed systems' (such as a gas enclosed in a perfectly isolated container). *But no such closed systems exist even in inanimate nature,* and whether or not the universe as a whole is a closed system in this sense is anybody's guess. All living organisms, however are 'open systems', that is to say, they maintain their complex form and functions through continuous exchanges of energies and material with their environment. Instead of 'running down' like a mechanical clock that dissipates its energies through friction, the living organism is constantly 'building up' more complex substances from the substance it feeds on, more complex forms of energies from the energies it absorbs, and more complex patterns of information — perceptions, feelings, thoughts — from the input of its receptor organs."

Brillouin[3] also realises this. "Both principles of thermodynamics" he writes "apply only to an isolated system, which is contained in an enclosure through which no heat can be transferred, no work can be done and no matter nor radiation can be exchanged." The world on the other hand is not a closed system. "It is constantly receiving energy and negative entropy from outside — radiant heat from the sun, gravitational energy from the sun and moon (provoking sea tides), cosmic radiation from unknown origin, and so on." In this way, "the sentence to 'death by confinement' is avoided by living in a world that is not a confined and closed system."

Von Bertalanffy[5] notes the same thing. Because they

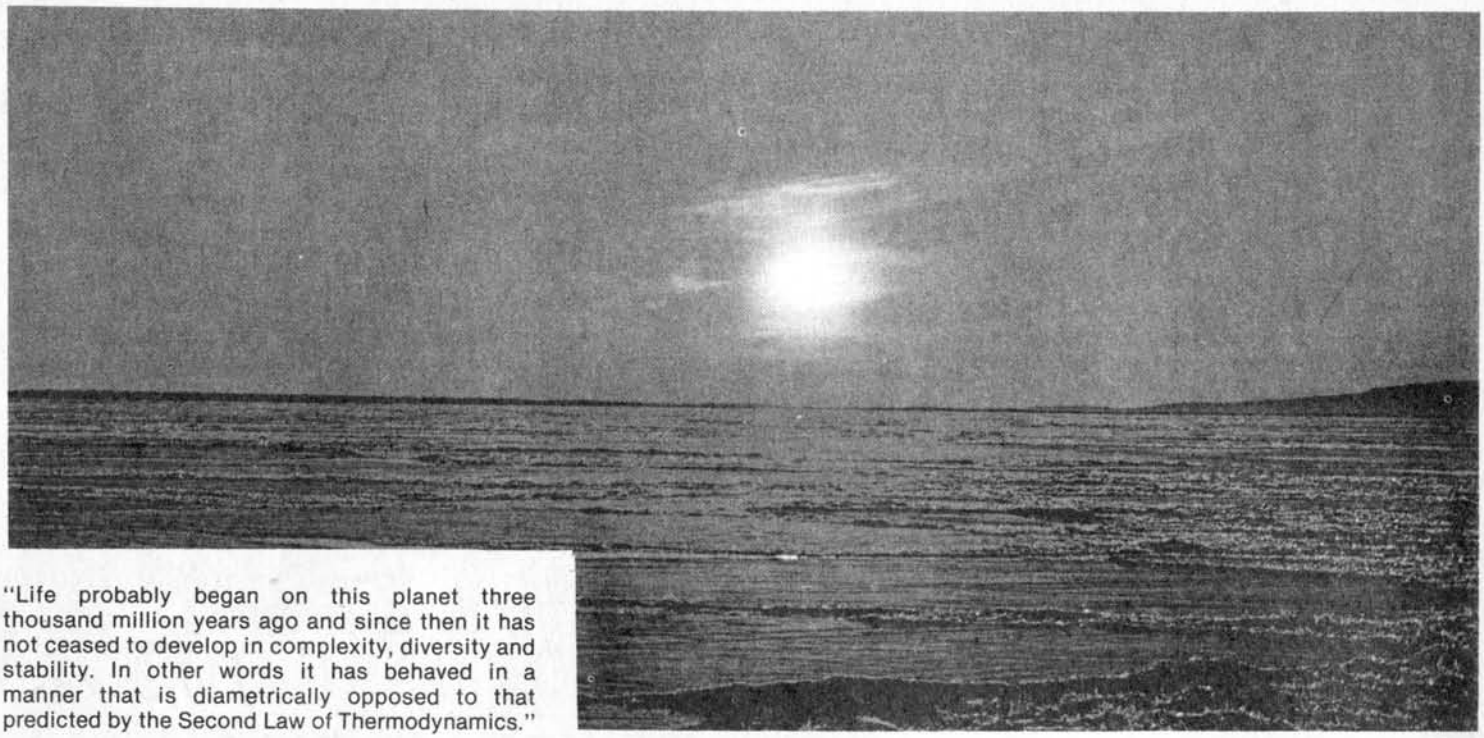


The book at the centre of the controversy. Rufus Miles called it "Earth shattering in its implications"; Hazel Henderson deemed it "The epitaph of economics."

live within an open system "living systems, maintaining themselves in a steady state, can avoid the increase of entropy, and may even develop towards states of increased order and organisation".

So too Waddington[6] regards the embryological process as a model for other biospheric processes. He notes that the embryo increases its complexity as it develops and for this and other reasons cannot believe that "any serious embryologists have considered that the second law of thermodynamics could be applied in any simple way to their subject material, in spite of what classical physicists might say." Indeed, Waddington assures us that the most creative physicists of his day, people like Blacketh, Cockroft, Wilson and Dirck, would not have been tempted to impose the entropy law *"as a rigid dogma of biology."* But is it only because the earth receives energy from the sun (i.e. because it is an open system) that the entropy law does not apply? There seem to be other reasons. After all, other celestial bodies are open systems just as is the planet earth. They are all bombarded with energy, "radiant heat from the sun, gravitational energy from the sun and moon, cosmic radiation etc." *Yet this has not enabled them to develop life as our planet has done.*

Another consideration leads one to the same conclusion. Even in a closed system, behaviour does not always occur as it should do were it governed by the entropy law. Thus if one puts a corpse in a closed receptacle, one would expect it to decompose into its



"Life probably began on this planet three thousand million years ago and since then it has not ceased to develop in complexity, diversity and stability. In other words it has behaved in a manner that is diametrically opposed to that predicted by the Second Law of Thermodynamics."

component parts, hence moving towards that state of disorder which our aristo-scientists identify with entropy. However, it will not do so, unless we open our closed receptacle and let in some oxygen.

The Reductionists

It is not altogether surprising that other conditions should have to be satisfied, for it is difficult to believe that the development of the biosphere can be explained as the entropy law implies, *simply in terms of energy*. Can sensible people really believe, as Rifkin tells us, that "the entropy law....this supreme physical rule of the universe purveys every facet of our existence *because everything is energy?*" This is an old myth which we can refer to as "energy-reductionism". It originally appears to have come into being as a way of getting round the problems associated with the understanding of matter. The atomic theory of matter was controversial. Thermodynamics was supposed to be based on it. Carnot however showed that this science was independent of such a theory. It only involves energy changes. As Mason[7] points out, this meant that "thermodynamics could proceed without a theoretical model of the nature of matter, indeed it could proceed *without the supposition that matter existed objectively.*"

Hence the 'Energetik' school which, like Rifkin taught that the phenomena of nature were explicable in terms of the transformation of energy. "What we hear", wrote Oswald[7], the principal proponent of this view "originates in work done on the ear drum and the middle ear by the vibrations of the air. What we see is only radiant energy which does chemical work on the retina that is perceived as light. From this standpoint the totality of nature appears as a series of spatially and temporally changing energies of which we obtain knowledge in proportion as they impinge on the body, and especially upon the sense organs fashioned for the reception of the appropriate energies."

Of course other writers (Pythagorus, Mayer) have told us that everything is number, while atomic reductionists like Francis Crick tell us that the world is exclusively made up of atoms. In reality, of course, it is the way these atoms are organised that is critical while there is no reason to believe that atoms have any greater reality than the objects — tables, chairs, dung-beetles, fiddler-crabs or whatever — into which they are organised.

The Illusion of Reductionism

It is only possible to maintain these various forms of reductionism if we limit our study to very simple inanimate objects like gasses and billiard balls. As soon as one looks at the behaviour of complex forms of life in the real world the illusory character of these theories is quickly revealed.

As Brillouin[3] points out, "For inert matter it suffices to know energy and entropy. For living organisms, we have to introduce the 'food value' of products. Calories contained in coal and calories in wheat and meat do not have the same function. Food value must itself be considered separately for different categories of living organisms. Cellulose is a food for some animals, but others cannot use it. When it comes to vitamins or hormones, new properties of chemical compounds are observed, *which cannot be reduced to energy or entropy.* All these data remain rather vague, but they all seem to point towards the need for a new leading idea (call it principle or law) in addition to current thermodynamics, before these new classifications can be understood and typical properties of living organisms can be logically connected together...."

It is easy to show that if a complex natural system is deprived of any of its basic constituents — whether it be energy, information or any of the basic chemicals of life, it will cease to function properly and will slowly disintegrate i.e. move in the direction of disorder or what Rifkin would call entropy. Thus it would be more precise to talk of 'energy-entropy' which would enable

us to distinguish this notion from that 'information entropy' and 'materials entropy'. We could then have a whole set of entropy laws, each one stating that, in the absence of a specific constituent, movement will be towards 'general' entropy. Such a law is implicit to Shannon and Weaver's theory of information. As we shall see, Georgescu Roegen also formulated such a law with regards materials — the Fourth Law of Thermodynamics. We can of course go much further still and subdivide materials entropy into carbon-entropy, phosphorous-entropy, water-entropy etc. — and so on for the essential irreplaceable ingredients of living things. All such concepts would be as *valid* as that of energy-entropy about which people make so much fuss, but they would be equally *invalid* once all the other conditions favouring biospheric development were satisfied, for then systems are either able to synthesize their own constituents or derive them from elsewhere in the quantities required.

The availability of these constituents then leads to a very strange, indeed, what appears to be, an unique phenomenon. They tend to organise themselves — not in a random or haphazard way as is suggested by Volterra,[8] May,[9] Mellanby,[10] Prigogine,[11] and many others, *but in a highly directive way,* for random organisation does not exist in the real world[12].

Now, living things develop — successive thresholds are achieved which are referred to as *levels of organisation.* Each time one is achieved new forms of behaviour appear that are governed by laws that were not previously operative. At the most sophisticated levels of organisation, behaviour displays those features we associate with life, and are governed by a set of laws that are quite unknown to the physicist and the chemist to the extent that their knowledge is derived for the study of behaviour at lower levels of organisation. What is particularly relevant to the thesis of this review is that living things are capable of overcoming many of the constraints applying to the behaviour of simpler things. On this subject it is worth quoting Brillouin[3] once more. "Consider a living organism" he writes, "it has special properties which enable it to resist destruction, to heal its wounds, and to cure occasional sickness. This is very strange behaviour, and nothing similar can be observed about inert matter. Is such behaviour an exception to the second principle? It appears so, at least superficially, and we must be prepared to accept a 'life principle' that would allow for some exceptions to the second principle? When life ceases and death occurs, the 'life principle' stops working, and the second principle regains its full power, implying demolition of the living structure. There is no more healing, no more resistance to sickness; the destruction of the former organism goes on unchecked and is completed in a very short time. Thus the conclusion, or question: what about life and the second principle? Is there not, in living organisms, some power that prevents the action of the second principle?"

The notion that living things have some property that distinguishes them from inanimate things is referred to as "vitalism". This property was once taken to be of a supernatural nature, as in the case of Aristotle's "Entelechy", or of Bergson's "Elan Vital". This notion of vitalism, as von Bertalanffy points out, however has been dead for a long time although "people continue to pour abuse on its carcass."[5]

Vitalism is condemned for another reason. It implies that the world cannot be understood purely in terms of physics, which our physicists — who want to maintain their dominion over science, indeed over knowledge in general — cannot conceivably accept.

Vitalism in its modern form simply implies that behaviour at that level of organisation achieved by living things displays features that were not present at the previous levels. As Waddington[6] writes "the contrast is not so much between mechanism and vitalism but rather between mechanism and organicism.

Overcoming Energy Constraints

Because of the way living things are organised they are capable of providing themselves with the energy they require to maintain their stability — green plants via photosynthesis and predators by consuming green plants. Significantly many economists and technologists, who see everything in terms of maximising production, tend to complain of the inefficiency of photosynthesis which only extracts a very small percentage of available energy from the atmosphere. They fail to realise that plants extract, via photosynthesis, precisely the amount of energy that they need and no more, that which is required for the purposes of maintaining their structure and reproducing themselves i.e. of assuring their stability within the ecosystem of which they are part. Were they to fix more energy they would use up more nutrients in the soil than could be made available on a permanent basis which would inevitably cause disequilibria leading to reduced stability.

A physicist might tell us that the sun's energy has been dissipated, but the answer to this is "So what?" As far as a student of the biosphere is concerned this dissipation is required to power the development of living things and to increase their stability and that of the biosphere, (I go as far as this with Prigogine, but as I shall show in the next issue of *The Ecologist*, no further).

Overcoming Material Constraints

The case for Georgescu Roegen's[13] fourth law is, superficially at least, a stronger one than his case for the second law, since, though the world is an open system from the point of view of energy, it is closed from the point of view of materials.

But once more living things can overcome this constraint by developing the means of recycling the materials they require, the waste products of specific biospheric processes serving as the raw materials of the next. A climax ecosystem such as a tropical rain forest can actually recycle materials so efficiently that it requires few resources from the soil beneath which tends to be thin and poor. The decaying vegetable matter that the forest trees are constantly generating pro vide many of the nutrients it requires, the rest being derived from the air (carbon) and the sub-soil (minerals). Nor in a balanced ecosystem does there

occur a loss during recycling that is not fully compensated for by normal biospheric production processes.

The application of this principle to the biosphere as a whole is made clear by Lovelock[14]. Whereas it has normally been assumed that life occurred on this planet when conditions became favourable to it, Lovelock shows that the biosphere, or Gaia, as he calls it, actually created those conditions that it required for its support. The oxygen is released by living plants during photosynthesis and carbon-dioxide is released as they die and decay. The atmosphere itself, as Lovelock shows, is the product of living things. If we accept the Gaia hypothesis (and I think it is difficult to avoid doing so) how is it possible to regard living things as dissipating those materials that they have themselves created? The biosphere, in fact, rather than dissipate the materials it requires for its sustenance, as it would do, were it really governed by Gerogescu Roegen's Fourth Law for Thermodynamics, does precisely the opposite and systematically builds up the stock of materials that it requires to move instead towards increasing complexity, diversity and stability.

The question we must now ask ourselves is why our scientists so stubbornly refuse to face both the theoretical and empirical evidence against the applicability of the entropy law to the world of living things?

The Obstinancy of Scientists

To understand their obstinancy, one must consider the world-view or paradigm of the physical sciences in the middle and towards the end of the nineteenth century. This is usually referred to as the Newtonian paradigm. In terms of it, the world was seen as an enormous machine whose components behaved largely like planets and billiard balls. It was just the world-view required to rationalise the trend initiated by the Industrial Revolution towards materialism, individualism, utilitarianism and economism — the closely associated values of the industrial age. The science of the times, as it has been until very recently, was largely identified with physics or aristo-science as Passmore refers to it. All other sciences were considered very inferior and their practitioners were largely preoccupied with raising their status by slavishly imitating the methodology of the physical sciences just as the lower castes in India increase theirs by imitating the Brahmans (which means, above all, prescribing the eating of meat and the remarriage of widows). If physics were to be the fundamental science governing everythingelse then the behaviour of physical things — billiard balls and the like — must be shown to provide a model for that of living things.

The trouble was that in terms of the Neo-Newtonian world-view it failed to do so on two counts. The first and most important was that Newtonian time was *reversible*. It could move backwards or forwards just as can a billiard ball, while, in the real world, time is *irreversible*, one cannot eradicate experience nor restore the past exactly as it once was. As Brillouin[15] puts it "one of the most important features about time is its irreversibility. Time flows on and never comes back. When the physicist is confronted with this fact he is greatly disturbed. All the laws of physics in their elementary forms are reversible."

Another associated defect of the Newtonian paradigm is that it does not explain the direction of time. Newton formulated laws governing the movement of bodies but did not tell us that they moved in one direction rather than any other. This again did not tally with the behaviour of living things.

The entropy law remedied all this. Since energy could only be degraded, it must follow that the time during which its degradation took place was irreversible. As Brillouin[15] notes "it is a strange coincidence that life and the second law represent the two most important examples of the importance of time's running backwards."

All this was just what our physicists were looking for: uncontrovertible evidence as they saw it, that the entropy law underlay the behaviour of living processes. This was further confirmed by the fact that, as in living processes, energy did not move in a random but in a specific direction.

The fact that Boltzmann had formulated the entropy law as a statistical law further confirmed the entropy thesis since the behaviour of living things was also held to be governed by such laws. Of course a limitless number of processes can be shown to tend statistically in an irreversible direction, a game of snakes and ladders for instance satisfies these conditions yet nobody suggests that this great nursery game provides a model for life processes. Why the behaviour of gas in a closed receptacle should provide a better model is not at all clear but what is clear is the stake our aristo-scientists have in providing that it does. Monod[16] sums up the aristo-scientist's attitude to the entropy law. "L'évolution dans la biosphere est donc un processus nécessairement irréversible, qui définit une direction dans le temps; direction qui est la meme que celle qu'impose la loi d'accroisement de l'entropie, c'esta-dire le deuxieme principe de la thermodynamique. Il s'agit de bien plus qu'une simple comparaison. La deuxieme principe est fondé sur les considérations statistiques indentiques à celles qui établissent l'irreversibilité de l'evolution. En fait, il est légitime de considerer l'irreversibilité de l'evolution comme une expression du deuxieme principe dans la biosphere."

Quantification

Another reason why our scientists are so keen to preserve the entropy law, contrary to all the theoretical and empirical evidence, is that it is easily quantifiable. This is a critical consideration for it is a dogma of aristo-science that only a quantifiable proposition can be regarded as scientific.

Entropy, as Erwin Shroedinger[17] notes, is not a vague concept or idea "but a measurable physical quantity just like the length of a rod, the temperature at any point of a body, the heat of fusion of a given crystal or the specific heat of any given substance. At the absolute zero point of temperature (roughly — 273°C) the entropy of any substance is zero. When you bring the substance into any other state by slow, re-

versible little steps (even if thereby the substance changes its physical or chemical nature) the entropy increases by an amount which is computed by dividing every little portion of heat you had to supply in that procedure by the absolute temperature at which it was supplied — and by summing up all these small contributions. To give an example, when you melt a solid, its entropy increases by the amount of the heat of fusion divided by the temperature at the melting point. You see from this, that the unit in which entropy is measured is cal./°C. (just as the calorie is the unit of heat or the centimetre the unit of length)".

Boltzmann, as already mentioned, developed the statistical concept of entropy and as Shroedinger notes "this too is an exact quantitative quantification, and is expressed by:

$$\text{entropy} = k \log D,$$

where k is the so-called Boltzmann constant (=3.2983. 10-24 cal./°C) and D a quantitative measure of the atomistic disorder of the body in question."

It is the quantifiability of many other scientific concepts that have led to their adoption by scientists often regardless of the fact that, as they are defined, they correspond to nothing whatsoever in the world of living things.

Shannon and Weaver's[18] concept of information, as already noted, has nothing in common with the sort of information that is organised within the biosphere. It has been taken to apply to living things, to begin with because it is reconcilable with the entropy paradigm (its mathematical formula being almost identical with that of entropy) and also because it is quantifiable.

Complexity and Diversity

Complexity, too, is defined in terms that make it easily quantifiable. Thus such authorities as May, Lotka and Volterra and Prigogine see it purely in terms of the number of interrelated parts without reference to the way they are organised. This means that by introducing a highly destructive alien parasite into an ecosystem (the rabbit into Australia for instance) one is actually *increasing* the complexity of the ecosystem in question. By defining complexity in this way, it is possible to maintain, as many ecologists still do (Professor Mellanby for instance) that complexity is associated with reduced stability. This enables them to justify the systematic simplification of agricultural ecosystems by means of destructive modern agricultural practices.

The question of the relationship between complexity and stability is further obscured by the general failure to distinguish between *complexity* and *diversity*.

The complexity of a system corresponds to the number of its sub-systems that can cooperate in responding to the challenges of a specific environment. Let me make this clear. One way in which systems can organise themselves is to permit a more perfect adaptation to a specific environment with which their relationship thereby becomes more stable. Such systems can be said to increase their *complexity*. This is justified if it can be predicted that this environment is unlikely to change too drastically, a condition which only tends to be satisfied when the environment is protected by the action of the larger system of which it is part. Thus in our internal environment, behaviour is highly specialised and highly adaptive, the relationship between sub-systems and their respective environments is very stable and characterised by very small fluctuations. In such conditions, small challenges can be dealt with extremely efficiently, *large challenges not at all.* This vulnerability to serious challenges, however, does not imply instability, because it can be predicted that they are unlikely to occur. We are sufficiently capable of controlling our *external* environment to prevent the disintegration of our *internal* environment. Thus one cannot say that a baby is unstable because, if left on its own in a hostile environment it would probably not survive. The point is that babies are *not* usually left on their own in a hostile environment. They are looked after by their families which are capable of providing them with an environment within which they display a high degree of stability.

A second way in which systems can organise themselves is for the purpose of adapting to a far less predictable environment, one that is far less under

Although the biosphere is a closed system as far as materials go, organisms can overcome this constraint by recycling. A tropical rain forest recycles materials so efficiently that it requires few resources from the soil beneath it.

control. In these conditions the sub-systems rather than cooperate, so as to assure a highly differentiated response to a specific environmental challenge, *must be able to act on their own.* Each must be specialised in dealing with a different challenge. They are thereby very much more loosely organised. This permits adaptation to much more radical challenges. Such a system can be regarded as displaying *diversity* rather than *complexity.*

It might be argued that diversity does not provide a basis for organisation — but this is wrong. The general information contained in all the genes is the *same* — otherwise the gene-pool would not give rise to a population of the same species (we would get dung-beetles instead of fiddler crabs, for instance). Within a gene-pool it is changes in the frequency of specific genes that differ from each other superficially that permits the changes in the particularities of the population's behaviour pattern in answer to different environmental challenges.

In practice of course, systems will display varying degrees of both *complexity* and *diversity.*

A gene-pool is designed to mediate a wide range of ontogenetic responses. It thereby displays great *diversity.* An amoeba's gene-pool displays little *complexity* since the ontogenetic responses it gives rise to are not highly differentiated. A human gene-pool on the other hand displays greater *complexity* because of its highly differentiated ontogenetic responses, i.e. because of the large number of different sub-systems that cooperate in the execution of these responses. Man, by virtue of his centralised nervous system and his highly developed neo-cortex, is also capable of a wide range of different behavioural (one might refer to them as 'neurogenetic' as opposed to ontogenetic or phylogenetic) responses and is thereby capable of a greater diversity to such responses than is an amoeba.

Surprisingly enough this distinction does not appear to have been made, explicitly at least. It is a critical one, which explains, among other things, why a complex system is vulnerable to serious challenges once its protective environment breaks down, — why a child, for instance, is vulnerable once its family has disintegrated or why a tropical forest disintegrates once the canopy trees are removed. It explains too why an ecosystem displaying great diversity but low complexity, i.e. in which the parts are not integrated, is characterised by greater fluctuations, but is less vulnerable to serious challenges.

For all these reasons there has been a frenzied effort to reconcile the thesis that the entropy law applies to the world of living things with all the theoretical and empirical evidence to the contrary. How, one might ask, has this been done?

Statistical Method

The first attempt was Boltzmann's transformation of the laws of thermodynamics into statistical laws. The 'statistical method' is very convenient. Indeed if the entropy law is seen as but a statistical law, then the development of the biosphere over the last three thousand million years, rather than provide a clear violation of the entropy law can be interpreted as nothing more than an exception which does not invalidate what is after all but a statistical law.

Georgescu Roegen[13] realises how unsatisfactory is Boltzmann's compromise. "According to this new disicipline," he notes, "a pile of ashes may very well become capable of heating the boiler. Also a corpse may resuscitate to lead a second life in exactly reverse order of the first. Only the probability of such events are fantastically small."

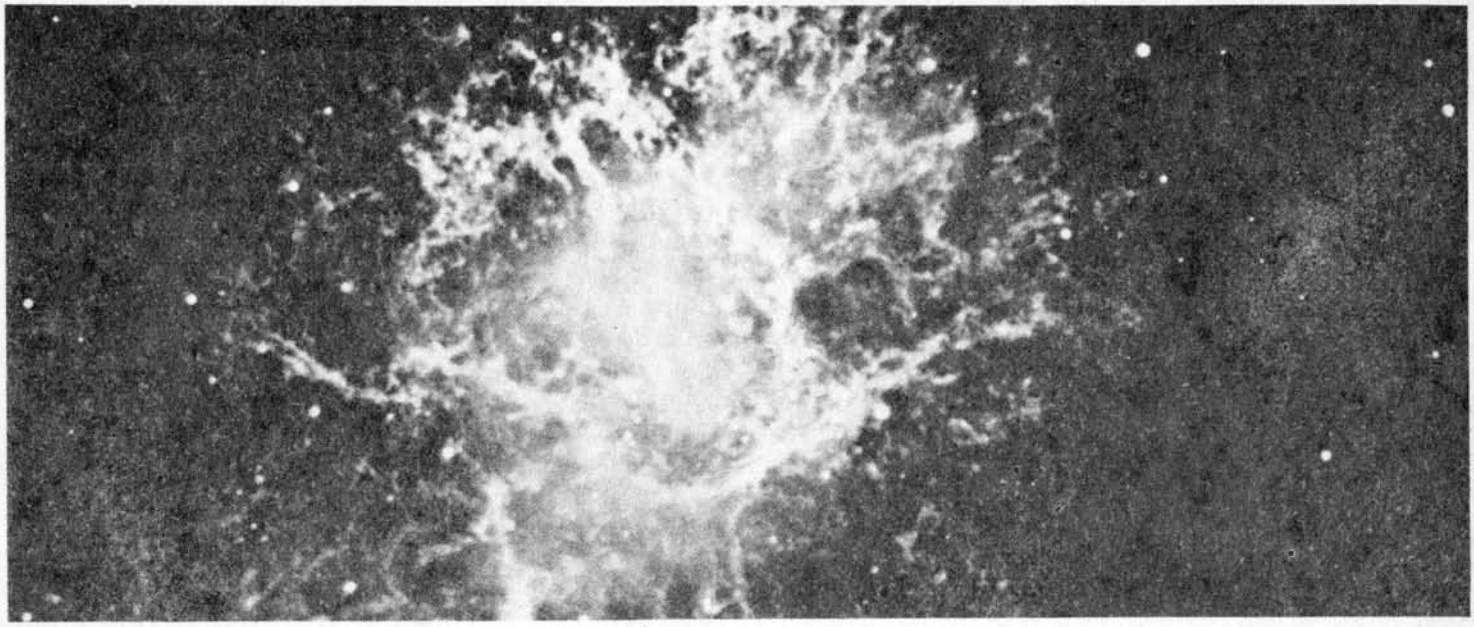
The statistical method is indeed largely a means of hiding one's ignorance as to what are the true forces determining behaviour in the world we live in. Thus Galton and others once drew up a statistical theory of genetics. But with the rediscovery of Mendelism, behaviour that previously appeared to be random and hence to justify the statistical approach, was shown to be governed by very definite laws and the statistical theory was abandoned. This is not to suggest that randomness does not exist — only that its incidence has been grossly exaggerated so as to accommodate scientific dogmas that are critical to the paradigm of science and that would otherwise be revealed as false. As Sir Peter Medawar[19], one of the high priests of science himself, admits "it is upon the notion of randomness that geneticists have based their case against a benevolent or malevolent deity and against there being any overall purpose or design in nature."

The statistical approach to thermodynamics is only justified if it makes sense to regard the three thousand million years, during which the biosphere developed out of the primaeval dust, as but an exception to the law that otherwise governs behaviour on our planet, and if we choose to ignore the nature of the biological and sociological laws in terms of which one can explain this remarkable development.

An Island of Negative Entropy in a Sea of Entropy

This brings us to the second device resorted to by our aristo-scientists to reconcile the entropy law with reality. It is to postulate a subsidiary law stating that any reduction in the entropy of the biosphere must be compensated for by an increase in entropy elsewhere.

Thus, all living processes are seen by Rifkin as giving rise to entropy in the world around them. For instance when a predator devours his prey, 80-90 per cent of the energy contained is 'wasted' in the form of heat, only 10-20 per cent of the energy stored in the prey being actually transferred to the tissue of the predator to be used in the next stage of the food chain. This is particularly serious, as Rifkin points out, by virtue of the sheer number of animals required to sustain predators as we move up the food chain. Thus: 'Three hundred trout are required to support one man for a year. The trout in turn must consume 90,000 frogs that must consume 27 million grasshoppers that live of 1,000 tons of grass." To maintain one human being therefore, requires the energy contained in 27 million grasshoppers or a thousand tons of grass. "Is there any doubt then", he asks, "that every living thing maintains its own order only at the expense of creating greater disorder (or dissipation of energy) in the overall



Even if we accept that the universe is a closed system and that, one day, the sun's energy will be entirely dissipated, is this consideration of any practical significance?

environment?" Yes there is. As Rifkin should know predators are essential for applying qualitative and quantitative controls on the populations on which they prey and for maintaining the structure and viability of the ecosystem of which they are part. *A predator must in fact consume his prey.* In an unbalanced ecosystem such as the one we live in it is undoubtedly true, as Barry Commoner always says, that there is no such thing as a free lunch, but the opposite is true in a balanced ecosystem in which *there is no such thing as a free fast.*

The Universe as an Open System

A third device is to postulate that though the earth may be an open system, the universe itself *is a closed one which means that life on earth can only develop at the cost of increasing the entropy of the universe.*

"The small local decreases in entropy represented in the building of the organism" according to Harold Blum, quoted by Rifkin, "is coupled with a much larger increase in the entropy of the universe." The trouble with this argument is that there is no reason whatsoever for supposing that the universe is a closed system. Braham[20] goes into this at some length. He points out that a completely closed system *"is a theoretical construct"*, and that *"we have no way of determining whether the universe is closed or not."* Also to say that the universe is an open system raises a number of difficult problems. It would mean for instance that it is exchanging energy with its environment, but we know nothing about such an environment, and if it exists, then it must be part of another universe, part in fact of a "mega universe" of which we are but a sub-system.

"What then" Braham asks "are the limits to the other, or to the mega-universe and so on?" Since we are quite incapable of answering such questions it may be convenient to postulate that the universe is closed. But would this help us very much? As Braham points out "to assume closure is to assume a boundary. By definition a boundary is between something and something else; there must therefore be something on the "other side". If we were to speculate meaningfully about this boundary we would require information about the "other side" and this would clearly require a leak in the system and hence no closure at all."

But even if we can find a way round this objection and accept that the system is a closed one and that one day the sun's energy will be entirely dissipated, is this consideration of any practical significance? The terrible problems we face today (such as the population explosion, social disintegration, deforestation, desertification, the contamination of groundwater, of our rivers and estuaries etc.) have not been caused by any reduction in the amount of energy generated by the sun. To preoccupy ourselves unduly with the possiblility that such a reduction may eventually occur would be to divert attention from these problems to an exceedingly long-term one (for no one suggests that the sun is likely to stop shining for a few million years or so). What is more, it is one about which we can do strictly nothing. I don't believe that even our most fanatical technomaniacs, the Herman Kahns or Gerard O'Neils of this world have yet thought of devising a technological substitute for the sun.

Physical Reductionism

As already mentioned, the entropy law is cherished by our physicists because it helps to obscure the fact that the Newtonian world-view does not apply to the world of living things and thereby enabling them to maintain their dominance over all other scientific disciplines.

As a result, academics still try to explain the behaviour of complex living-things in terms of methodology of physics and of the concepts developed by physicists to explain the behaviour of inanimate objects. The result has, not surprisingly, been disastrous. As Alexander Koyre[21], possibly the leading Newtonian scholar himself admits that "The enthusiastic imitation (or pseudo-imitation) of the Newtonian (or pseudo-Newtonian) pattern of atomic

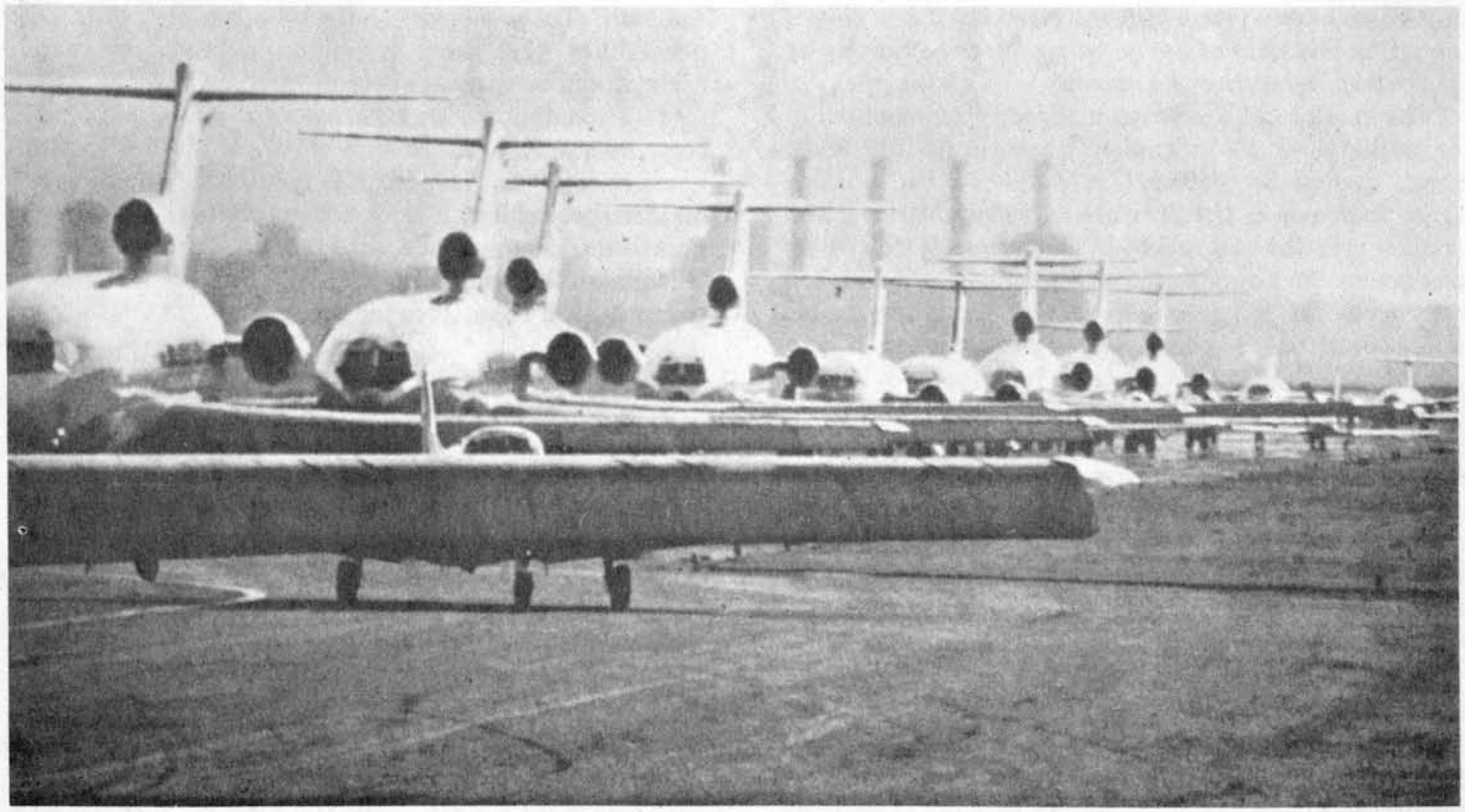
analysis and reconstruction that up to our times proved to be so successful in physics, in chemistry, and even in biology, led elsewhere to rather bad results. Thus the unholy alliance of Newton and Locke produced an atomic psychology, which explained (or explained away) mind as a mosiac of "sensations" and "ideas" linked together by laws of association (attraction); we have had, too, atomic sociology, which reduced society to a cluster of human atoms, complete and self-contained each in itself and only mutually attracting and repelling each other. Newton, of course, is by no means responsible for these, and other Monstra engendered by the overextension — or aping — of his method."

Unfortunately living things are infinitely more complicated than billiard balls or even atoms. As Wolfgang Kohler[22] notes; "If organisms were more similar to the systems which physics investigates, a great many methods of the physicists could be introduced in our science without much change. But in actual fact the similarity is not very great. One of the advantages which makes the physicist's work so much easier is the simplicity of his systems....An amoeba is a more complicated system than all systems of the inanimate world."

As von Bertalanffy[23] points out the basic features of the living things "concepts like *organisation directiveness, teleology,* etc. just do not appear in the classic system of science (which he identifies with physics). As a matter of fact in the so-called mechanistic world-view based upon classical physics, they were considered as illusory or metaphysical. This means, to the biologist for example, that just the specific problems of living nature appeared to lie beyond the legitimate field of science."

He illustrates this point very convincingly[5]. "Organismic processes as a rule," he writes, "are so ordered as to maintain the system. But this makes no sense within the conventional categories of physics. From this viewpoint, *there is no difference between physical and chemical processes taking place in a living organism and those in a corpse; both follow the same laws of physics and chemistry — and that's all that can be said.* To the biologist and physician, however, there is a profound difference between events so ordered as to maintain the system, and those running wild to destroy it. What are the principles of order and organization? What does "health" or "norm" mean in contrast to "disease" and "pathology"? Nothing, so far as laws of physics and chemistry are concerned... But without these and similar notions there would be no science of medicine and indeed biology."

At the same time if we adopt the physicist's world-view to understand the behaviour of living things, we are saddled with a number of concepts which may help in understanding the behaviour of billiard balls and atoms but that are totally useless for the purposes of understanding the far more complex behaviour of living things. One such notion is 'causality'. One of the basic principles of physical causality is that a similar cause will have a similar effect. This is simply not true in the world of living things, where a given state of a system can be achieved by a large number of different processes — a principle referred to as 'equifinality'. As von Bertalanffy points out, it is precisely this consideration which led Driesch to come to the conclusion that the behaviour of living things could not be explained without introducing a 'vitalist' principle of some sort.



Rather than recognise the mounting problems that confront our society as the symptoms of 'eco-devience', we interpret them instead as clear indications that material progress has not proceeded far enough.

Another concept of physics with which we are saddled and that is inapplicable to the world of living things, as Koyre intimates, is the reductionist notion that the behaviour of a system can be understood by studying its component parts. Crick[24] states the reductionist credo very explicitly. "Eventually" he writes, "one may hope to have the whole of biology 'explained' in terms of the level below it, and so on right down to the atomic level....So far everything we have found can be 'explained' without effort in terms of the standard bonds of chemistry — the homopolar chemical bond, the van der Waal attraction between non-bonded atoms, the all important hydrogen bonds, and so on."

This may appear to be true in physical systems *whose parts display the minimum organisation*, but as already mentioned, living systems are vastly more complex. They display a very high degree of organisation and are thus, to use a consecrated phrase, very much more than the sum of their parts. This means that their behaviour cannot be understood from a study of these parts. For exactly the same reason the principle of isolating living systems from their natural environment in order to understand their behaviour — a technique that may be perfectly adequate in the physical sciences, when applied to the study of living things, provides but the most superficial information. To quote Wolfgang Kohler[22], "Some behaviourists have rightly said that it is the whole organism which we have to study. Unfortunately in the whole organism one can seldom follow the change of one particular variable, as though it alone were affected by a certain change in outer conditions. The change of one factor usually involves concomitant changes in many others, and the latter changes again affect the former. Now, isolation of functional relationships and reduction of variables which take part in an event are the great artifices by which exact investigations are facilitated in physics. Since this technique is not applicable in psychology, since we do not have to take the organism more or less as it is, any kind of observation which refers to the behaviour of our subjects as complex acting units will be right in our case."

Passmore[25] feels that it is precisely because of this insistence on trying to understand the world in terms of physics — aristo-science as he refers to it — that scientists have been so unsuccessful in understanding the real problems that face us today. "If we are still ignorant about most of the phenomena we encounter in our daily life — whether it be human nutrition or the life history of animals — this ignorance can in part be set down to the aristo-scientific emphasis on a very different kind of knowledge. Scientists themselves are beginning to emphasise as much. Even within physics — and remember Rutherford's dictum that "science is either physics or stamp collecting" — the Cavendish professor at Cambridge, Brian Pippard, has recently told aristo-scientific physicists that it is time for them to turn their attention towards what he calls "the difficult and less elegant phenomena of the real physical world" in contrast with their past concentration on these phenomena the behaviour of which can be described in beautifully concise formulae."

Indeed, contrary to what our scientists try to make out, physics does not provide the only model. As von Bertalanffy[23] writes, "physics is but one model dealing with certain aspects of reality. It needs not to have the monoply, nor is it the *reality.*"

It seems clear that if we are to provide a theoretical framework for understanding what is happening to the biosphere, it is not in terms of physics that it should be formulated. The problems that we face today, that threaten the very survival of our species, have not been caused by violating the laws of physics or thermodynamics. If the entropy law really applied to the world of living things and we had violated it, then the biosphere would be short of energy. But it is not. On the contrary our problems, rather than being being due to a shortage of energy, *are due to a surplus which we have temporarily created by using the energy locked up in fossil fuels that have previously been stored away in the bowels of the earth.*

If it were possible to measure the biospheric devastation our industrial activities are giving rise to (and we have shown in the pages of *The Ecologist* over the last eleven years that our problems are largely the symptoms of this devastation), then *it is in terms of the energy consumed by us over and above that required for the normal functioning of the biosphere.* This was in effect the conclusion of the prestigious *Study of Critical Environmental Problems* (SCEP)[26]. By making use of this surplus energy, (and many other surplus resources too) we have developed a behaviour pattern that violates the laws that must be observed in order to maintain the proper functioning and hence the stability of the biosphere.

A Hierarchy of Constraints

I shall be more explicit. First of all, what do we mean by laws? I thing it is best to regard them, as Waddington suggests, as *constraints.*

Thus the behaviour of an individual person must be subjected to a given set of physical, biological and social constraints if he is to survive. If he jumps off a cliff, refuses to eat any food or poisons himself with paraquat and insists on murdering his neighbours, the chances are that he will not survive for very long. Once he marries and has children a new level of organisation has been achieved and a new larger system brought into being, of which he is but a sub-system. To assure the survival of this system a new set of constraints over and above the previous set must now be observed. Thus, if he does not behave in a husbandly way towards his wife and in a paternal way towards his children, though he may continue to survive as an individual, his family will cease to do so. But at the same time, his family is part of a larger community which in order to maintain its stability and survive, must subject its component families and individuals to a *further set of constraints,* while the community is in turn part of a larger society whose stability too can only be assured if its members are subjected to yet *another set of constraints.* If we prefer to do so, we can regard each set of constraints as laws which can, of course, be violated but only at the cost of causing the disintegration of the system whose integrity and stability their observance assures — which in turn must affect to a varying degree the integrity and stability of their component sub-systems.

In my writings in *The Ecologist* over the last eleven years, I have been at pains to point out that it is our failure to observe the constraints associated with the integrity and stability of the various social and ecological systems of which we are part that is giving rise to their disintegration, of which the problems that confront our society today are but the symptoms.

Evolution and Anti-Evolution

All this leads one to view biospheric development or evolution as a process involving the accumulation of constraints — those that at each new level of organisation are required to maintain or increase overall stability. This view of evolution is not acceptable to our aristo-scientists. One of the reasons is that it provides a criterion for distinguishing, on the one hand, those biospheric changes that have occurred over the last three thousand million years and have *tended in the direction of increased biospheric stability* and, on the other hand, those that have occurred during the historical era (and in particular since the beginning of the industrial age) and which have *tended instead towards decreased stability.* It is appropriate, I believe, to refer to these two totally distinct and indeed competing trends as *evolution and anti-evolution.* It is worth looking at this critical distinction more closely.

At the level of biological organism, it is important to distinguish between the accident that causes a wound and the process that heals it. At the level of an ecosystem one might distinguish, on the one hand, between an accident such as the intrusion into an ecosystem of some alien species, its poisoning with biocides or a climatic change, and on the other hand, the processes that lead to the restoration of its normal functioning: the ecosystem's healing process. Each accident can be represented graphically by a large oscillation leading to smaller and smaller oscillations as healing takes place and stability is restored. But not always. One must make a further distinction between those accidents that the system is capable of dealing with adaptively and those that it is not capable of dealing with and which lead to the establishment of a new climax at *a lower level of stability.*

It is the latter that we must regard as *anti-evolutionary* for they are effectively reversing the evolutionary trend towards increased stability. Serious anti-evolutionary accidents of this sort have already occurred. Volcanic eruptions have made whole areas less favourable to supporting complex ecosystems. Ice ages have had a similar effect, as have large-scale ecological invasions of the sort that occurred when previously separated land masses were joined as a result of the slow action of continental drift.

The Industrial Era, by far the most serious biosperic accident to have occurred so far, would if it lasted for another few decades probably see the extermination of most complex forms of life on a planet that would have become too degraded to support them.

It could be argued that such a catastrophe is a nec-

essary stimulus to further evolutionary development, and that from a degraded, contaminated and largely depopulated planet, there may emerge, after a few billion years, new forms of life that are more adaptive than those that have been annihilated.

What serious grounds, though, do we have for believing such a theory. Even if there such grounds, this thesis would provide little consolation to those who are today witnessing the reversal of three thousand million years of evolution.

Needless to say, to accept this critical distinction between evolution and anti-evolution is to reject the very notion of material progress and hence the value of all those enterprises that have promoted it, including the development of science itself.

To avoid having to make this distinction our scientists insist on seeing the evolutionary process in one of two different ways. Some have made it out to be no more than random change. This is convenient because it enables one to see man's Promethean enterprise as giving rise to the only truly purposeful changes — the only ones designed to improve human welfare. It is also a view that fits in nicely with the general paradigm of physics and thermodynamics which sees behaviour moving in the direction of entropy or randomness. Such a view, however, is impossible to reconcile with experience as it is with the findings of evolutionary biology. For these reasons the trend has been away from this view. In fact the position of most of our leading scientists today is that evolution is directive, although this is not taken as implying 'teleology' which is still taboo, but 'teleonomy' a term originally coined by Pittendrigh[12]. The 'teleonomic' view of behaviour is that it is indeed directive but not because it must be so to satisfy the requirements of the biospheres, but because it is *programmed* to behave in this way — in this way teleonomy is reconcilable with causality. The goal of behaviour, however, is not taken to be increased stability but increased *complexity* and *no attempt is made to distinguish between the complexity of the biosphere and that of the technosphere.* Failure to do so of course obscures the fundamental distinction and incompatability between the two rival organisations of matter and the two rival processes that brought them into being — *evolution* and *anti-evolution.* It thereby enables our aristo-scientists to pretend that the historical era and in particular the industrial era are part and parcel of the same evolutionary process.

Medawar[19] for instance talks of industrial development as 'exosomatic' evolution, and makes fun of a student who asked him if humans "might not evolve to possess wings and so make it possible to fly", He regards this as a "foolish question" since "it is obvious that human beings have already acquired some of the capabilities of both birds and fish — capabilities which they owe to their own special style of evolution, the 'exosomatic'."

Some of our scientists go further. They see the historical and industrial eras as periods of *accelerated evolution.* Even Huxley[27] sees things in this way. He writes "in psychosocial evolution it is quite clear that, at least in the last few millennia and especially in the last few centuries, there has been an acceleration instead of a more or less uniform rate."

Even ecologists have fallen into this terrible trap. Margalef[28] for instance tells us that "industrialisation has brought mankind a marked acceleration of evolutionary processes."

The concept of material progress implies that man is free to determine his own evolution; that biospheric or ecological constraints can be ignored not only with impunity but to our lasting benefit. What the scientists I have quoted (and indeed the scientists in general) are in fact providing is the mythology that justifies, and indeed legitimises, the anti-evolutionary enterprise to which they are committed. Prigogine and Jantsch go still further. The mythology they develop is designed (consciously or unconsciously) to legitimise the most extreme anti-evolutionary enterprise we have seen so far — that of modifying the genetic information in living things on an industrial scale in order to programme them to fulfil economically useful tasks. Jantsch[29] goes so far as to tell us that it is "a profound truth which man has known, forgotten, refound, reduced, and expanded over many millennia: that the evolution of mankind forms a meaningful and integral part of a universal evolution — that mankind is an agent of this universal evolution, and even an important one."

The Position of Rifkin and Howard

Rifkin and Howard, on the contrary, rather than seek to legitimise material progress seek instead to legitimise a policy that would lead to its very reversal.

Like everybody else, Rifkin and Howard fail to distinguish between evolution and anti-evolution. Like everybody else, too, they see development and industrialisation as an integral part of the evolutionary process, but rather than accept the evidence of our experience of evolutionary biology, and of the study of the dynamics of industrialisation, they see both evolution and anti-evolution as purely random processes tending in the direction of entropy. Thus they write; "The Entropy Law says that evolution dissipates the overall available energy for life on this planet. Our concept of evolution is the exact opposite. We (that is other people) believe that evolution somehow magically creates greater overall value and order on earth. Now that *the environment we live in is becoming so dissipated and disordered* that it is apparent to the naked eye, we are for the first time beginning to have *second thoughts about our views on evolution, progress and the creation of things of material value.*"

That they may secretly realise that the two processes in opposition to each other is suggested by the following passage. Man, they tell us, has "yet to move from a colonising to a climactic phase", implying that he will learn to be less destructive, and that human society will become very much more stable as in the climactic phase of an ecosystem.

On the other hand, if they fully understood the true relationship between these two processes, they would realise too that in the prehistoric era man had already achieved a 'climactic phase'. The societies developed by our paleolithic ancestors, by contributing, rather than

Evolution . . .

detracting, from the stability of the climax ecosystems in which they lived, formed *climax social systems*, a conclusion which an ecologist can only avoid having to face by accepting that man's behaviour is not governed by biospheric laws — the very thesis ecology teaches us to reject. At the same time this thesis is difficult to reconcile with the entropy law which Rifkin and Howard so highly values since to move towards a climactic phase is to move away from entropy, in fact as far away from it as one can go.

What they are basically trying to say is that the Industrial Era is particularly destructive because it is accelerating the rate of evolutionary change towards entropy. If it is phased out and we develop a more satisfactory lifestyle we may achieve a sort of steady state which they identify with a climactic phase. I agree entirely with the spirit of what they are saying, but not with the substance. The industrial process is destructive because it is anti-evolutionary and builds up the technosphere at the cost of causing the disintegration of the biosphere. Angrist and Heppler, whom Rifkin and Howard quote, are quite right when they tell us that "each localised *man-made* or *machine made* entropy decrease is accompanied by a greater increase in entropy of the surroundings thereby retaining the required increase in total entropy, (To the extent, of course, that the term 'entropy' can be used synonymously with the biospheric devastation that technospher growth must inevitably give rise to.) They are quite wrong, as already noted, if this is also taken to be true of each localised "nature made" entropy decrease or more precisely instability decrease.

In other words what they say is *true of anti-evolution but not of evolution.* In the same way, I can only agree with Rifkin and Howard when they tell us that economic growth "is really a decrease in the world's wealth", since technospheric growth must necessarily involve a corresponding disintegration of the biosphere which provides our only real and lasting wealth. But it is *not true of the evolutionary process that created this biosphere.* Also the world-energy shortage that Georgescu Roegen and Rifkin regard as explicable in terms of the Entropy Law certainly affects the technosphere, which makes use of increasing quantities of fossil fuels. As they are burnt so is energy degraded in such a way that it becomes correspondingly less available "to do work", but this does not affect the biosphere which, as we have already seen, is quite capable of photosynthesising all the energy it requires. On the contrary the energy shortage has already reduced the rate at which the technosphere is growing and hence the destructiveness of its impact on the biosphere. In other words *the energy shortage adversely affects anti-evolution not evolution.*

When Georgescu Roegen and Rifkin tell us that an external source of energy is required to assure the recycling of minerals, a process which results in a 30 per cent loss which cannot be made good (hence the Fourth Law of Thermodynamics), they are quite right if they are referring to the recycling of materials *within the technosphere* — a crude process indeed — but quite wrong if they are referring to this process as it occurs within *the biosphere,* where recycling , as already noted, is highly efficient, the losses or wastes of one process serving as the essential raw materials of another. Once more the material shortages they refer to *adversely affect anti-evolution but not evolution.*

The Great Misinterpretation

This fatal confusion between evolution and man-made change, between the development of the biosphere and that of the technosphere, has given rise to what I refer to as *the Great Misinterpretation* — a title which I propose to give to a book I have been working on for some years.

Rather than recognise that the mounting problems that confront our society today are largely the symptoms of 'evo-deviance' to use a term coined by Stephen Boyden (i.e. to the increasing diversion of our biological, social and physical environment from the evolutionary norm or climax), *we interpret them instead as clear indications that material progress has not proceeded far enough. In other words these problems, rather than being seen as the consequences of what we currently refer to as development (i.e. to biospherically random, anti-evolutionary, man-made change), are interpreted as but symptoms of underdevelopment, that is of insufficient biospherically random, anti-evolutionary, man-made change.* The solution to all our problems is thereby assumed by governments, international agencies and all our

economists and scientists alike to be *further development*, whether it be of the urban or rural variety. This belief is unshaken by all the empirical evidence which shows, beyond any shadow of a doubt, that development throughout the world has *only served to increase* these problems, in many cases, *very drastically indeed* — causing, in the last thirty years, human misery on an unprecedented scale.

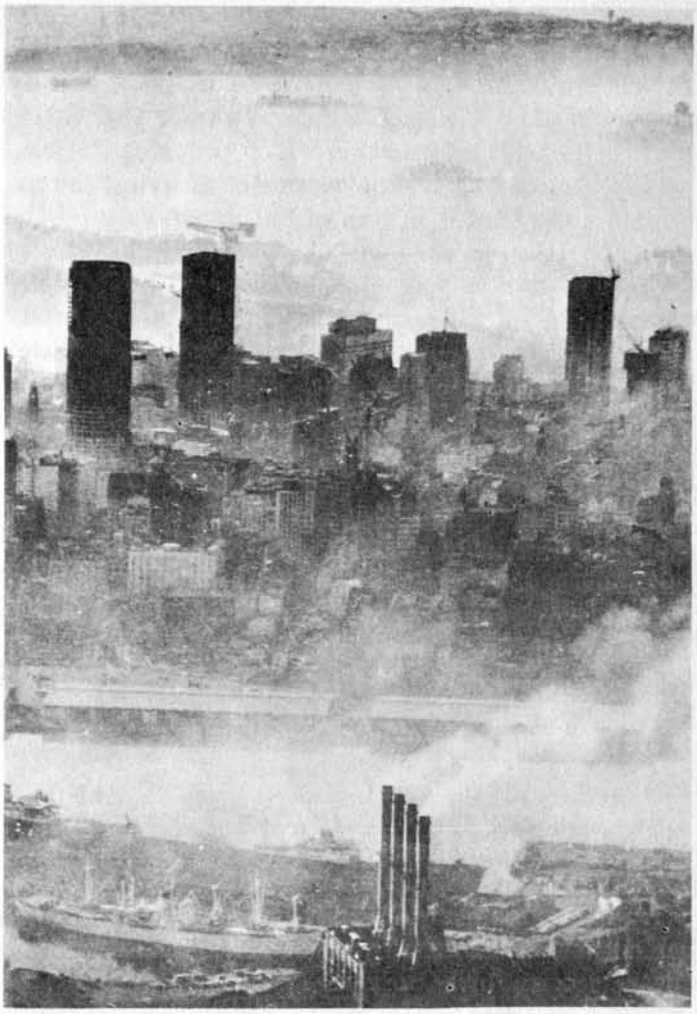
It is conveniently ignored, too, that none of these problems exist among members of hunter gatherer societies — i.e. in climax social systems — that still survive in something approaching their natural habitat. Amazonian Indians, for instance, do not have at their disposal the gadgetry available to the alienated members of anonymous mass society of the West. On the other hand there is no evidence that man has any real need for such gadgetry. If we regard man in terms of his total experience on this planet rather than in that of the last 150 years during which he has become an industrialist, it is clear that he has biological and social needs and also spiritual and aesthetic ones, all of which are admirably satisfied in a climax social system.

For instance malnutrition and famine are unknown among such societies as are the problems mentioned above. This is particularly apparent in countries where such groups still survive at not too great a distance from sedentary peoples. In India, for instance, it is fairly clear that the remaining tribal societies that precariously survive in the North East frontier territories on the Chinese border are unaffected by the problems that beset the settled villagers of mainstream India. Unlike them, they do not inhabit a treeless wasteland with eroded soils and dried up streams. They still live in what remains of a jungle teeming with wildlife and where there is an abundance of clean fresh unpolluted water. They do not suffer from the same parasitic diseases, nor do they ever go hungry. On the basis of any sensible definition of the term, they are not poor.

All that progress has done is create aberrant and inevitably temporary conditions in which gadgetry is required not per se but for the sake of satisfying, very inadequately, some of these needs and diverting people's attention from the fact that others remain unsatisfied. *Materialism* — a relatively new development, *not religion*, which satisfies basic and permanent human needs, *is the opium of the people.*

All this, we conveniently ignore, because it is simply not reconcilable with the world-view of industrialism, in terms of which, development and industrialisation, its latest phase, are identified with progress and are assumed to provide the only means of improving human welfare. So the problems that confront us are interpreted as the *symptoms of material deprivation, that is in such a way as to justify more material goods and technological devices, whose provision must cause further biospheric degradation, correspondingly, exacerbating our problems and setting the whole process into motion once more.*

So long as the *Great Misinterpretation* persists, so long as we remain imbued with the aberrant world-view that leads us to mistake biospheric degradation for development, anti-evolution for evolution, and regress for progress, so long must we continue to mistake the causes of our problems for their solution, and thereby deploy all our energy and ingenuity into assuring their further aggravation.



...And Anti-Evolution. Evolutionary changes increase the stability of the biosphere: anti-evolutionary ones decrease stability. Our failure to distinguish between the two has brought us to the brink of disaster.

The Laws of Ecodynamics

It is not in terms of the laws of thermodynamics, any more than those of Newtonian mechanics, that we are going to explain the behaviour of natural systems nor the problems confronting us today. On the other hand I think that they can be very adequately explained in terms of a very different set of laws which I shall refer to as the Laws of Ecodynamics.

There are four basic laws of Ecodynamics and of these the first two (as with thermodynamics) are the most basic. Let us look at them briefly.

The First Law of Ecodynamics

This can also be referred to as the Law of the Conservation of Structure. Conservation is the basic goal of behaviour. Even Darwin accepted this. In a letter to Lyell he admitted that were he to start again, he would use the term 'natural preservation' rather than 'natural selection'. But it is not just matter that behaviour seeks to conserve or preserve but *structure* — both informational and somatic. We know that genetic information is organised in such as way as to assure its preservation, since the generalities of that

organisation of information (or 'cybernism' as I refer to it), on the basis of which a system's behaviour pattern is mediated, is *non-plastic* i.e. unmodifiable by a system's *short-term experience.* We know that this is so of the genetic information which provides the general instructions for the development of living things. We know too that it is true of the generalities of the cultural pattern on the basis of which the behaviour of a social system is mediated, and which is normally referred to as its religion. What people do not generally realise is how *essential* it is that these generalities should be non-plastic. They do not see that it is in this way that a system's behaviour comes to reflect its long-term evolutionary or cultural experience and *not just the short-term experience of a single generation.* If it were not so, then biological and social systems would be constantly 'adapting' to freak conditions which may never recur. Such adaptations would not be real since they could only be achieved at the cost of radical structural changes which could only occur in an orderly and integrated way over a long period. Rapid large scale changes can thereby only lead to disorder and disintegration, which it is precisely the object of behaviour to prevent.

The adaptive response to radical environmental changes is to *oppose* them and reverse them rather than to accommodate them as we are taught to do in our industrial society. The latter course can only be justified if natural systems are infinitely *malleable* which we know they are not.

Scientists who seek to legitimise material progress will do everything they can to avoid facing this principle, and will, on the contrary, go out of their way to pretend that people, societies and indeed ecosystems, are *infinitely malleable* and that they can be worked like clay into any shape that suits the requirements of the state of the market — totally ignoring all the theoretical and empirical evidence to the contrary.

The Second Law of Ecodynamics

To say that the goal of behaviour is conservation is to say that natural systems tend towards stability. This means that rather than change in the direction of 'entropy' or disorder as Rifkin tells us, they tend instead towards what, in ecology, is referred to as a *climax*, i.e. a state of maturity or adulthood.

Once a climax is achieved, then they cease to grow. They do not have to anymore, since they have now reached the maximum degree of stability that can be achieved in the circumstances, i.e. taking account of their own potential for adaptation and that of the environment to which they are adapting. From then on, they use energy and resources exclusively for maintaining the functioning of their own metabolism (internal environment) for healing wounds and for maintaining the status quo in the relationship with their external environment.

A climax must be achieved without violating any of the other basic laws governing the behaviour of the biosphere, or the biosphere as we have seen would disintegrate, and cease to be stable which would be self-defeating since a climax is a desirable state precisely because *it is the most stable.* Of course what constitutes a climax may constantly change — though undoubtedly very slowly because the parts must remain adapted to each other, which would not be the case if one or more of them changed at a rate which the others could not keep up with. Such a change would also be self-defeating since, as we have seen, living things are regarded as stable to the extent that they can maintain their basic structure, in the face of change. If either the system or its environment or both are subjected to some serious disturbance, the healing process will occur — but in the changed circumstances, the potential for achieving the same degree of stability or adaptation (in its true sense of the term) may have been reduced, which must imply that the climax state would be a less stable one.

Of course, a favourable change in the climate — an evening-out of climatic differences between the seasons for instance — would, if all other conditions were satisfied, have exactly the opposite effect. The climax could then occur at a position of higher stability. Whatever happens, it will always represent the most stable position possible, and once it has been reached, growth will come to an end.

Any growth over and above the climax state cannot be progress in ecological terms since it will only be achievable by violating basic biospheric laws — which must lead to biospheric distintegration, hence a diversion from the optimum organisation, i.e. that required to maximise stability.

Such changes — in which category we must include those that occurred during the historical era and in particular during the industrial era which we identify with progress — must by their very nature, be temporary, for the technosphere which such changes are giving rise to is by its very nature unstable.

The reason is that it violates the Third and Fourth laws of Ecodynamics (see below). Since the problems that the increasing instability gives rise to are interpreted in such a way as to justify further technospheric growth (The Great Misinterpretation), instability must grow by positive-feedback until the inevitable collapse occurs. After the collapse, the natural self-regulating mechanisms of the biosphere must, in time, take over to heal the wounds. They will permit the eventual achievement of a new climax — but one displaying lower stability. It will be, however, the maximum that can be achieved in a highly degraded biosphere.

By taking the First and Second laws of Ecodynamics instead of the First and Second laws of Thermodynamics to be the basic laws governing behaviour within the biosphere we learn the following things:-

- that living things seek to conserve their information, structure and behaviour (rather than simply materials.) This means;
- that living things tend towards the achievment of a climax i.e. a state of maximum stability (rather than entropy);
- that if they are then disturbed and their stability reduced, they will *return to a new climax,* which may display greater or lesser stability depending on the new conditions;

— that this climax must correspond to ecological equilibrium (rather than thermodynamic equilibrium);
— and that the climax is the most probable state (rather than the least probable.)

The Third Law of Ecodynamics

This can be regarded as the Principle of Ecological Order, the Principle of Ecological Mutualism, the Principle of 'Homeotely' (from the Greek, Homeo = same, telos = goal) for the Principal of Environmental Conservation depending on which way we look at it.

Biospheric Order v Homeotely

Order is defined as the influence of the whole over the parts and as this influence is exerted, the parts become specialised in fulfilling the specific differentiated functions required to ensure the stability and hence the survival of the whole. If our bodies function properly, it is that our various organs and tissues and their component cells and molecules are organised in this way. They thereby all tend in the same direction — and are 'homeotelic'.

This is clearly true of such natural systems as the family and the community though in these cases the influence is not quite so pronounced and the subsystems are not so highly specialised. From this consideration alone it must follow that the structure of a natural system is *not random but highly directive* or purposive, i.e. it must be that which best favours the survival of the whole.

It is not only true of natural systems in which the dominant form of behaviour is cooperative, but of those in which competition dominates i.e. in ecosystems. The structure of an ecosystem is such that if favours all its overall conservation or stability. This that predators for instance are behaving homeotelically to the ecosystem when they consume their prey. It is only by doing so that they maintain the qualitative and quantitative controls on the prey populations which they must do if the ecosystem's basic structure and viability is to be preserved.

Now this relationship is not just a one-way one. (There are few one-way relationships in the natural world which is one of the reasons why the physicist's concept of 'causality' is unacceptable). If the behaviour of the parts is that which satisfies the requirements of the whole, then the behaviour of the whole must also be that which satisfies the requirements of the parts. In other words the structure of a natural system is a mutualistic one (of course I am using the term in a wider sense than it is usually used in biology). The reason should be clear. Systems develop to fulfil specific functions in a specific environment. A cell for instance is slowly adapted during the course of its development to fulfil its specific functions within a specific environment — our liver for instance. A child as it grows up is progressively 'socialised' i.e. learns to become a member of its specific family and community. That is what education in a stable society means. Assuming that the environment to which adaptation occurs is similar to those to which previous generations have learnt to adapt (i.e. to which the general information which both the cell and the human baby inherit permits them to adapt to), then one can say that the specific environments to which they have been adapted are those which best satisfy their genetic and ontogenetic (in the case of a child one might say cultural) requirements.

Environmental Conservation

It must follow that the optimum satisfaction of their needs and their optimum welfare (if the term can be applied to a cell) are best assured *by conserving their self-generating* or *vernacular*, in the sense in which which they, together with their environment, constitute. One can formulate a subsidiary law (The Law of Hierarchical mutualism) to the effect that, *in the natural world*, behaviour that satisfies the requirements of the whole, also satisfies that of the differentiated parts and vice versa. It will not of course be true of random parts which, in any case, natural systems will seek to eliminate.

This means that the behaviour of any sub-system must serve to maintain or increase the stability of the relationships between all the interrelated parts of the smaller systems that compose it and the larger system of which it is part. Each response, in other words, *contributes* to the solution of all the problems of its internal and external environment. Each can be referred to in fact as a *solution multiplier*.

In the technosphere the opposite is true. Expedients are exploited for dealing with individual problems without reference to their effect on the stability of the other parts of the internal and external environment, which in any case our scientists are incapable of predicting. The problems are thereby 'solved' at the expense of creating a host of new problems. Each technospheric 'solution' can thus be seen as a *problem multiplier*.

It is also convenient to see technospheric responses as *heterotelic* (from the Greek hertero = different and telos = goal) as opposed to *homeotelic*. Rather than tend in the same direction, towards increasing overall stability, they tend in different directions towards the solution of individual problems, even if this is incompatible with the achievement of the overall goal of maintaining biospheric stability. Rather than being environmentally *conservative* they can also be seen as environmentally *destructive*.

The Fourth Law of Ecodynamics

Behaviour will only satisfy the requirements of the first three laws of Ecodynamics if it is *spontaneous, self-generating* or *vernacular*, in the sense in which Illich uses the term. Control which is what behaviour achieves by maintaining a system on its correct course — that which leads to increased stability — must be *self-control*, or *auto-control*, or to use a very current expression, *self-regulation*. This means the system *cannot* be run, controlled or regulated *externally* or *asystemically* by an external agent of any sort, in the way our society is controlled by the state and the market.

It is only if a system is self-regulating that the necessary feedback loops which link it to its environ-

ment, at many different levels of organisation, are capable of functioning properly and thereby assuring its adaptation to its environment by bringing about those changes to the particularities of its behaviour that are seen to be required in order to assure the conservation of its generalities — those that assure the conservation of its basic structure.

It is only if a natural system is self-regulating that it will seek to satisfy all the requirements of the larger system and thereby behave homeotelically so as to maintain its optimum structure and that of its environment (*see* the Third law of Ecodynamics). A system regulated from the outside by the state or the market will seek to satisfy a goal that is *random to it* and to the larger systems of which it is part.

To say that a system is self-regulating implies too that it is *self-powering* in the sense of being capable of obtaining the *energy* it requires in a renewable way and in one that favours rather than adversely affects the proper functioning of all the other parts of the system of which it is part. It also means that it is capable of providing itself with all the necessary resources it requires in a sustainable way and by of behaviour that enables it to contribute to rather than detract from the normal functioning of the biosphere and its component sub-systems. It also means that it is capable of disposing of its waste-products in such a way that these do not accumulate or interfere with the functioning of the other parts of the biosphere.

Vernacular self-regulating systems are also *self-motivating.* They fulfil all their necessary functions because they are designed to do so by their evolution and upbringing and because it is by doing so that their basic needs are best satisfied (*see* the Third Law of Ecodynamics). For this reason the notion of '*work*' as an activity that is not fulfilled spontaneously but which people must be induced to fulfil — by paying them to do so, for instance — is unknowm in vernacular self-regulating, i.e. tribal, societies. The very word does not exist in their vocabulary. As vernacular self-regulating functions are taken over by institutions, instability must set in at all levels of organisation. Let us see why.

If a system's behaviour is to be adaptive, it must, among other thing, be able correctly to *identify* the environmental challenge to which it is responding. It need of course always be able to. In nature, mimicry is a well known phenomenon. Certain beetles, for instance, that feed on the larvae of a specific species of ants, learn to imitate those ants that have become specialised in looking after the larvae. In this way, they obtain access to the larvae, which they promptly eat. Mimicry is, in this case, assuring the success of parasitic behaviour which is *homeotelic,* in that it permits the application of normal qualitative and quantitative controls on the host population and thereby serves to maintain the optimum structure of the biosphere.

Once a system breaks down, however, its internal environment and thus the environment of its sub-systems, undergoes change and the latter are faced with new conditions which they can only interpret in terms of their past experience — and which they must now interpret *incorrectly.* In a sense, the new environmental conditions created by the system's disintegration *mimic* those that prevailed when the system was functioning normally and hence *homeotelically.* In the new conditions, responses which are designed to satisfy, to a varying degree, the requirements of the sub-systems *are no longer those that satisfy the requirements of the larger system. Behaviour is thereby heterotelic rather than homeotelic .*

Let me provide an obvious example. A man, in a stable society, will have been designed by his evolution and his cultural upbringing to fulfil those functions within his family that will assure its stability and survival. He fulfils them *spontaneously,* because it is by doing so that he *best satisfies his own individual requirements.* Thus the husbandly behaviour he displays towards his wife, which he must display if the family is to survive, will also satisfy, by the same token, a host of *basic individual needs* such as sex and companionship.

In aberrant conditions, these same needs may be satisfied by displaying similar behaviour towards a woman who is *external* to the family unit and who may be regarded as '*mimicking*' his wife. Husbandly needs are thereby satisfied *heterotelically.* This means that a mechanism designed to hold together the family unit has been mobilised *to do exactly the opposite.* The family unit, as a result, will become highly precarious. A one-parent family is very unstable and does not provide a satisfactory environment for the children. In a traditional society, where the family will be of the extended type, other family members are likely to step in to compensate, in different ways, for the father's defection, and other different social groupings within the community will do likewise. Not so in an industrial society, however, in which the extended family has disintegrated, as has the small community. In normal conditions, after a period of chaos, new social structures will emerge associated with new cultural patterns that assure their adaptation to the changed conditions. The massive literature on Messianic or 'Revitalist' cults, as they are referred to by Wallace[30], shows how this occurs.

In our industrial society, however, these biospheric 'healing' processes are prevented from occurring. The state, together with the market, conspire to perpetuate the state of social disintegration — and hence poverty or social deprivation, which is the form it takes in the industrial West — by seeking to fulfil, by *external* or *asystemic* or *institutional* means, those functions that were previously fulfilled spontaneously in a vernacular way.

Thus, children, who can no longer be looked after by their mothers who have to go to work, often many miles from their homes, or by elderly relatives who have been consigned to some institution for the aged, may be left to spend all day at a creche. When the family breaks down, social workers step in to try to repair it. If they cannot help, the children are then consigned to some special institution. Later, like other children, they must attend some vast factory-like compound that we dignify with the title of school. Children will thereby tend increasingly to be brought

up by institutions that cannot hope to satisfy their real needs to the same degree as the extended families and small communities in which they were previously brought up.

As a consequence, the socialisation process simply does not occur and rather than become differentiated members of a family, community and a society, they constitute an unabsorbed disorganised mass of alienated people — mere randomness from the point of view of society, increasingly too from the point of view of the economy which, once it ceases to grow, will become ever less capable of absorbing them.

Thus institutions are *heterotelic* to the individuals, families and communities whose behaviour they seek to control.

Right wing political ideologists have glorified the State to whose interests those of its members they insist should be mercilessly subordinated. Liberal ideologists, on the other hand, have glorified the individual at the expense of the State. Our choice, in reality, is not between the State and the individual, but, as Clastres[31] points out, *between the State and society.*

The State is a new development. It has never played a role in the strategy of nature, i.e. in evolution — only in anti-evolution. The state is an institution that is external to society. Society and its constituent communities, on the other hand, are *spontaneous, vernacular* and *self-regulating.* As de Tocqueville[32] writes; "Ce sont les hommes qui ont fait les royaumes, mais la commune semble sortir de la main de Dieu."

Whereas there is a constant conflict of interest between the *State* and the individual, harmony reigns, between *society,* its constituent communities and the individual citizens. The relationship between them is severed by the principle of hierarchical mutualism. This means that behaviour that satisfies the requirements of the former must also satisfy those of the latter.

At the same time, institutions by usurping the functions that are designed to be fulfilled by natural systems, cause the latter to disintegrate and atropy. As this occurs so do we become correspondingly more dependent on and indeed addicted to the services that institutions provide. Seen in more general terms, as instability increases throughout society and its environment so is there a greater need for the institutional activity required to maintain some semblance of order, however superficial (*see* the Great Misinterpretation).

The problem is that these institutional controls are increasingly difficult to provide. As we have seen they are not *self-powering* as are vernacular ones; nor are they *capable* of providing the resources they require from within the system by efficiently recycling them as do natural systems; nor are they *self-motivating*, which means that the people working in the institutions must be paid. To maintain the required social controls thereby requires an ever increasing amount of energy, materials, work and of course finance which for reasons are well known to the readers of *The Ecologist* must be in ever shorter supply.

For these reasons institutional behaviour can only replace vernacular behaviour very *temporarily*. It is only the latter that can display any permanence because it alone satisfies the requirments of the Third Law and hence of the First and Second Laws of Ecodynamics.

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Books

A New Cosmology and Ethic.

ECO-PHILOSOPHY: Designing New Tactics for Living. Henryk Skolimowski. Marion Boyars, £2.95.

While the world has become locked in an increasingly pervasive ecological crisis, one might well ask what our philosophers have been doing about the serious problems that we now face. Unfortunately, there has only been silence from the very quarters from which we should have expected the most penetrating criticism of contemporary assumptions, and the most unambiguous assertion of our true priorities. The explanation for this state of affairs is to be found in the fact that our philosophers have not only acquiesced in the distorted and impoverished world-view of scientism (by which I mean the urge to sever moral considerations from the pursuit of knowledge, and to reduce the latter to that which can be quantified and analysed into its least components), but they have been the positive accomplices, if not indeed the instigators, of such a view. This constitutes the core of Professor Skolimowski's uncompromising critique of contemporary Anglo-Saxon philosophy, which he holds responsible for promulgating the very values and outlook that have resulted in the ruthless exploitation and ecological devastation of the world. The Positivist tradition especially is held to blame for reducing philosophy, by systematically excluding from its competence any discussion of really important or humanly relevant problems, to nothing but mental acrobatics and exhibition of mere technical virtuosity. Not only has contemporary academic philosophy been apparently oblivious to environmental and ecological concerns, but it has in its committment to the scientific ideals of moral neutrality and detachment, and in its deep-rooted belief that all talk that trancends the level of triviality tends towards incoherence, and has precious little to say about the deeper spiritual concerns of human beings.

Skolimowski's thesis that the separation of the pursuit of knowledge from that of value — a separation wrought by the development of the physical sciences since the 17th century — has been the chief cause of the ecological plight of the present time. It lies at the root of the technological ethos that places instrumental values (concerned with how best to get what you want) above intrinsic values (concerned with what is best, with which ends are *In Themselves* worth pursuing). Our society looks favourably upon technical efficiency and all that goes in the way of material progress, without making a serious question of what it is that is really worth pursuing. To answer this question requires a study of the nature of the human being, and such a study — so Skolimowski argues — will reveal that the domains of fact and value mutually entail each other. This being the case, scientism is shown to be both false and out of date.

The new view of the world that we are presented with is not, however, incompatible with the state of scientific knowledge today. Indeed Skolimowski argues — and here he is indebted to the lost philosophical tradition of Alexander and Whitehead, and more especially to the theology of Teilhard de Chardin — that a thoughtful consideration of the facts of science reveals that the universe is not such a strange and alien place as we are told by the pundits of scientism, but that in its characteristics and structure it may be viewed as providing the necessary preconditions for the evolution of life, consciousness and finally the value-conscious creature — man. In short, through its size, density and age, it reveals itself as nothing less than a "home for man", a being who is endowed with unique moral and spiritual potentialities. As matter has evolved into increasingly complex structures and organisms, so it has been able to provide the vehicle of increasingly higher forms of life and consciousness, until finally, in the human being, Nature transcends itself in producing a creature which is itself creative. But the transcendent character of the human being must not lead us into the error of thinking of humanity as opposed to the rest of Nature, for in so far as we are the products of evolution, the very features by which we are distinguished from other creatures are nevertheless due to the creative exuberance of the evolutionary process. Human creativity — whether in the religious, aesthetic or moral sphere — is therefore to be related to the process of the unfolding cosmos, which may be conceived of as a gradual humanization and spiritualization of primordial matter. It is this perception that is at the heart of "ecological humanism".

Skolimowski advocates three values or "imperatives" as characterizing the new ecological humanism: to perfect and transcend our present condition through moral progress and altruism, which is the new dimension in which evolution must now go forward; to treat the life of every human being as an end in itself (and thus celebrate life at its highest point); and to care for our ecological habitat because it is a part of us and we are part of it. The ecological humanist will not compromise himself by advocating an instrumentalist ethic with regard to the environment (for instance, that we must preserve our resources simply because it would be bad economic management to destroy them) for the reason that ethics and cosmology co-define each other: just because we are part of the environment and it is a part of us, we should treat it as having intrinsic value.

The practical application of Eco-philosophy will be appreciated by all who believe that human praxis is governed by the ideas entertained by the human mind. To exemplify this, Skolimowski adds a chapter on architecture and Eco-philosophy, in which he argues that the shortcomings of much contemporary architecture are traceable to the shortcomings of our culture that, dominated by the tenets of scientism, tends to see space in purely physical, Newtonian terms. From the standpoint of ecological humanism, other types of space would be recognized — social, psychological, aesthetic, etc. — and a new architecture would accordingly design for the quality of life rather than simply in the context of economic and technological factors.

It may occur to the reader of *Eco-philosophy* that the new cosmology advocated by Skolimowski embraces in a rather paradoxical fashion a view of human evolution that is the product of the very scientism that he is at pains to attack. Certainly this view of evolution, that matter miraculously transforms and refines itself to the point where it creates man, is not incompatible with a conception of man as Nature's crowning glory — a spiritual being endowed with divine potentialities. But this view does, like the whole of the new Cosmology advocated by Skolimowski, have as its foundation a conception of the world that is under the sway of an essentially reductionist metaphysic. One is therefore tempted to speculate that were science to proceed from the kind of principles that, despite itself are evinced in its own findings — namely, that the universe displays

teleological characteristics that contravene the Second Law of Thermodynamics, that organized wholes are in a very real sense prior to the parts of which they are composed, and that therefore qualities and forms are as valid an object of study as atoms and particles — would we not then find ourselves with a new KIND of science that, taking proper cognizance of these and other aspects of the world, launches into a domain that has for too long been shunned as subjective? I think we should be sceptical of the possiblility of deriving any metaphysic from the findings of science as it is currently practised, for the reason that science itself assumes a metaphysic that effectively restricts the scope of its enquiries to a certain limited dimension, from which is excluded the whole domain of qualities and forms, let alone values, to the benefit of explanation in terms of quantities and interactions of smallest parts. The modern theory of evolution is no exception, for it also proceeds from the least to the greatest, trying to force an explanation of the more perfect from the less perfect. It would make more metaphysical sense if we were to explain the gradual metamorphosis of forms by reference to the most developed, harmonious and perfect form, which would act as the standard by which we look at or judge those that are less developed. Not only would the human form then be seen as the archetype which all mammals more or less perfectly embody, but the human being in all his capacities would appear as the pivotal point of the evolutionary process. Such a perspective would provide the rationale for a new type of science that, rather than utilizing only a fraction of our human capacities and endowments in order to attain its results, would depend on the moral, aesthetic and spritiual development of the whole human being. Skolimowski does indeed recognize the need for an "epistemology of life" that breaks free of the limitations of contemporary scientific method, towards an awareness of the living in Nature. But it should be emphasised that such an epistemology must depend upon the cultivation of faculties more penetrating, subtle and qualitatively aware than those currently regarded as reliable by science, if it is to catch hold of the more subtle and refined aspects of life, which inevitably escape the gargantuan grasp of crude empiricism.

We should, however, give a warm welcome to this book, not least because of the optimistic tone of the last chapter in which Skolimowski attests his faith in the eventual triumph of Life over the death-wish of our civilization. The book is thoroughly readable, written with a freshness and zest that one rarely associates with professors of philosophy. The style is free from academic pedantry, and one feels that each sentence comes from the heart. In one of his books, Schumacher said that if one goes to a philospher asking for the bread of life, all one gets are stones. Skolimowski's book is an eloquent testimony to the fact that philosophers can still provide us with spiritual nourishment.

Jeremy Naydler

A Subject for Moral Enquiry

SCIENCE, ANIMALS AND EVOLUTION
Catherine Roberts. Greenwood Press: Connecticut & London, £12.50.

Dr. Roberts writes that a radical change in our attitudes is necessary if the world is not to become "spiritually uninhabitable". Anthropocentric humanism, which she equates with materialism, must be replaced by a spritually informed theocentric humanism. Men have unique spiritual potential and must grow toward the Good, but modern "objective" science with its tradition of animal experimentation, sets us back upon the Way even when we get some material advantage from it.

The belief that "objective science" is the only route to knowledge, let alone to spiritual Good, has had its opponents. Some have pointed to the element of personal involvement that lies behind any scientific endeavour, to the moral discipline necessary to success in that craft. Some have proposed that mystical or spiritual experience (which Dr. Roberts herself properly distinguishes) can itself be examined with scientific rigour, and that the World may prove a wider one than materialists allow. Most have insisted that there is no reason to think that science can itself answer all questions (what, after all, is the scientific status of the claim that science could?). Dr. Roberts points out that such critics have signally failed to dissociate themselves from the industry that now exploits (and sometimes, by any reasonable test, torments) our non-human kindred. Until they do, their plea for a genuinely humane science must be incomplete. The new science must be a practice of saintliness: men must exercise compassion if they are to find a knowledge worth possessing.

The thesis that true science rests on the arbitrary postulate of objectivity, a refusal to "participate" or to engage one's emotions in the things which one studies, has been advanced with the authority of a great scientist, Jacques Monod, in his *Chance and Necessity*. As I have myself argued elsewhere his scientific greatness did not stop him talking philosophical nonsense. "Objectivity", a refusal to be deceived by one's prejudices, is of course a virtue: "objectivism", the creed that we ought to regard everything without any emotional affect, ought to treat everything as mere material for our current purposes is inadequate even as a rationalization for psychopathy. Monod was a lousy philosopher and a naive moralist: but it may be that his book did express an attitude to life endemic in the contemporary scientific community. Animal experimentation has played a part in establishing this nonsense.

At the centre of her book (which is, in part, a collection of previously published papers) Dr. Roberts has had the courage to print her confrontation with Robert White of Harvard, who has succeeded in keeping the severed heads of monkeys alive and apparently conscious: "the eyes tracked the movement of individuals and objects brought into their visual fields and the cephalons remained basically pugnacious in their attitudes, as demonstrated by their biting if orally stimulated." Both Dr. Roberts and Dr. White profess to be Christians; both are concerned about man's situation in the environment, and about spiritual progress. Yet Dr. White finds it wholly inconceivable that non-human animals should have any claim on our respect: he claims, apparently without any notion of the absurdity of what he says, that "R.D. Guthrie (who?) has recently demonstrated the impossibility of including animals in our human ethical system", and thinks it enough to discredit the opposition that material advantages for (some) men have been won from animal experimentation.

Outsiders could perhaps be forgiven for thinking that a debate between fanatics is rarely profitable: neither side is willing to consider that the other has anything to be said for it. Current debate within the profession is perhaps not so hampered: scientists are increasingly willing to consider that their actions are subject to moral enquiry, that animals are worthy of some respect and should not be used merely as means to human (or rather, almost always, Western) profit. But Dr. Roberts may be right that only a total rejection of animal exploitation, on the land as well as in the laboratory, is compatible with our real spiritual welfare. To desire a continuation of earthly life and health at the price of "scientific violation of both human and animal creatures" is to fail at the test.

If this life is all we have it is easy to suppose that nothing should stop us seeking as trouble-free life as we can, at whatever expense to those other creatures who share the world with us but cannot force their wills on us:

easy for some, at any rate. Dr. Roberts seems to think the only plausible reply is that this life is not all we have, that we must reckon on an eternity of spiritual progress. How foolish, if that be so, to buy a few years here at the expense of our soul's health! The plea is a strong one, with distinguished precedent. But it is surely also possible to think that even if we are "only natural creatures" still we may find some peace in identifying ourselves with the continuing enterprise that is the terrestrial biosphere. We are not bound to think only of our own well-being, or our own race's well-being: we can consider the well-being of Gaia herself, and lend our worship to the single cosmos that so marvellously and improbably exists. Anthropocentrism is not the only option for a materialist, and not all materialists are Monodtheists.

Although I think her case is incomplete, I have some sympathy with it. Peculiar things are happening amongst physicists, and it may be that a new, more spiritually open science is on its way. Whether the current revival of religious feeling in the world at large will prove helpful to the animal creation seems uncertain. "Born-again" Christians sometimes have strange ideas about the land. My own fear is that our repentance will come too late, that the land shall have its sabbaths, its rest from our depradations, when we are gone from it. To Dr. White it seems absurd to worry about a few monkeys or rats when we are beset by so many and so great dangers. I share Dr. Roberts' conviction that it is in our treatment of the weak and defenceless that our character is shown, by our treatment of human and non-human victims that we shall be judged. It is time that we remembered that virtue is shown not in the posturings of human pride but in "a loving submission to that which is superior to the purely human".

Stephen R.L. Clark

Monitoring Rural Suicide

FARMING AND WILDLIFE, by Kenneth Mellanby. Collins, £9.50.

A melancholy fatalism pervades Professor Mellanby's book. 80 per cent of our land, he says, is farmed and if the most economic practices spread to all this land our most cherished wildlife will disappear. Agricultural economics dictate what happens. So far as the fertility of the soil is concerned it is unlikely that progressive agriculture will reduce it; techniques of minimum cultivations and a greater knowledge of soil micro flora together with improved fertiliser use and pest and weed control will stabilise the conditions for crop growth; so conservationists who hope that the agricultural husbandry which is destroying wildlife will bring about its own economic decline should not deceive themselves. All conservationists can hope for is that farmers from the kindness of their hearts will set aside a few wild areas as a habitat for wildlife.

How contemporary husbandry reduces wildlife is presented to us chapter by chapter with extensive knowledge based upon years of participation in, and direction of, research; it is like an intellectual man recording the details of his own terminal illness. For a patient who is not reconciled to his own death *Farming and Wildlife* provides valuable information. The only cure, however, that Dr. Mellanby offers us — and that is in the appendix — is that we should eat less meat. If we eat less meat then land that is now down to arable solely for feeding livestock could be released. This cereal growing land is the most destructive of wildlife. Intensive livestock production — factory farming — is, therefore, indirectly, a major destroyer of wildlife; but it is integrated with our economy so we can't make it illegal.

When it come to describing the effects of pesticides and herbicides on wildlife the Professor has the empirical gullibility of the 'plant protection' experts. He sees paraquat, for instance, as a means to improving the conservation of soil fertility because it makes minimum cultivations possible. He is apparently not aware that this can be practised without soaking the earth in paraquat season after season; by means of a new technique, seeds which have been direct drilled can be mulched with the weeds that have germinated since the harvest, and all achieved in one operation. No doubt the chemical firms would not be so keen on minimum cultivations if they thought it could be done without herbicides.

A consideration of hedges crystallises the problem of farming and wildlife — and a good deal more besides. Hedges are the major habitat for wildlife in farming country and the wilder and more unkempt they are the better they are as wildlife habitats. But they have no economic value for the farmer and may even harbour more pests than predators and release the vectors of plant diseases. Aesthetically hedges are a matter of taste; some countrymen have liked them and some ain't liked them — including the poet John Clare who saw them as symbols of the injustice of enclosures and preferred the old unhedged common lands: but in his day there were sufficient wastes, heaths, woods, forests and the like to provide for wildlife. But still, it is hardly surprising that farmers, when asked to conserve hedges, should ask the rest of us whether their job is to produce food or act as the guardians of wildlife. Are they keepers of nature reserves? If so, let their role be redefined. That the problem could be stated in these terms shows how far we have strayed from a sane and integral civilisation in the search for economic efficiency; for once we start to believe that only the economics of farming is important we consign our rich, varied inherited landscape to oblivion; we do worse than that, we condemn to death our culture and the British character. Our national character has been moulded through the centuries by the twin foundations of society, urban and rural life. If one of them goes we are but half men. The policies of this government, if we judge them by their effects, are based upon the conviction that rural life is obsolescent in an industrial economy.

As a consequence of our efficient agriculture driving out people as well as wildlife, the people who once lived in the hamlets and villages are now part of the landless proletariat in the factories and the dole queues: and as there is no work for the young on the land — which until this century was the greatest employer of labour — they form into gangs to smash up the civilisation they hate. And one would despair of the human spirit if they didn't. Yet despite that, learning nothing from history, we go on industrialising the countryside.

Professor Mellanby agrees with the Ministry of Agriculture that present trends must continue: and no doubt he will publish another book describing the still further destruction of wildlife in scientific terms. He will lament that we did not eat less meat and do more research into organic farming. But there you are, to get really Bolshy about it is to offend the NFU and the Ministry who are after all pretty intelligent and have our interests at heart; they don't want us to starve or farming to go bankrupt. As for the Government, one third of them are rich landowners — two of the principle ministers are large farmers themselves — so you can't expect them to cut their throats for the sake of birds and wildflowers; besides, don't culture and civilisation depend on economics? If we tried to save our wildlife and our rural community by changing our methods of husbandry, it would increase inflation...and that would be the end of everything as Milton Friedman and Mrs Thatcher can testify.

So carry on agriculture: finish off wildlife: ruin the rural community: what there used to be will be recorded in glossy coffee table books financed by multinational companies and written by nature conservancy scientists and environmental journalists.

What Professor Mellanby does not tell us — he could say it was not his brief — is how the farming lobby and the farming technocrats are monopolising all the land and driving out the small farmer and doing it with impunity because they have the government in their grip; or that this destruction of our countryside is costing the nation a billion pounds annually out of the tax payer's pocket. This is the situation we have to tackle if we are going to conserve wildlife and the countryman. Never mind about vegetarianism.

We shall have to find a way to a new revolution: a double revolution in which man serves the spirit and the economy equally and farming becomes once more a way of life as well as a business. We can thank Professor Mellanby for describing what is happening: and then study how to stop it while he is wringing his hands.

Robert Waller

Social Prescriptions

ECOLOGY AND PLANNING: An Introductory Study, by Paul H. Selman. George Goodwin Ltd, £10.
COUNTRYSIDE CONSERVATION, by Bryn Green. George Allen & Unwin, £13; paperback £6.95.
INTERACTION BETWEEN HERBICIDES AND THE SOIL, edited by R.J. Hance. Academic Press (London), £20.60.
SOCIAL ECOLOGY: Exploring Post Industrial Society, by Martin Large. Self-published by Martin Large, 25 Reservoir Rd, Gloucester, £4.95.
POPULATION SYSTEMS: A General Introduction, by Alan A. Berryman. Plenum, New York, $16.95.

The ecological movement has formulated a series of prescriptions for a post-industrial society. If these are ever to be realised, it will be necessary to make a close study of the dynamics of social change, which entails an investigation of where power lies in society today. One group of people whose influence retards any movement towards ecological sanity is the planning profession, which sees ecological considerations, where it acknowledges them at all, as strictly subordinate to economics, *Ecology and Planning* by Paul Selman attempts to redress this situation, offering an integrated ecological perspective that can be incorporated throughout planning practice. If students of planning are impressed by this book, there is hope for a slow continental drift of professional attitudes, and hence in the direction of social change. For the non-planner, the book's accounts of climate, geology, soil structure, vegetational patterns, and animal life in the British Isles, of resource competition and land-use conflicts, and of the sources and consequences of waste and pollution provide an exhilarating breadth and clarity of vision

Landscape types and the life which they support are treated in more detail in *Countyside Conservation* by Bryn Green, a book of much narrower concerns, written from a sense that the British countryside is under threat.

An important point which it raises is that simply preserving tracts of countryside is not enough: they must be managed. Few British landscape types are climax ecosystems; they are the result of specific husbandry practices, and of the attentions of a specific local fauna, and if they are left untended, or if that fauna is disturbed, they will change drastically. Grassland, in particular, is characterized by a great diversity of species, and the species composition is very plastic: different mowing and grazing practices can, by favouring some species and penalising others, lead to very different kinds of grassland ecosystems. For example when myxomatosis decimated the rabbit population in this country in the late 1950s, the grasslands which the rabbits no longer grazed rapidly degenerated to scrubland, with an upgrowth of bramble and thorns.

The idea that conservation is an active management process raises fundamental and difficult ethical issues: why should one ecosystem be preferred over another? Bryn Green argues in terms of aesthetics, amenity value, and the need for genetic diversity in plant and animal stocks, but in a sense this debate ignores the real issue: as long as society at large is committed to anti-ecological goals, countryside conservation will remain at best a holding operation, the losing side in a long war of attrition.

The attitude of conservationists to agriculture, as Bryn Green points out, has undergone a radical change in the last forty years. Whereas traditional agriculture was regarded as the most effective way of preserving the countryside in its traditional form, intensive agriculture can only sustain limited, and impoverished ecosystems. The use of herbicides, for example, is a factor leading to the simplification of farmland ecosystems. Just how little is known about the effects of herbicides emerges from *Interactions Between Herbicides and the Soil,* a collection of papers by the Herbicide-Soil Working Group of the European Weed Research Society: there is ignorance of the factors determining the persistence and transformation of pesticides in the soil and their uptake by plants; the properties of herbicides which may disrupt microbial fauna in the soil and hence soil fertility cannot be identified or quantified: and the consequences of herbicide action on soil fauna are not regarded as predictable. All in all, not a reassuring state of affairs.

Ecology is a term that means different things to different people. Martin Large takes social ecology to mean 'social house wisdom', the principles of ordering human existence. His book is hard to assess. He is certainly aware of the need to study the dynamics of social change but all his flow charts and models of decision-making processes leave this reader at least no wiser than he began. Large is certainly well read: E.F. Schumacher, Rene Dubos, Barbara Ward, Laurie Lee, Rollo May, R.H. Titmuss, James Robertson, Carl Rogers, Theodore Roszak, Margaret Mead, R.D. Laing, Frederick Leboyer and many more are brought on as witnesses, but the overall effect is of nothing more enlightening than a whistle-stop tour around contemporary preoccupations. Martin Large has worked with the Netherlands Pedagogical Institute, an organisation which bases its work on the philosophy of Rudolf Steiner, and this may have some bearing on the book's curious tone: intensely detailed about proposals for a post-industrial society and bafflingly vague about the institutional structures that exist now. I was stifled rather than stimulated.

Finally, a book which adopts a systems approach to its subject. Systems theory lends itself well to holistic ecological analyses, and it's encouraging to see it taken up more widely. Alan Berryman's *Popular Systems* is not a book that will interest the general reader, because it confines itself to societies other than the human, and the social and political systems which would be required in order to extend Alan Berryman's treatment to human population dynamics would fill another large volume. He does address himself, however, in a brief epilogue, to the problem of human population and finite resources, and singles out the contribution of economics: there is a need, he says, for a new economics built around the concept of maximum sustainable yield. This is certainly true, and the question of how we are to achieve such an economics brings us back to our starting point.

Bernard Gilbert

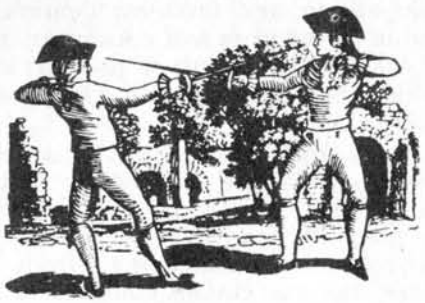
OTHER BOOKS RECEIVED

Helping Ourselves — Local solutions to global problems, Bruce Stokes. (A Worldwatch book). W.W. Norton and Co, New York. No price given.
The title tells the story. Bruce Stokes has little time for those who lament and grumble about the state of the world, but do not believe there is anything they can do about it. His book is an excellent guide for those who *do* want to try and make things better and are prepared to mobilise, and encourage their neighbours to do so as well as to struggle and plead for what they believe in. Perhaps it *is* the least but utopian, but if it makes people get up and go, then it's none the worst for that.

Population and Resources, Harry Robinson. Macmillan £14.00; paperback £6.95.
Population control, living space and the distribution of resources are subjects that engage vast numbers of statisticians, environmentalists and other experts, worldwide, but as Robinson says ". . .there is a very wide range of views which extend from extreme optimism to extreme pessimism . . ." The author has obviously done an enormous amount of research and has tried to present the truth as objectively as possible. He offers his own solutions which will appeal to some and be chewed up by others, but his book must be regarded as a serious contribution to the debate.

Fresh Fruit and Vegetables, *and* **Pulses, Seeds and Grains, both by McCullum in the new Real Food Guide series by The Molendinar Press at £2.95 each.**
"These books", says the publisher's blurb, "fight a war against junk food — and win." Well, I'm not sure that they should be claiming any great wins just yet, but let's hope they will. I think they contain too much chat about the names, origins and geographical roots of their subjects and not enough about enjoying them, and the lay-out is particularly ugly, but if you like a lot of background info about what you eat you'll revel in them.

Clean Coal, Dirty Air *or* **How the clean air act became a multibillion-dollar bale-out for high-sulfur coal producers and what should be done about it. Bruce A. Ackerman and William T. Hassler. Yale University Press. £12.60. Paperback £3.50.**
A powerful exposé of those who can and do profit from the conundrum posed by the requirements of environmental protection and the demand for energy. The authors show how hopelessly legislation for clean air entangles the whole energy programme and how ignorant many of those, who must make vital decisions, are.



Letters

Sloppy Protection

Dear Sir,

On Page 138 of Volume 11, No.3, 1981 you show a photograph of workers in protective clothing.

It is curious that one is wearing his protective trousers tucked into his protective boots and another has his protective jacket sleeves tucked into his protective gloves. Maybe there is a reason for this but anyone who wears protective waterproofs in the rain will be well aware that to wear them this way invites a bootful of water or contamination in peeling off the gloves.

Yours faithfully,
L.D.C. Owen
3, Higher Lavorrick,
St. Austell,
Cornwall.

An Irrational Approach to Sewage?

Dear Sir,

I cannot allow the article written by P.J. Riley and D.S. Warren "Money down the Drain", (Vol. 10 No. 10) to pass without comment. This so-called "Rational approach to sewage" uses the vehicle of high sewer replacement costs to promote a positive obsession to conserve nitrogen.

To say that "we should ensure that a modern knowledge of physics, chemistry and microbiology is used in any new system" is an insult to the highly qualified staffs of the national Water Authorities, who continually improve the techniques of sewerage and sewage treatment

The authors perpetrate a basic fallacy that effective treatment depends upon separation of faeces, urine, grey-water and trade effluent. This is ridiculously impractical if not impossible in western civilisations! The Utopian ideal of New Villages where everyone cultivates large gardens fertilized by their own excrement is quite unrealistic! To propose regular collection of separate containers of faeces and urine on a regular basis for central treatment and storage is absolutely appalling! The statement "Adaptations of this scheme to existing towns should not be difficult" is incredibly stupid!

I have been associated with treatment of industrial wastes for over twenty years, and for the authors to dismiss these wastes in two words "often toxic", and suggest such wastes should be "excluded" from their grand plan, is simply avoiding the issue.

The system proposed by the authors may be possible in small, rural, agricultural based communities, but to suggest its application nationally, to all our urban areas, is grossly irresponsible!

The sewer replacement programmes are for densely populated towns and cities. To carry out the authors' proposals would require a social revolution. A massive devolution of unprescedented scale, unacceptable to most of the population and surely only possible under a military dictatorship! The risk of disease would be greatly increased and the cost would grossly exceed that of sewer replacement and savings over the use of conventional fertilizers would be negligible by comparison!

The U.K. enjoys one of the worlds most efficient and hygienic waste disposal systems in the world and we should strive to maintain this enviable position. Messrs. Riley and Warren cannot be serious.....or are they?

Yours faithfully
D.F. Tilley M.I.W.P.C., M.I.P.H.E.,
Senior Trade Effluent Officer,
Avon Division,
Severn-Trent Water Authority.

ERRATA Vol. 11, No. 2, page 100.
In a review of **Lead or Health?** in our March/April issue, we incorrectly ascribed the authorship to Professor Bryce-Smith and Robert Matthews. The authors are in fact Professor Bryce-Smith and Dr. Stephens. We apologise to all concerned for the error and to our reviewer, Nicholas Kollerstrom.

Classified

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What are Nursery Rhymes? They are folk rhymes made childish. The "The Nursery Rhymes Restored To Their Adult Originals", £3 (p.p. 24p) from Norman Iles, 381 Marine Road, Morecambe, Lancs., on a book-back money-back, basis.

SCIENCE, PROGRESS, EDUCATION: Can you live without these myths? Don't want your children indoctrinated? Then the matriarchal community needs you. Literature 45p from Lux Madriana (E), 40 St. John Street, Oxford.

PERSONAL

Widow, 45, plump (but presentable), resides in North West England. Would like to correspond with intelligent males from Cornwall and also abroad. Write to: Box No. 141, at The Ecologist.

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CONFERENCES & EVENTS

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GOOD HEALTH. A one day symposium organised by the Vegetarian Society, on Saturday 26th September 1981 at the Commonwealth Institute Theatre, Kensington High Street, London W.8. starting at 10 am. Topics and speakers are: Dr. Haines, Diet and Risk of Cancer; Dr. Grant, Migraine; Dr. McDonald, Acupuncture; Dr. Mead, Transcendental Meditation; Prof. Alberman, How Mother's Health affects her Baby; Dr. Forbes, Non-toxic Cancer Therapy. Tickets £1.50 from the Vegetarian Centre and Bookshop, 53 Marloes Road, London W.8.

NUCLEAR WEAPONS—NUCLEAR POWER. THE CONNECTIONS. A day conference with speakers: Prof. Rotblatt — Civil and military nuclear power, the connection. Prof. Lindop — The medical effects of radiation. Colin Sweet — The politics and economics behind nuclear power/weapons. On Saturday, 26th September from 10.15 am to 5.00 pm at the Co-operative Education Centre, Broad St., Nottingham. Fee £2.50. Bookings in advance please. Contact the Safe Energy Group, c/o Environmental Information Centre, 15 Goosegate, Nottingham.

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