The Trap Chapter 5
Modern Agriculture and the Destruction of Society

You believe that intensive farming, on which modem agriculture is based, damages public health and destabilizes
society. Why?

Intensive farming is based on the belief that food is like any other product and that agriculture will respond to technology in the same way as industry does. If new technology is introduced, the argument goes, enhanced efficiency and productivity will follow. Large, mechanized modern farms using the latest scientific discoveries will produce more food, more cheaply, for the benefit of the economy and of people throughout the world. The necessary elimination of rural jobs, the reasoning continues, is no different from the daily loss of industrial jobs due to technological innovation. What is more, men and women will be liberated from the land and made free to participate in the dynamic sectors of contemporary industry, where they will contribute to the growth of GNP and to public prosperity.

At first sight this seems obvious. Yet it is totally wrong. When people leave the land, they gravitate to the cities in search of work. But throughout the world there are not enough urban jobs and the infrastructure-such as lodgings, schools, hospitals, etc.-is already insufficient. The result is increased unemployment, with the attendant costs of welfare, as well as a need for substantial expenditure on infrastructure. These are the indirect costs of intensive agriculture and they must be taken into account.

There is also a deeper price. When, as a result of change, jobs are lost in a particular industry the fundamental balance of society is not altered. Some declining companies necessarily suffer while other, more competitive entities emerge. But loss of rural employment and migration from the countryside to the cities causes a fundamental and irreversible shift. It has contributed throughout the world to the destabilization of rural society and to the growth of vast urban concentrations. In the urban slums congregate uprooted individuals whose families have been splintered, whose cultural traditions have been extinguished and who have been reduced to dependence on welfare from the state. They form an alienated underclass. From the first world to the third, these huge shantytowns have become tragic, morbid intumescences. The cost of such social breakdown can never be measured. The damage is too fundamental. Throughout the world social breakdown in the mega-cities threatens the existence of free societies.

As Jose Lutzenberger, the far-Sighted former Environment Minister of Brazil, writes,[1] the notorious slums of Brazil, known as favelas, were the direct result of the rural dislocations caused by the Green Revolution of the 1950s. This was the first major scientific initiative to apply intensive farming to a large area. It was supposed to end, for all time, famine throughout the world.

But do you question the assertion that intensive agriculture is more productive?

The only measure by which large farms are more productive is in the use of labour. If productivity is measured in terms of production per acre, or per unit of energy, or relative capital input, it is the small farm which comes out best.[2]

Output per person might have been an important consideration in the highly developed western nations, where the cost of labour is great and standards of living are high. But we are entering a new world in which we must accommodate 4 billion people who have suddenly joined the world economy, including the populations of China, India, Vietnam, Bangladesh and countries of the ex-Soviet Union among others. These populations are growing fast, and are forecast to reach 6.5 billion in thirty-five years. Under these new circumstances, the question is no longer how to save

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[1] Personal communication from Jose Lutzenberger, September 1992.

[2] Daly, H., and Cobb, J., *For the Common Good,* London: Green Print, 1991

labour. The problem is how to stabilize these vast and fast-growing populations, a very large part of them unemployed.

Take Vietnam as an example. It has a population of 74 million of whom 80 per cent live in the countryside (compared to 14.8 per cent in Australia, a major agricultural country).[3] Driving them from the fields into urban slums would create devastation.

In the world as a whole, there are still 3.1 billion people living in the countryside. If intensive methods of agriculture were imposed universally and productivity per person were to reach the levels of Australia, then, as we have discussed, about 2 billion of these people will lose their livelihood. Rural communities throughout the world would be washed away as if by a great flood. Whole populations would be uprooted and swept into urban slums. As the affected nations become ungovernable and impoverished, so their people would be forced to seek refuge elsewhere. Mass migrations of displaced people would follow. Yet economists totally disregard these social and economic costs when they calculate the cost of food produced by intensive methods.

Modern society believes in intensive farming because modern culture is based on measuring and counting rather than on trying to understand long-term and more important consequences.

What are the other effects of intensive farming?

Its effects on the environment and on the public are well known: soil erosion, water pollution by chemical effluents, accelerated depletion of ground water, destruction of genetic diversity, pollution of foodstuffs and damage to public health.

You talk of the effects on public health of intensively produced food. What do you have in mind?

The purpose of intensive rearing of animals is to achieve the greatest weight gain over the shortest period of time for the lowest cost. It seeks weight gain not nutrient gain, and that is achieved most easily by putting on fat rather than protein. At present chickens, turkeys, ducks, pigs, veal calves and beef cattle are commonly reared by intensive methods. Salmon, trout, halibut and some other fish are more recent recruits.

As an example I will take the meat which was first produced by modern factory farming, chicken.

Broilers, typically, are reared in sheds each containing 40,000 growing birds. There are eight crops per year, so eight times each year 40,000 one or two day old chicks are delivered to each shed from incubators in a hatchery. There they will remain until they are ready for slaughter, forty-two days later. Their feed contains very little natural vegetable material, but instead consists of a considerable proportion of fish meal and what is discreetly called 'bone meal'. This, in fact, is the remains of previous generations of their own and other species. In many cases, to their feed will be added artificial growth promoters such as antibiotics (virginiamycin, for example) and anticoccidials to treat fungal infections. Regular feeding of antibiotics to intensively reared animals produces an additional weight gain of perhaps 5 per cent.[4] Similar industrial processes are applied to other animals.

Intensively reared animals are physically different from their free-living counterparts. In the meat of free animals, the protein content far exceeds the fat content. In intensively reared animals the proportion of fat to protein is much higher. After converting the figures to their calorific value, the ratio of fat to protein is often found to be nine times greater in domestically reared animals than in their free counterparts. In chicken, it has been demonstrated that since the end of the last century the carcass fat content has risen by nearly 1,000 per cent.[5]

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[3] *World Urbanization Prospects: The 1992 Revision,* New York: United Nations, 1993.

[4] Lacey, R., *Unfit for Human Consumption,* London: Souvenir Press, 1991, p. 32.

[5] Crawford, M., Gale, M., Woodford, M. And Casperd, N., 'Comparative Studies on FAtty ACid Composition of Wild and DOmestic Meats', *International Journal of Biochemistry*, New York, 1970, pp 295-305; Crawford, M., 'Fat Animals - Fat People', *World Health,* ROme: Word Health Organization, July - August 1991; Crawford, M., and Marsh, D., *The Driving Force, Food Evolution and the Future,* London: Henemann, 1989, p 228.

The change goes further. Generally speaking there are three main types of fat, two of which concern us most-polyunsaturated and saturated. Polyunsaturated fat includes essential fatty acids, so called because they are essential for the growth and development of the brain and are components of all cell membranes which need them in order to function effectively. They help to produce hormone-like substances which regulate, among other things, the immune and vascular systems. Saturated fats, on the other hand, are a significant contributory factor in heart disease and possibly also a factor in breast and colon cancer. [6]

Wild pigs are expected to have twice the concentration of essential fatty acids as of saturated fat. In contrast, the modern pig has five times more saturated fat than polyunsaturated fat-a transformation by a factor of ten times, the wrong way.[7]

So the damage to the value of our food is twofold: the meat will contain relatively more fat than protein, and the quality of that fat will have been perverted.

There is still more. The limited space in which the animals live facilitates the transmission of microbes which increases the spread of infection. The unnatural living conditions are themselves likely to damage the animals' health and reduce their resistance to disease. And as the animals are bred from uniform genetic stock constituting a form of monoculture, they are all vulnerable to the same infections. Vaccines, antibiotics and other drugs are administered to prevent epidemics. The systematic use of antibiotics may create resistant bacterial which can then spread to man.[8]

Is mad cow disease connected to intensive rearing of animals?

Mad cow disease or bovine spongiform encephalopathy (BSE) is one of a group of infectious diseases known as TSEs: transmissible spongiform encephalopathies. The TSE which affects sheep is called scrapie and the form which principally affects humans is known as CreutzfeldtJakob disease. The diseases are always fatal and there is no known treatment. They are transmissible to other species I have very long incubation periods and are present in many tissues of the animal's body long before symptoms are seen. They act by causing the disintegration of cells throughout the brain and replacing them with microscopic holes which give a spongelike appearance, hence the name 'spongiform'.

The disease is transmitted by infectious agents whose chemical nature is still unknown. They are very small, smaller than all classified viruses, and there is no way of identifying infected animals before they have developed symptoms, except by injecting cells into mice. Even then the results may not be available for up to a year.

The infectious agents are extraordinarily tough and heat-resistant. Experiments have shown that they can survive any dose of X-rays or irradiation that is viable in practice; antiseptics or enzymes or formaldehyde; exposure to 360 degrees centigrade for one hour; and autoclaving under

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[6] Food and Agriculture Organization and World Health Organization, *The Role of Dietary Fats and Oils in Humans Nutrition,* 1978; Moncada, S., and Vane, J., 'Prostacyclin, Thromboxane and Leukotrienes', *British Medical Bulletin,* 39, 1983, p. 209; World Health Organization, *Diet, Nutrition and the Prevention of Chronic Diseases, Rome, 1990*

[7] Crawford, M., Gale, M., and Woodford, M., 'Muscle and Adipose Tissue Lipids of the Warthog (Phacochoerus Aethiopicus)' *International Journal of Biochemistry*, New York, 1970, pp. 654-58; Crawford, M., Doyle, W., Drury, P., Ghebremskel, K., Harbige, L., Leyton, J. and Williams, G., 'The Food Chain for n-6 and n-3 Fatty Acids with Special Reference to Animal Products', in *Dietary w3 and w6 Fatty Acids: Biological Effects and Nutritional Essentiality,* London: Plenum Press, 1989, pp. 407-14.

[8] Lacey, R., *op. Cit.* Pp 38-40.

conditions that kill all other known infectious agents.[9] They are durable and will persist for many years in .the soil.[10] Domestic cooking is not expected to have any effect on them at all.

TSEs affect mammals, but not other species (except for the long-lived ostriches). It is interesting to note that when a TSE is transferred from one species to another, the properties of the infectious agents change. For example, it seems that scrapie cannot be transmitted directly from sheep to rhesus monkeys and in light of the genetic relationship between the rhesus monkey and humans this is consistent with the view that scrapie does not directly affect man. But if scrapie is transmitted experimentally from sheep to mink, then the mink TSE develops new properties and can be experimentally transmitted to rhesus monkeys.[11] Thus it seems that TSEs can be transferred either directly or indirectly across the barriers between species.

The first cases of BSE were identified in 1986. Many scientists believe that the infectious agents were transmitted to cows through feed which contained products from rendering plants, i.e., factories that process the remains of slaughtered animals, including cows. The material they produce is added to animal feed and described variously as concentrates, protein supplements or bone meal. Thus, we are feeding cow remains to cows, in other words forcing cows into cannibalism.

It is interesting to note that in the first half of this century there was another form of TSE which affected humans-Kuru disease. It occurred in the Fore tribe, a Stone Age civilization which at the time practised cannibalism.

How did the British authorities react when BSE appeared?

The government found itself in an extremely difficult position. Evidence was slim and the risks, although great, were unproven. As there is a considerable period of incubation it would take some years to establish whether the epidemic could spread from cows to humans. A full alert by the government might have caused panic and would have had a potentially disastrous impact on British farming.

So the government reacted by establishing advisory scientific committees and taking some precautionary measures to reassure the public.

As of 1989, 'high-risk' organs were to be removed from slaughtered cattle[12]-a useful decision which might or might not be wholly successful, because it has not been established where in the tissues of cattle the infectious agents settle. For example, all organs and meat contain nerves that are in physical connection with the brain. It is known that several infectious agents pass between an animal's peripheral organs and the brain by moving along the nerves. Therefore, if the brain is infected, the nerves may also be infected.

Furthermore, it was decided that cattle thought to be infected with BSE were to be reported and milk from obviously ill and infected cows was banned from sale. This was also useful but, as I have explained, there is no ready way of identifying infected animals until the disease reaches the final stages, so the effects of these decisions are necessarily limited to those animals in which the disease is already obvious.

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[9] Fraser, H., Farquhar, C., McConnell, I. And Davies, D., 'The Scrapie Disease Process is Unaffected by Ionizing Radiation', *International Journal of Biochemistry,* 317, New York, 1989, pp. 653-58; Gajdusek, D., 'Unconventional viruses and the origin and disappearance of Kuru', *Science,* 197, Washington, 1977, pp. 943-60; Brown, P., Liberski, P., Wolff, A. And Gajdusek, D., 'Resistance of Scrapie Infectivity to Steam Autoclaving after Formaldehyde Fixation and Limited Survival after Ashing at 360°C: Practical and Theoretical Implications', *Journal of Infectious Diseases,* 115, Chicago, 1990, pp. 393-99.

[10] Brown, P. And Gajdusek, D., 'Survival of the Scrapie Virus after 3 YEars' Internment', *The Lancet,* 337, London, 1991, pp. 269-70

[11] Dealler, S., 'Bovine Spongiform Encephalopathy (BSE): The potential effect of the epidemic on the human population', *British Food Journal,* 95, York, 1993, pp. 22-34.

[12] *The Bovine Offal Prohibition Regulation,* London: HMSO, Statutory Instrument, No. 2061, 1989.

The committees also recommended a ban on the feeding of ruminant-based protein to ruminants. In other words, no more cannibalism to be imposed on ruminants. That was an excellent decision but the ban was not extended to pigs and poultry, which continue to be fed on the remains of their own species. In any case, the effects of this recommendation must now be reassessed as a result of the convincing evidence of maternal transmission of BSE from darns to their calves. Although contested by government scientists, it now seems almost certain that natural transmission of BSE from cow to calf has been taking place and will continue unless preventive action is taken.[13]

One of the principal conclusions, in February 1989, of the government-sponsored Southwood Committee was: 'From present evidence, it is likely that cattle will prove to be a "dead-end host" for the disease agent and most unlikely that BSE will have any implications for human health. Nevertheless, if our assessment of these likelihoods is incorrect, the implications would be extremely serious'.[14] The phrase 'dead-end host' means that the BSE stops here and will not be transferred from the cow to other species.

Do you believe that this conclusion was right?

More than five years have passed since the Southwood Report was published and the epidemic has spread much more rapidly than predicted. Instead of the total of 20,000 affected animals forecast by the Committee, the figure is already above 130,000 with some 30,000 farms having experienced at least one case of the disease (52 per cent of UK dairy farms).[15] According to Dr Stephen Dealler of the Department of Microbiology at York District Hospital, this figure only represents about 20 per cent of the animals affected, the remainder having been eaten before the diagnosis had been carried out.[16] In addition, the disease has been transmitted to seventeen out of the eighteen mammal species which are known to have been exposed to BSE.[17] These include the mouse, the antelope, the oryx and the cat, as well as the pig and the marmoset monkey. The appearance of the disease in the pig is significant because pig tissues are similar to those of man (various connective tissue components from the pig have been used for human grafts). Transmission of the disease to monkeys is especially disquieting because of their close relationship to humans. According to Professor Richard Lacey of the Department of Microbiology of the University of Leeds, 'the central tenet of the government's reassurances that BSE cannot be a danger to man because it cannot "spread" is now completely discredited. The implications for cattle farming and probably also for human health are very grave'.[18]

Already two cases are known of beef cattle breeders who have contracted Creutzfeldt-lakob disease, the human version of TSE. There is also a sixteen-year-old girl dying from Creutzfeldt-lakob disease, the cause of which doctors have so far been unable to determine.[19]

BSE has now been identified in countries other than the UK, among them Canada, France, Germany, Ireland, Portugal and Denmark, where the disease is thought to have spread from imported British cattle. It was this, along with increasing concern about inter-species transmission, that led the German government to question the safety of British beef. The Germans tried to adopt a preventive approach to the' issue, with Health Minister Horst Seehofer commenting that 'we cannot live by the slogan "Because there is no scientific knowledge we don't need to act"'.[20] The German government called for a Europe-wide ban on the export of British cattle, which was

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[13] Lacey, R., *Mad Cow Disease*, St. Helier: Cypsela Publications (in Press)

[14] Southwood, R., *Report of the Working Party on Bovine Spongiform Encephalopathy*, London: HMSO, 1989

[15] 'EU backs Britain in row with Germany over BSE', *Independent,* London, 31 March 1994.

[16] Dealler, S., *op. Cit.*

[17] Patterson, W., and Dealler, S., 'BSE and possible risk to human health: food for thought', *Journal of Public Health Medicine,* (accepted for publication).

[18] Lacey, R., 'The BSE Epidemic', *Journal of Nutritional Medicine,* 3, Oxford, 1992, pp. 149-51.

[19] 'Womens's illness fans beef fears', *Guardian,* London 28 January 1994.

[20] Quoted in 'Mad Cows and Englishmen', *Independent,* London, 31 March 1994.

fiercely resisted by the British government. When the European Commission failed to act, in June 1994 the Germans declared a unilateral six-month ban on imports of British beef, risking prosecution by the European Court of Justice. This finally forced the European Union to act on the matter, and on 18 July it was agreed to amend EU regulations on the export of cattle carcasses. British farmers are now required to certify that any beef carcasses exported to the EU have not come from a herd which has had BSE during the last six years. Previously the time period was two years, but that was not long enough to allow incubation and therefore identification of the disease.

Are these isolated incidents or should we expect other problems resulting from intensive farming?

The new frontier of intensive agriculture is biotechnology, which includes genetic manipulation. No doubt it will bring some remarkable and unexpected results.

The story of the bio-synthetic Bovine Growth Hormone is a good example of the way in which genetically engineered products destined for agricultural use are tested and presented to farmers and to the public. The chemical industry changed the name of this product to Bovine Somatotropin or BST, presumably so as to eliminate the word 'hormone', which makes the public suspicious. Originally the industry claimed that BST, while substantially increasing the milk production of a cow, would do so without augmenting the level of hormones in milk and without adverse or toxic effects on the health of cows. Milk produced in this way, it is claimed, is safe for humans.[21] A further attraction of using BST is that it requires little capital investment.

The initial reactions from the US Food and Drug Administration and from the UK government were positive. The British Minister of Agriculture went so far as to say: 'The idea that Britain should stand aside while allowing everyone else to produce milk in the modern way is barmy ... Nobody has any doubts about damage being done to human beings, it is totally safe'. [22]

Nonetheless there were dissenters who questioned the benefits and safety of pushing cows like highperformance machines with the aid of greater amounts of drugs.

The dissenters' case was much reinforced when documents were leaked to Samuel Epstein, Professor of Occupational and Environmental Medicine at the University of Illinois Medical Center, detailing the results of BST tests carried out in the laboratories of the Monsanto chemical group.[23] Here are a few verbatim extracts from the leaked documents:

> -'Significant increases in milk Somatotropin were noted at the five times level of treatment'. Somatotropin is the synthetic hormone in BST, which was not supposed to carry into milk.
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> -'From all groups ... adrenal to body weight percentages and adrenal to brain weight percentages of the right adrenal were significantly greater than those of the controls'. In other words, when compared with untreated animals the right adrenal gland of BST treated animals was inflamed.
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> -'The left adrenal absolute weight ... for all treated groups was significantly increased'.
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> -'The absolute kidney weights ... were significantly greater than those of the control group'.
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> -'The heart to body weight percentages for the three times and five times groups were considerably greater than those of the control group '

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[21] See for example the responses to the public consultation on BST held by the Vetenary Medicines Directorate of the Ministry of Agriculture, FIsheries and Food. The findings of this consultation in the summer of 1994, are available from the ministry in London.

[22] John Gummer at the Grassland South West Show, quoted in *Independent on Sunday,* London, 29 June 1991.

[23] Leaked confidential Monsanto file, 'TOxicity of CP11 5099 in a Prolonged Release System in Lactating Cows', 13 January 1987, p. 28.

-'The liver to body weight percentages were significantly increased'.

-'Statistically significant weight increases also occurred for lung, pituitary and left ovary'.

The Monsanto files also indicated that BST levels in treated cows appeared in concentrations up to 1200 times higher than that of the natural BST in the blood of untreated cows.

These facts contradict the claims made by the chemical industries involved.

Yes, they do. The Chairman of the US Congressional Committee on Government Operations wrote to the Inspector General of the Department of Health and Human Services as follows:

> Specifically, I am seriously distressed with allegations concerning critical research information that has been withheld from public scrutiny by the Food and Drug Administration and the Monsanto Agricultural Company, in efforts to approve commercial use of Bovine Growth Hormone, without regard to the adverse health effects on animals and humans. More importantly, and contrary to the public assurances made by both the Food and Drug Administration and Monsanto, the industry files indicate high levels of the hormone are found in the milk of cows treated with synthetic Bovine Growth Hormones ... Further, I am deeply concerned that little actual research exists on the human safety aspects of Bovine Growth Hormone.[24]

But on 5 November 1993, under pressure from the agrochemical lobby, the Food and Drug Administration yielded, notwithstanding the protest of the General Accounting Office, another branch of the US administration, as well as the official in charge of consumer protection in the State of New York, who both stressed the risk to public health.

No doubt to protect itself from litigation, Monsanto has now published the following information about BST:

> Use of POSILAC may result in reduced pregnancy rates in injected cows and an increase in days open for first calf heifers. Use of POSILAC has also been associated with increases in cystic ovaries and disorders of the uterus during the treatment period. Cows injected with POSILAC may have small decreases in gestation length and birth weight of calves and they may have increased twinning rates. Also, the incidence of retained placenta may be higher following subsequent calving ....
>
> Cows injected with POSILAC are at an increased risk for clinical mastitis (visibly abnormal milk). The number of cows with clinical mastitis and the number of cases per cow may increase. In addition, the risk of subclinical mastitis (milk not visibly abnormal) is increased. In some herds, use of POSILAC has been associated with increases in somatic cell counts ....
> Use of POSILAC may result in an increase in digestive disorders such as indigestion, bloat, and diarrhoea ....
>
> Studies indicated that cows injected with POSILAC had increased numbers of enlarged hocks and lesions (e.g., lacerations, enlargements, calluses) of the knee (carpal region), and second lactation or older cows had more disorders of the foot region.[25]

The public reaction to the government approval of BST was immediate. Numerous retail food chains and milk distribution chains refused to sell the polluted product. Monsanto's response was to sue several small dairy concerns which informed consumers that their milk was BST-free and printed this on their label.

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[24] Letter from Congressman John Conyers, Chairman of the Congressional Committee on Government Operations, to the Hon. Richard P. Kusserow, Inspector General, US Department of Health and Human Services, 8 May 1990.

[25] Instructions for use of POSILAC, Animal Sciences Division of Monsanto Company, St. Louis, April 1993.

Monsanto's decision to sue indicates the lengths to which the company was willing to go to force BST onto the market. It has also come to light that Monsanto has applied considerable political pressure to avoid an official study on the consequences to society of using BST.[26] In August 1994, the US Justice Department was petitioned to launch an investigation.

For their part, the European authorities have focused their attention on whether BST is needed at all during a time of surplus milk production, and whether large supplies of cheap, hormone-induced milk would drive small farmers out of business. In July 1993, the European Commission recommended a seven-year ban on BST, an action which was ratified by the European Parliament. In December the Parliament went further, voting to dissociate the ban on BST from the issue of milk quotas (paving the way for a total ban, irrespective of EU milk production levels) and to extend it to milk and milk products from BST-treated cows imported from other countries. Almost simultaneously, however, the Council of Ministers decided to ignore both the European Commission and the European Parliament and to reduce the moratorium from seven years to one. BST milk might be on sale in Europe as early as 1995.

As David Martin MEP, a vice-president of the European Parliament, commented, 'It is a constitutional outrage that the Council of Ministers should act in this fashion. Meeting in secret, it is probably acting on the advice of top-level government advisers with vested industrial interests'.[27]

Britain and Belgium are thought to have pushed for immediate abandonment of the moratorium. Gillian Shephard, then British Agriculture Minister, claimed that licensing BST would 'avoid international trading problems'[28] - in other words, that under GATT any European ban on BST, however temporary, could be illegal as an impediment to free trade and that for this reason the drug should be marketed in Europe. Here is another example of the doctrine of free trade taking precedence over the most fundamental need of society, public health. And it illustrates the complicity that has developed between politicians and business interests.

Further evidence of this complicity is provided by a memo to the House of Commons European Select Committee from the Ministry of Agriculture. The Ministry cites Dista Products at Speke in Merseyside to make its point: 'Investment of 40 million pounds could be affected, together with 150 jobs. The [European] Commission communication [i.e., the seven-year moratorium] means that a considerable domestic and EC export market would continue to be unavailable for these products', and a BST ban would 'pose a serious threat to the development and commercialization of biotechnology ... and deter investment'.[29] It seems that at no time do the governing elites concern themselves with the jobs lost in rural communities as a result of intensive agriculture-which are by nature less obviously quantifiable than industrial jobs-nor with the potentially serious effects on public health.

Must one conclude that biotechnology should be rejected entirely?

No. In human medicine, as a means of curing specific diseases, biotechnology will be useful, but we must exercise particularly tight controls over its development so as to avoid serious accidents. In agriculture, I feel that the disadvantages greatly outweigh the advantages. Let's take the case of the most extraordinary form of biotechnology: genetic engineering, also known as recombinant DNA technology. The aim of genetic engineering is to transfer genes from one cell to another and thereby to create new forms of life. It is now possible to manipulate and transfer genes from one species to another. For example, researchers at the University of Kentucky have transferred genes

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[26] 'Democrats' New Overseer Is Everybody's Mr. Inside' *New York Times,* 19 August 1994.

[27] Quoted in 'The Milking of the Cash Cow', *Independent,* London, 29 January 1994.

[28] *Ibid.*

[29] *Ibid.*

from a fish to a soya bean plant.[30] Other researchers have introduced a gene for the human growth hormone into a pig.[31]

In agriculture genetic engineering is applied to plants, animals, bacteria and viruses. The consequences of genetically altering the plant realm are far-reaching. Supporters of biotechnology claim that genetically engineered seeds will produce crops which are tolerant of herbicides and more resistant to drought, frosts, disease and pests. It is also claimed that they will reduce the need for chemical fertilizers and insecticides.

As a result of lobbying by the biotechnology industry, it is now possible to obtain a patent on living organisms altered by genetic engineering. New life forms will become patented commercial monopolies.

Of course, there are those who consider this new industry to be unacceptably dangerous. Debate must be encouraged, as we are playing with the fundamental elements of all life on earth.

The principal arguments against genetically engineered seeds are:

One: This is a perilous replay of the Green Revolution which attempted to transform agricultural processes by advanced scientific methods during the 1950s and 1960s. At the time there was great enthusiasm for synthetic organic chemicals. Natural raw materials were replaced and yields increased by applying chemicals to genetically selected strains of seeds which became known as 'miracle strains'. This led to the development of monocultures; in other words, it converted large areas to be used for growing a single crop of similar genetic origin. It also resulted in greater mechanization and ever-increasing use of chemicals and energy. As Fowler and Mooney, laureates of the Right Livelihood Award (known as the Alternative Nobel Prize), put it, 'achieving high yield required fertilizer and irrigation. Fertilizer and irrigation nourished weeds as well as crops, creating the need for herbicides. And pests found the uniformity of new varieties appetizing which necessitated the use of insecticides as well .. . The fertilizers made the new varieties possible. The new varieties made the fertilizer necessary'.[32]

Two: Contrary to the industry's claims, the use of herbicide-tolerant seeds is likely to result in a need for more and stronger herbicides.

Recent studies at the University of California have demonstrated that pollen can be carried to plants over 1000 metres away and alter their genes. Thus, in the words of Dr David Ehrenfeld of Rutgers University: 'It will only be a few growing seasons before we can expect to see this engineered herbicide resistance transferred naturally, in the field, to the weeds themselves'.[33]

Three: The way of the world is constant change, evolution and adaptation. Insects develop resistance to insecticides just as weeds develop resistance to herbicides. In the US, despite a tenfold increase in the use of insecticides, annual crop losses to insects over the years have nearly doubled.[34]

Similarly, the agents that cause diseases evolve and can adapt to new circumstances. In a relatively short time, mutations will enable them to break through the defences of the genetically engineered plants and as they are genetically homogeneous-in other words, all vulnerable to the same diseases-whole crops could be eliminated.

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[30] Fowler, C., Lachkovics, E., Mooney, P. And Shand, H., 'The Laws of Life. Another Development and the New Biotechnologies', *Development Dialogue,* 1-2, Sweden, 1988.

[31] *Ibid.*

[32] Fowler, C. And Mooney, P., *The Threatened Gene,* Cambridge: Lutterworth Press, 1991, pp. 58, 60.

[33] *Ibid., p. 143*

[34] Hindmarsh, R., 'The Flawed "Sustainable" Promise of Genetic Engineering', *The Ecologist,* Sturminster Newton, September 1991, pp. 198-99.

Scientists cannot predict reliably how the new altered organisms will evolve and behave once released.

Four: It will never be possible to control the releases into the environment of untested and unauthorized organisms. Since 1986, numerous examples of such behaviour have come to light.[35]

Five: The development of genetically engineered mono cultures will cause further devastation of the world's genetic resources. Genetic diversity is one of nature's greatest treasures. Many years ago the plant pathologist Martin Wolfe, working with the geneticist John Barrett, confirmed that polycultures are healthier than monocultures.[36] They demonstrated that a blend of three different types of barley was almost entirely resistant to mildew, whereas the three when grown separately were not. Should an infection attack one particular variety, each stem, surrounded by other varieties, is shielded by its resistant neighbours which themselves might not be affected. They concluded that whereas a monoculture might produce higher yields in a given year, the polyculture produces more over the long term.

What would be the dangers resulting from the loss of genetic diversity?

History supplies many well-known warnings. For example, there are still 5000 varieties of potato grown around the world. But in Ireland in the nineteenth century, all potatoes descended from only two varieties. The genetic limitation resulted in a lack of resistance to potato blight, which therefore reached epidemic proportions and caused the great famine.[37]

After the Southern corn leaf blight of the 1960s, the US National Academy of Science confirmed that the principal cause of the epidemic was corn crop uniformity. The corn variety in use was based on a hybrid. The Academy concluded: 'When one genetic component became susceptible to the new blight, the whole American crop became vulnerable'.[38]

The same is true of the Russian wheat epidemic of the 1970s. Forty million hectares had been sown with a single variety of a so-called 'miracle strain'. Unexpectedly and despite scientific experimentation, the strain sometimes proved incapable of surviving the harsh winter. Because of genetic uniformity, the consequence was a general crop failure.[39]

Intensive agriculture destroys genetic diversity not only in seeds, but also, of course, in all forms of animal and vegetable life subjected to cloning, embryo transfer, gene selection, creation of monocultures, tissue culture, genetic engineering and the other processes of intensive agriculture. The granting of patents for new life forms will accelerate this trend because patent law requires that the new varieties be internally consistent} that is to say uniform. Also} new varieties will have to be genetically uniform to be registered with the appropriate authorities} and it will be illegal to sell unregistered seed.

As farmers must survive in a competitive world, they will farm intensively or be driven out of business. What is more, farmers will become tied to and dependent on the chemical suppliers. As the patented seeds and their plants will be genetically engineered to respond to particular chemicals, the suppliers of those chemicals will control the farmers who use the seeds.

What are the questions that should be asked and answered before we proceed too far with biotechnology?

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[35] Burch, D., Hulsman K., Hindmarsh, R. And Brownlea, A., 'Biotechnology Policy and Industry Regulation: Some Ecological, Social and Legal Considerations', submission to the House of Representatives Standing Committee on Industry, Science and Technology Inquiry into Genetically Modified Organisms, Australia, September 1990.

[36] 'Healthy Crops - Simply Irresistible', *Economist,* London, 10 August 1991.

[37] Fowler, C., and Mooney, P. *op. cit.* p. 43.

[38] *Ibid, p. x.*

[39] *Ibid, p. x.*

Can we understand the long-term effects, direct and indirect, of these wholly new and partially explored products? Can we obtain their benefits without terrible consequences? Do we really believe that new regulations will be sufficient to stop uncontrolled releases into the biosphere of these new forms of life? How can we prevent new forms of life, such as genetically engineered microbes, causing unlimited damage? Their very 'newness' means that existing life on earth, both animal and vegetable, has never been exposed to them and therefore has no immunity against them. Do we understand that by creating instantaneous, unexplored new forms of life we have thrown away the vital protection of being able to learn from our mistakes?

With thousands of researchers experimenting throughout the world and using their imaginations to create instantaneous new life forms unknown to nature and therefore untested by the trial and error of millions of years of natural evolution, is it possible to avoid mistakes and accidents which could have unimaginable consequences? We should always remember that there are no reliable shortcuts for testing new chemicals. Their effects may take years to become apparent.

But there are deeper questions. Has man the moral right to create new microbes, new animals, new life forms? Are we wise to transform the course of evolution artificially and to do so instantaneously? Do we realize that much of the change is irreversible? Can we convert animals and fields and forests and all things living into unnatural high-perfOrming machines whose only purpose is to serve human beings? Is changing fundamental genetic information in living things, which will remain an inherited characteristic, the ultimate form of pollution?

Has the hubris of mankind become dangerously inflamed?

What solutions do you propose?

We need to revise our priorities. The purpose of agriculture is not just to produce the maximum amount of food, at the cheapest direct cost, employing the least number of people. The true purpose should be to produce a diversity of food} of a quality which respects human health} in a way which cares for the environment and which aims at maintaining employment at a level that ensures social stability in rural communities.

That means transforming the ways in which many developed nations subsidize their farmers and their agriculture?

Yes. Most official support, including that traditionally provided by Europe's Common Agricultural Policy, is granted on the basis that the state will buy a farmer's production at a fixed price. If a system is based on quantity, the natural consequence is that farmers will want to produce the maximum amount and intensify their methods of production.

Are you suggesting moving to organic farming and, if so, can it be economic?

I am not suggesting a general move to organic farming. I am suggesting a return to a form of agriculture that substantially reduces the use of pesticides, chemical fertilizers, pharmaceuticals such as hormones and antibiotics, and the products of biotechnology. Many analyses of farms operated in this manner have been done. David Pimentel of the New York State College of Agriculture and Life Sciences at Cornell University has shown that less intensive methods can produce food economically.[40] The trouble, of course, is that unsound and destructive agriculture makes a qUicker profit in the short term than sound and healthy agriculture. Obviously, the quick profit only appears if indirect costs are not taken into account.

I have already quoted the studies of Herman Daly and John Cobb which indicate that when productivity is measured in terms of production per acre, or of energy consumed or capital invested, smaller farms show greater productivity. The large, mechanized modern monocultures come out best when Productivity is measured in terms of numbers of people employed.

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[40] Pimental, D., 'Environmental and Economic Benefits of Sustainable Agriculture', in Paoletti, M., Napier, T., Ferro, O., Stinner, B., and Stinner, D., eds., *Socio-Economic and Policy Issues for Sustainable Farming Systems,* Padua: Cooperativa Amicizia, 1993, pp. 5-20.

Who would be the losers and who would be the winners if we moved from intensive to less intensive methods of agriculture?

Let's start with the winners. The stability of rural communities would be re-established. The cities and their inhabitants would benefit as the exodus from the countryside ceases. Consumers would have healthy food to eat. Pollution of the environment by chemical and biotechnological products would be substantially reduced. Nations throughout the world would be relieved of the cost of welfare which has to be paid to those who are uprooted from the land and find no employment. Nor would they have to invest in further urban infrastructure to receive rural refugees.

The losers are easy to identify: the chemical and the biotechnology industries, along with their paid experts and lobbyists.