

WORKING PAPER 540

ENVIRONMENTAL ISSUES IN THE GREEN CONSUMER DEBATE:
A CONTEMPORARY GUIDE

S.E. EDEN

School of Geography
University of Leeds
Leeds LS2 9JT

November 1990

ENVIRONMENTAL ISSUES IN THE GREEN CONSUMER DEBATE:
A CONTEMPORARY GUIDE.

Preface.

This paper is the first in a series of three Working Papers dealing with contemporary aspects of public expressions of environmentalism. Two primary behaviours expressing such pro-environmental ideas are the purchasing of products according to their environmental impacts - a phenomenon often labelled green consumerism - and the growing subscriptions and donations to voluntary environmental organisations. Although environmental ideas about protection and conservation of wildlife and natural systems such as the atmosphere are very much in the public eye, the background to the arguments publicised is often inadequately presented or fragmented. This reduces the opportunities for access by those of the public who are interested in the environmental debate but are not trained nor properly informed about the problems at issue. This paper aims to provide such information by collating and clarifying the technical data regarding those environmental processes which have a high profile in that debate. Rather than concentrating upon individual specialist fields, the coverage is wide-ranging and presents the central academic arguments as continuing rather than conclusively resolved.

The second paper, Voluntary Organisations and the Environment, explores the two-way influence between public expressions of environmentalism and the embodiment of environmentalism in the ideologies of the organised environmental

groups. There is a discussion of the development and differentiation of the environmental movement alongside wider social changes and growing public support and also consideration of the present status of the movement in terms of its membership, methods and foci.

The third paper, Green Consumerism and the Response from Business and Government, deals with two other sets of agents in the environmental debate: business and government. The recent emergence of green consumerism has brought about changes in technology, marketing, legislation and the political process. Such changes are discussed in terms of their development and also in terms of the critical response they have received from other groups, including environmentalists.

ENVIRONMENTAL ISSUES: A CONTEMPORARY GUIDE.

November 1990

CONTENTS

	Page
1. Introduction.....	5
2. Pollution.....	8
2.1. Introduction.....	8
2.2. Water Pollution.....	8
2.2.1. Nitrates.....	8
2.2.2. Detergents.....	11
2.2.3. Phosphates.....	13
2.2.4. Bleaches.....	14
2.2.5. Metallic pollutants.....	15
2.2.6. Other pollution sources.....	16
2.3. Air Pollution.....	17
2.3.1. Lead.....	17
2.3.2. Other car exhaust emissions.....	18
2.4. Other Forms of Pollution.....	23
2.4.1. Pesticides.....	23
2.4.2. Other chemical pollutants.....	24
3. Climate.....	27
3.1. Introduction.....	27
3.2. Global Warming.....	27
3.3. The Ozone Layer.....	32
3.4. Consequences of Climatic Change.....	35
4. Recycling.....	38
4.1. Introduction.....	38
4.2. Paper.....	39
4.3. Metals, Glass and Plastic.....	41

5. Energy.....	44
5.1. Introduction.....	44
5.2. Energy Conservation and Efficiency	45
5.3. Renewable Energy Sources.....	47
6. Organic Agriculture.....	50
6.1. Introduction.....	50
6.2. Organic Methods.....	51
6.3. Economic Considerations.....	53
7. Habitat and Conservation Issues.....	56
7.1. Tropical Forests.....	56
7.2. UK Habitats.....	59
8. Concluding remarks.....	60
9. Bibliography.....	62
Table 1: Estimated Costs of Various Energy Generation Methods.....	48

1. Introduction.

This paper seeks to provide the basic information needed by readers interested in the environmental debate and in the background to 'green' and 'non-green' products, with particular reference to the UK market. The emphasis is therefore upon the technical data necessary to an understanding of the environmental processes affected by the production, use and disposal of many of the commercial goods used in the Western world today.

Although environmental issues have a high profile in both the mass media and the public consciousness at the present time, there is a great deal of confusion and lack of knowledge about the basic processes involved. This makes it difficult to discuss possible solutions and the advantages of various policies and behaviours - such as the rise of green consumerism, the purchasing of products on the basis of their environmental effects. Although it is impractical for everyone interested in environmental issues to have the kind of specialist knowledge of all fields that research workers might have of their own field of expertise, it is possible for everyone interested to understand some of the basic processes and terms used by those in possession of both more experience and detailed background information. It is especially important that some of the confusion and possible deception involved in the current growth of 'green marketing' is cleared up so that consumers can be properly informed about what they choose to buy, its environmental effects and the advantages or otherwise of the 'environmentally friendly' alternatives now available.

In order to focus on some of the particularly high profile environmental concerns, this paper is divided into explicit sections, in no special order, each dealing with a set of environmental issues. Of course, as in the real world, the processes described within each section interrelate in complex ways and so the information provided may be repeated in different sections for clarity and also be cross referenced where appropriate. Because this paper is not aimed at the specialist in any academic field, the treatment of the information acknowledges the various academic arguments, but without detailed analysis of the evidence which forms their bases.

A consideration of different arguments is important because there is an ongoing debate about many environmental issues, especially in terms of their health risks. While some groups, academic and non academic, regard the causes of some environmental effects as proven, other groups counteract with the claim that results of different tests are contradictory and that causal links between, say, car exhaust gases and lung infections are not conclusively proved beyond reasonable scientific doubt.

Where such causes have been postulated but not proved, various kinds of evidence are cited in favour of the postulated relationship. The evidence is usually based upon the coincidence of two features in a population and the aim is then to show that, when all other factors (e.g. diet, social conditions) that could influence the outcome (e.g. risk of cancer) are removed, the existence of a substance (e.g. dioxin) still affects the outcome. While such a correlation does not prove that the substance causes

the outcome, it does point out a significant correlation, that is a coexistence of features in a population that would not be expected under normal conditions. It is also worth noting that whilst such links between substance and outcome are difficult to prove conclusively, they can be just as difficult to *disprove*.

One way to prove or disprove allegations of cause and effect in the environment would be to isolate two groups of people and subject them to different conditions, much as occurs in laboratory experiments. One set would be the control group, living under normal conditions, and the other set would live under the same conditions but in addition they would be exposed to the substance under investigation. The only changes in health or whatever could then be ascribed to this one difference in living environment. It is immediately obvious that such an experimental setup using people as subjects would not be possible in an advanced society, whatever the influence of the scientific community. It is therefore easy to refuse to accept coincidental measurements as proof and to ascribe differences in health to factors other than higher concentrations in the substance under investigation, as many other living conditions will differ between any two groups in the real world. These problems of proving a case should be borne in mind when assessing the evidence for environmental damage brought forward by any sort of organisation.

2. Pollution.

2.1. Introduction.

Pollution of any medium means that there are excessive amounts of a substance or substances which, while they might be benign elsewhere, cause stress or damage within that medium. The polluting substance may occur naturally but has increased appreciably beyond its original proportions, e.g. carbon dioxide in the atmosphere, nitrate in rivers. Alternatively, the polluting substance may be synthetic or alien to the medium which it pollutes, e.g. CFCs in the atmosphere. The stress caused by such pollutants may be of various forms: causing or accelerating chemical changes; affecting and therefore tipping over natural balances to alter a whole system; health problems; species reduction or extinction. This paper deals with the different types of pollution according to the medium in which they occur: firstly water, then air and finally substances polluting either media.

2.2. Water pollution

2.2.1. Nitrates.

Nitrogen fertilisers have been used in conventional agriculture in the UK primarily since the second world war: 1.4 million tonnes were used in 1982 compared to 50,000 tonnes in 1939 (Gear 1987). The nitrogen is either extracted from rocks or taken mechanically from the atmosphere where, as a gas, it constitutes about 78% by volume. Only about half the amount of

nitrogen applied to the soil is actually taken up by the crop (Hodges 1985): the rest is lost in solution in surface runoff after rainfall, or in solution which filters through rocks, eventually reaching water-holding underground layers (aquifers). Either of these pathways may lead to reservoirs or other water bodies at the surface and thence into drinking water operations. The Royal Society estimated in 1983 that of 440,000 tonnes of nitrogen fertiliser added to UK arable soils, up to 150,000 tonnes were leached away along such pathways.

Nitrate itself is not dangerous to human health except at very high concentrations: in water this is a rare occurrence. However, nitrate can be converted to nitrite under certain conditions, such as in the human stomach, mouth or intestinal tract, or during food storage or preparation (Hodges 1985). Once produced in the body, nitrite can combine with blood haemoglobin and convert to methaemoglobin which prevents the transport of oxygen about the bloodstream (Commoner 1971). Such a condition is known as methaemoglobinaemia (or cyanosis) or more commonly 'blue baby syndrome' due to the poorly oxygenated appearance of the blood. Babies and young children are more susceptible than adults to this condition because their younger stomachs are more conducive to the conversion of nitrate to nitrite. The condition is potentially fatal and bottled water has been supplied to nursing mothers in areas in the UK with particularly high nitrate levels in drinking water.

Nitrite may also react in the stomach with amines or amides present in other foods or tobacco smoke to form nitrosamines

which are known to be toxic (poisonous), mutagenic (causing mutations in the DNA or genetic material in body cells) and carcinogenic (causing cancer) in many animal species. Although high correlations have been found between occurrences of high nitrate levels in drinking water and stomach cancer in adults (Hodges 1985), the causal link between the two is not conclusively proven as yet.

The safe limit suggested by the World Health Organisation (WHO) for nitrate in drinking water is 11.3 milligrams per litre. Above this level health problems may occur and levels above 22.6 mg per litre are considered by WHO to be dangerous to human health. This latter limit has been exceeded in the arable lands of Eastern England and has lead to the description of a 'nitrate time bomb' (ibid.) as more nitrate-bearing runoff from the agricultural land seeps into aquifers now, and thence to reservoirs supplying the local population over a period of time.

Nitrate may also become concentrated to excessive levels in crops, where fertiliser applications exceed plant requirements and nitrogen is taken up and stored in plant cells rather than being converted to useful plant growth. Up to 70% of a person's daily nitrate intake results from nitrate taken in food, with only 20% from water, so the levels in vegetables and other affected crops could be important in assessing the effects of nitrogen fertilisers on human health (Hodges 1985).

Organic agriculture does not allow the application of nitrogen fertilisers and hence its practitioners contrast their less damaging influence on water regimes and crop uptake with the influence of conventional farmers, whose yields depend upon such

applications.

There is another facet to the use of nitrogen and other inorganic fertilisers, such as those containing phosphates (qq.v.), by farmers. Runoff into rivers and lakes may contain large amounts of dissolved nitrogen and phosphates from both agriculture and sewage outlets bearing the remains of domestic detergents. Together with sunlight, these elements provide large food supplies for algae (small plant organisms) in the water, and can result in algal blooms, bursts of much algal growth, which can release toxins into the water they inhabit. Such potentially fatal toxins were found in Rutland Water reservoir in the summer of 1989 and killed several dogs there (Brown 1989). 70 sites were also identified by Friends of the Earth as affected in June 1990 (Earth Matters 1990b). The toxins can also cause infections in swimmers, but have not been found to reach drinking water due to the treatment process between the reservoir and the tap. Where the algae die and fall to the bottom of the water body, they break down to release the phosphates and oxygen in their cells which can then be trapped in the lower water layers. This depletes the water of elements needed by other aquatic life (Commoner 1971). Organic agriculture does not cause the runoff of excess nitrogen and phosphates, and phosphate free washing powders may also alleviate the problems outlined above.

2.2.2. Detergents.

Domestic (household) and industrial detergents are another source of water pollution. Prior to 1964, there was a lot of visible pollution of rivers in the shape of floating foam. This

was due to the main cleaning constituents of detergents known as surface active agents or surfactants. These are non biodegradable enzymes derived from petroleum when it has been distilled, or burnt, and then put through chemical reactions with chlorine at high temperatures. These surface active agents have a branched molecular form which, when they reach the disposal point, e.g. a river system, resists biodegradation. This means that they cannot be attacked and broken down into simpler chemical arrangements by the bacteria there, which can usually deal with the waste organic fats from traditional soap-based detergents (Commoner 1971). The enzymes - the surface active agents - therefore remain in the water in their original form of foam or bubbles from some time, resistant to the bacteria.

This problem was approached in 1964 by the phasing out of such branched surface active agents in favour of alkyl benzene sulphonate based agents (ABSs) which are unbranched and therefore susceptible to bacterial attack and biodegradation (Manson 1989). A 1977 EC directive specified a time period from initial discharge of a detergent as waste in which 80% of its volume must biodegrade.

It is worth noting at this point that there are various degrees of biodegradation. Primary biodegradation means that active organic substances in water are broken down into smaller compounds which are chemically inert, i.e. they are stable and do not act upon any other chemical in the environment, nor do they cause foaming. Secondary, or total, biodegradation means that the active substances are broken down to their simplest forms

like carbon dioxide and water, which can then enter systems, e.g. through take-up by plants, rather than remaining in the water system. Because of the EC directive mentioned above, most domestic detergents are biodegradable to some extent, but they may only break down into the smaller compounds described and not into the simplest substances which occur naturally and abundantly in the water anyway. Ecover and Ark products, however, claim 96% to 100% biodegradation to simplest forms over a shorter time period than the more established brands (Manson 1989) - Ecover specifies 3 to 5 days for total breakdown of its washing up liquid in the water system.

Other additives in conventional detergents include optical brighteners and preservatives of synthetic origin. Ecover products do not contain such substances and also package bleach separately so that it is not used unnecessarily.

2.2.3. Phosphates.

Phosphates have been mentioned in connection with algal blooms (see: Nitrates) and they are also a constituent of washing powders, where they act as water softeners, making the water more alkaline. They are not found in washing up liquids for dishes and never have been, despite misleading 'phosphate free' claims made by manufacturers (The Ethical Consumer 1989). About one quarter of the weight of washing powders is due to phosphates - the amount is greater for dishwashing powders. The National Rivers Authority in the North West of England put a figure of 50% on the contribution of detergents to overall phosphate levels in inland waters, and Environmental Data Services Ltd. (ENDS) a

figure of 25% to 30% (ENDS 1989).

2.2.4. Bleaches.

Domestic detergents also contain bleaches such as sodium perborate, which can lead to the contamination of rivers with boron, a metallic element, and sodium percarbonate which, together with a compound in the detergents known as EDTA, can combine with toxic metals to pollute drinking water.

More significant overall, however, are the bleaches used in industry, such as in processes for bleaching paper, nappies and sanitary protection. The aim is to eliminate colour and smell from the original wood pulp and also to increase the absorbency of the materials: this is usually achieved by the use of chlorine bleaches. There are 210 chemical arrangements known collectively as dioxins associated with chlorine and 17 of these have been linked to the presence of birth defects and some types of cancer as well as decreased immunity and skeletal damage in fish and animals (Moyle 1989a).

TCDD (2,3,7,8-tetrachloro dibenzo - p - dioxin) is one extremely toxic by-product of herbicide manufacture or of the disintegration of associated chemicals which are less toxic. The term 'dioxin' is sometimes used by authors to mean this particular compound, TCDD, or to mean any of the general group of chemicals which are arrangements of several chlorine atoms on benzene rings (Hay 1982). There is no doubt about the carcinogenic effects of TCDD in animals, where it causes tumours of the liver, lungs and thyroid. However, the causal link between such dioxins and human cancers has not been conclusively

proved but dioxins are widely regarded as harmful compounds, especially considering the fact that as they are not biodegradable they remain in the environment unchanged for some time. Dioxins also become more concentrated as they pass up the food chain through the consumption of smaller organisms by fish and of fish by humans. This process of concentration in higher organisms is known as biomagnification and its effects were displayed in measurements published by the Department of Trade and Industry in 1989 where dioxin levels in breast milk were shown to be 70% greater than levels in chlorine bleached paper. This does not mean that chlorine bleached paper is better for human children than mother's milk, as might be inferred from the DTI's publication.

Alternative bleaching processes use hydrogen peroxide, such as in Peaudouce's 'green' nappy. However, these methods are usually applied to pulp which has already been treated with chlorine (see Recycling: Paper).

2.2.5. Metallic pollutants.

One source of metallic pollutants recently carrying some 'green' advertising is that of electrical batteries. The three main metals which may seep out from the battery casing after disposal are lead, mercury and cadmium. The health risks attributed to lead are dealt with in the section on Air Pollution. Cadmium has been linked to bronchitis, anaemia, some forms of cancer, bone anomalies and gastrointestinal problems, while mercury has been linked to tumours, kidney damage and deterioration of the nervous system. Both persist in the

environment as they are not readily taken up by plants. Some manufacturers, such as Varta, have removed mercury and cadmium from their batteries, but the metal casing remains unchanged and unrecoverable in the waste disposal sites. The lead cannot be removed from batteries as yet (Moyle 1989b). Spoil heaps from mining may also contain lead and zinc and, where the spoil was further crushed, lead and cadmium dust are liberated and then picked up in runoff water which can then enter river systems (Routledge 1990).

The presence of aluminium in water has been linked to the occurrence of Alzheimer's Disease, especially following an incident at Camelford, in the South West of England, where the South West Water board have been cited as responsible after the accidental insertion of aluminium into local drinking-water supplies (Prysor-Jones 1989).

2.2.6. Other pollution sources.

Industrial outlets discharge a wide variety of compounds, both natural and synthetic, which have different effects on aquatic life as well as human health. For example, the Velva Liquids plant on the mouth of the River Tyne in North East England has permission to discharge various compounds into the North Sea, including toluene and xylene - two types of volatile, polyaromatic hydrocarbons (PAHs) (see Air Pollution: Other car exhaust emissions), tetrahydrofuran and trichloroethane, chloroform, dichloromethane, trichloroethylene and oil (Routledge 1990). These can all be toxic to fish and other forms of marine life, resulting in deformities and death, and have economic

consequences due to the smaller volume of fish caught in an area.

2.3. Air Pollution.

2.3.1. Lead.

Lead is a metallic element which is of no benefit to human health and all its documented effects on the human body are unfavourable. The health risks ascribed to lead are mostly *subclinical* effects, that is those due to long-term low-level exposure affecting the efficiency of normal bodily routines. Lead is a neurotoxin - it affects, or poisons, the nervous system, especially in children, thereby disrupting normal development and functioning of the brain resulting in disorders of behaviour and intellect. Some studies have shown lower IQ levels in children correlating with exposure to lead in the atmosphere, which has entered the body through breathing or attached to dust particles which are attracted to the skin. However, such links were not corroborated in similar studies. Links have also been postulated between lead exposure in the foetal state and birth weight, head size and development during the first two years of life (Russell Jones 1989).

80% of the lead in the lower atmosphere originates in the lead in petrol via car exhausts. Tetraethyl lead was first added to automobile fuel in 1923 in the United States to improve performance (Commoner 1971) but since 1986, due to a reduction from 0.4 grams of lead per litre of petrol in 1985 to 0.15 grams per litre (MAFF 1989b) and an increase in the proportion of unleaded petrol consumed, the yearly contribution from petrol per year to the atmosphere has decreased by 50% (Russell Jones 1989).

This latter trend in the spread of unleaded petrol use is also encouraged by legislation specifying that all cars must be constructed to enable them to run on unleaded petrol from 1st October 1990, and also the fact that the UK government has ensured that unleaded petrol costs about 10 pence per gallon less than leaded. However, the phasing out of lead in petrol may lead to an increase in other substances, such as benzene - a carcinogenic component of petroleum, and toluene and xylene - which are PAHs (see: Other exhaust emissions to the atmosphere), especially in the high octane grades (Epstein 1989).

Lead also seeps into the environment, and water systems particularly, from old paint - it is no longer added to decorative household paint - and lead pipes in plumbing systems. (The Latin name for lead is in fact *plumbum*.) In tests carried out in 1975-1976, 45% of Great Britain households (about 9 million) had lead in their water distribution systems and 7.8% of households in England and Wales had levels exceeding WHO guidelines of 50mg per litre in domestic tap samples. This latter proportion was much higher in Scotland, standing at 34.4% (CLEAR 1989).

2.3.2. Other car exhaust emissions.

Carbon monoxide (CO) emissions have increased by 15% over the period 1975-1985 and WHO guidelines for concentrations are often exceeded in London (Dunmore 1989). When inhaled, carbon monoxide inhibits oxygen absorption by the blood.

Hydrocarbons (HCs) are remnants of unburnt or partially burnt fuel and emissions of these have increased by 12% over the

period 1975-1985 (ibid.). Their various types include methane and polyaromatic hydrocarbons (PAHs) which are of particle form (soot) rather than gas and have been associated with lung cancer.

40% of nitrous oxide (NO_x) emissions in the UK originate in road traffic and are of three forms: nitrogen oxide (NO), nitrogen dioxide (NO₂) and nitrous oxide (N₂O). The last form is also associated with ozone depletion (see Climate: The Ozone Layer). Nitrogen dioxide can affect lung functions especially in children and asthmatics even after short term exposure to 0.3 parts per million (ppm) concentrations and has been implicated as a cause of lung infections at lower concentrations (0.07ppm) over longer exposure periods (ibid.). Chemical changes can convert nitrous oxides to nitric acid (HNO₃) which can materialise as a brown gas causing reduced visibility and contributing to smog problems (see below).

Sulphur oxides (SO_x) are also released from exhausts, especially sulphur dioxide (SO₂) which contributes to acid rain. In this case sulphur dioxide from the atmosphere is dissolved in rainfall which causes whole or partial destruction of the vegetated areas over which it falls. Some 50% of West Germany's trees were visibly affected in 1984, with the proportion being particularly high in the South West region (75%) due to the proximity of the Ruhr industrial region (Elkington with Burke 1987). The emissions of power stations are were previously cited as a more important source of the atmospheric sulphur blamed for acid rain than the emissions of vehicle exhausts, but this issue has not been satisfactorily agreed as yet (Pearce 1990).

Vehicle fumes also include smoke and soot particles, which cause damage to building frontages and can attract HCs to form PAHs as mentioned, and aldehydes which are potential irritants to nose and throat passages when breathed in (Dunmore 1989).

Carbon dioxide is also emitted due to the burning of fuel by the engine and is often cited as a very important contributor to the greenhouse effect (see Climate: Global Warming).

All the above are primary pollutants and legislation seeks to regulate such emissions with varying degrees of success. Some secondary pollutants which result from car exhausts but in less significant quantities, or after chemical reactions in the released fumes, include ozone and CFCs. Ozone, while benign in the upper atmosphere, in the lower layers can affect lung functions and cause chest pain in humans and is formed through reactions between nitrous oxides and hydrocarbons in strong sunlight, especially where the air is still. Such conditions are also favourable to the production of smog (see below) as well as ozone. CFCs are released from air conditioning systems in cars, especially in the climates of Southern USA and Japan and, together with ozone, has climatic consequences when they reach higher levels in the atmosphere (see Climate: The Ozone Layer). Peroxyacetyl nitrate (PAN) can cause eye, nose and throat irritations when inhaled as part of photochemical smog (ibid.).

Smog problems were first publicised in the UK when the London smogs of 1952 were linked to the deaths of 4000 people in the area (Elkington with Burke 1987). The primary culprit cited was sulphur dioxide because it attacks the ciliated cells of the lining of the lungs which bear tiny hairs to clean pollutants

from incoming air. This attack makes the lungs more sensitive to dust and other incoming carcinogens (cancer-causing substances), such as benzpyrene, in the air. As in other cases cited, the causal link has not been conclusively proved.

In California, USA, the term photochemical smog is used to distinguish the type common there from ordinary fogs made more dense by the presence of particles in the air. The smogs in the region are formed not through the trapping of cold, condensing air in hollows as in normal climatic fogs, but by the chemical reactions between nitrous oxides, polyaromatic hydrocarbons (PAHs) and peroxyacetyl nitrates (PANs), and other compounds. Such reactions require strong sunlight and still air to produce large quantities of visible smog, conditions which often occur in California. The problem was reaching intolerable levels in 1988 when it was thought that 98% of the population of South California was affected and on 75 days of that year schoolchildren were advised to stay indoors because of the conditions. The simplest solution adopted by the authorities in the region was the use of stringent restrictions on car emissions and the encouragement of reduced car usage by the very mobile population, e.g. through the establishment of car pools between company employees.

Under an EC directive, the exhaust systems of all new cars from the end of 1992 must emit 75% less than at present (Department of the Environment 1990). There are two main types of products which can be installed to reduce emissions to comply with this directive. The first type is the lean-burn engine

which operates using less fuel and more air per mile at cruising speeds. Conventional engines use about 15 parts air to 1 part petrol but this engine design can operate at ratios of 22:1 at favourable speeds - at lower speeds this advantage is lost (Dunmore 1989). Such engines can be combined with an oxidation catalyst which reduces carbon monoxide and hydrocarbon emissions on the same principles as the second main product type, the three-way catalytic converter. This is designed into the car exhaust system and comprises a ceramic or metal honeycomb structure coated with metal catalysts such as rhodium, platinum and palladium. These react with and convert 90% of the carbon monoxide, nitrous oxides and hydrocarbons from petrol burning and exhaust fumes to simpler compounds such as water vapour, nitrogen and carbon dioxide which do not foster smog development (ibid.). In addition, such cars cannot run on unleaded petrol as this damages the catalysts. These three-way converters will be a standard fitting on new cars with engine capacities over two litres from October 1991 to comply with an EC directive to this effect.

Many other types of emissions issue from industrial plants into the atmosphere and into our water systems. Paint manufacture for instance emits solvents and this procedure is currently under scrutiny apropos of the Environmental Protection Bill and the recent White Paper (Department of the Environment 1990). Less research has been made available to the public on such industrial pollution processes, but it is hoped that this will change under the aforesaid Bill.

2.4. Other Forms of Pollution.

2.4.1. Pesticides.

Synthetic compounds for pest control in agriculture were developed last century, e.g. DDT (dichloro diphenyl trichloroethane) in 1873, but came into widespread use after World War Two, along with inorganic fertilisers, to raise yields. In 1950 there were 15 insecticides or pesticides in common agricultural use. By 1989, there were 426 products cleared in the UK (Snell 1989). Because they have no natural predators amongst microbial populations, e.g. bacteria, these substances are not biodegradable but persist in the environment and are incorporated into the food chain. By a process of biomagnification, their concentrations in the body are maintained or increased as lower organisms are consumed by higher ones. Their influences on human health and growth are difficult to prove because they are usually part of a battery of influencing factors, but some have been voluntarily withdrawn by manufacturers after adverse publicity and public protest, e.g. aldrin in 1975 due to its breakdown to dieldrin, and others have been officially banned by Western governments, e.g. DDT in 1985 for all uses. This latter is one of many potentially harmful pesticides which continue to be exported to and used in the Third World despite bans or restrictions on their use in the countries of manufacture; other examples are lindane, also known as gamma-HCH, and aldrin. In the UK in 1985, a government working party said that pesticide residues were not a problem in UK food. In 1986 the London Food Commission stated that such

residues posed a danger to human health. Such contradictions are possible because the links, e.g. between DBCP (dibromo chloro propane) and stomach cancer, have not been absolutely proved beyond correlations of high levels in certain populations (Hodges n.d.). Unfortunately, the onus is not upon the manufacturers to prove that the product is harmless, but on their opponents to prove that it is harmful. Hence bans are either unenforced, ignored or restricted to one or more food-producing nation (Snell 1989). Legislation is patchy in coverage and usually each commercial compound is treated separately and only when publicity or research necessitates action.

Organic producers recognise the potential dangers of synthetic inputs in conventional methods of pest control and therefore adopt different methods, such as crop rotations (see Organic Agriculture: Organic Methods). Whilst organic produce cannot be truly pesticide-free, because no part of the environment is isolated from areas where such chemical compounds have been used and therefore still persist, it does not cause any addition to this problem and may show reduced levels of pesticides due to its more environmentally benign cultivation.

2.4.2. Other chemical pollutants.

Some synthetic chemicals leak from industrial processing plants, e.g. dioxins from the manufacture of 2,4,5-T, or PCBs (polychlorinated biphenyls) from electrical equipment where they are used as insulators (MAFF 1983). The latter have posed a considerable threat to marine mammals, due to their apparent high genetic susceptibility and the fact that the PCBs accumulate in

the top layers of water, which is the home of the photosynthetic organisms at the start of the marine food chain. Some studies show concentrations of 410 ppm in whale blubber and 833 ppm in dolphins - levels of 50 ppm in industrial goods require such items to be labelled as 'toxic waste'. The manufacture of PCBs is now banned, but equipment containing them is still in use and a potential source of seepage (Cummins 1988).

Other synthetic pollutants stem from the use or storage of chemical weapons, e.g. Agent Orange, a spray defoliant used by the Americans in the Vietnam war which, though its use ceased in 1971, still persists in the environment. One of its constituents, 2,4,5-T, can react in the environment to form the toxic compound TCDD or dioxin (see: Pollution: Water Pollution: Bleaches). Links have been postulated between such defoliants and the extreme foetal deformities still emerging in hospitals in the sprayed regions (Hay 1982, Cumming-Bruce 1990).

Dumps of chemically violent weapons and radioactive waste or other toxic waste are potential sources of leakage to the environment of undegradable, longlasting compounds, the effects of which are unresearched and virtually unknown. Some possible consequences of exposure were detailed after the Nevada A-bomb tests in 1953, where strontium-90, an isotope in fallout, was linked to cancer due to its build up around the lining of bone cells (Commoner 1971). Such potential damage is very difficult to predict and some high level, i.e. very radioactive, waste needs to be stored safely for 250,000 years with no leakage. The amount of waste needing safe disposal sites increases yearly, with the USA nuclear power industry presently looking for a safe

place, in both geological and political terms, to dump 21,000 tonnes and an additional 2,000 tonnes per annum (Tisdall 1989).

3. Climate.

3.1. Introduction.

Climatic change is one of the issues in the environmental debate persistently maintaining a high profile. Because the climatic changes under discussion are global and represent the possible deterioration of a global public good to which all have access, they affect all people in all nations. In addition, the possible modifications to the atmosphere, temperatures, sea levels and so on may be on a scale that outweighs other environmental perturbations in the public consciousness merely because it is far simpler to visualise a globe drying out under temperature increase or being inundated by the sea than to imagine the insidious influence of lead in the atmosphere or nitrates in the soil. The first is a disaster which we are familiar with on a smaller scale, such as yearly droughts and flooding of river deltas, and these items regularly make the news due to their visibility to the camera.

3.2. Global Warming.

It is necessary to start this section by discussing some of the basic distinctions made in physics between different kinds of radiation. There are different kinds of light in the radiation, or electromagnetic, spectrum and all are visible or heat-giving at different levels. It is sometimes clearer to talk about light, sometimes about heat and sometimes to combine the two concepts and talk about radiation. Neither ultraviolet (UV) nor infrared (IR) rays are visible as light to the human eye and they

separately mark each end of the spectrum of visible light - the seven colours of the rainbow. Beyond the longer wave IR rays at one end of the spectrum are longer wavelength radio waves, e.g. AM and FM, whereas shorter wavelength waves, e.g. X-rays and gamma rays, are found at the other (UV) end. Because UV and IR rays have different wavelengths, by their very nature they are subject to different processes in terms of their reflection and absorption in the atmosphere.

The basic physical mechanisms of atmospheric heating systems are relatively well established. Incoming solar radiation - sunlight - is about 43% visible light, 49% IR and 7% UV (Lutgens and Tarbuck 1979). Before reaching the surface of the Earth some is reflected back into space by ozone in the middle atmospheric layers, collectively known as the stratosphere, between 10km and 50km above the Earth's surface. Ozone has three oxygen atoms in every molecule (it is usually written as O_3) and is particularly effective in reflecting the ultraviolet (UV) radiation. Some of the solar radiation is also scattered back away from the Earth by clouds in the lower atmosphere, mainly less than 6km above the surface. About half of the incoming solar radiation succeeds in passing through the atmosphere and hitting, and thereby warming, the Earth's surface. This is then partially reradiated from the surface to space mostly in the infrared part of the spectrum. This kind of radiation can be intercepted by clouds which may scatter the heat in any direction through the atmosphere. It may also be absorbed by carbon dioxide.

Carbon dioxide therefore traps heat radiated from the Earth

on its way out to space, and warms the atmosphere as that is where the heat is retained. Other heat trapping gases are methane (CH_4), nitrous dioxide (see Pollution: Air Pollution: Other car exhaust emissions), water vapour and chlorofluorocarbons (CFCs): together, these have been termed the 'greenhouse gases'. This is an analogy with the glass in a greenhouse which allows solar radiation in through the glass but does not allow all of it to be reradiated out, as its wavelength is then longer, reflecting a portion back to heat the air within the greenhouse again.

The records relating to the volume of greenhouse gases over the last two centuries show increases in volume from pre-industrial levels (18th century) to 1988 of about the following magnitudes: carbon dioxide up by 25% from 280 ppm (parts per million) to 350 ppm; methane up 100% from 800 ppm to 1700 ppm; nitrogen dioxide up 10%; CFCs up from 0% (not yet synthesised) to very small traces only measurable in parts per trillion parts of air (Warrick and Farmer 1990). Although the latter group, the CFCs, show very small volumes in the atmosphere even today, they can be 10,000 times as effective in changing radiation patterns than naturally occurring carbon dioxide, and may contribute 20% to 25% of overall global warming (Earth Matters 1989, Hekstra 1989). There is some consensus in the scientific community on these levels, but it is by no means absolute as the reliability of records depends on many factors, such as regional variations causing anomalies at measurement sites and the reliability of the measurement instruments themselves e.g. ice cores from Greenland exhuming layers of snow laid down a century ago under different

climatic conditions.

The sources of these gases are multiple, but the most significant are: the burning of fossil fuels such as coal, oil, gas and wood; car emissions - a particularly rapidly expanding source (see Pollution: Air Pollution); industrial emissions. Deforestation is also important in the case of increasing carbon dioxide, as forests consume this atmospheric gas and use it in photosynthesis which provides energy for growth. If forests and other vegetated areas are reduced in size by clearance, less carbon dioxide is extracted and used by plants. The sources of increasing atmospheric methane are various organic processes; expansions in cattle keeping and paddy field cultivation are significant examples.

The actual consequences of carbon dioxide increases are difficult to predict because of the complexity of the atmospheric processes involved. Modelling of these has been going on since the 1970s particularly with greater computing power, but the power available is still inadequate to imitate the vast range of interrelated gaseous processes across the globe. General circulation models (GCMs) are the most accurate ones so far but these depend upon calculations of climate only at intersections on a grid which can have lines hundreds of kilometres apart, which is too coarse for reliable use. Most atmospheric processes operate at a scale of tens of kilometres or less and therefore models can not simulate important changes that occur between their widely spaced gridlines (Williams 1990b, Guest 1990b). Feedback processes, where one change can then produce a variety

of changes in consequence, are intricate and even where understood in theory, they cannot be accurately represented in global models which are still at crude scales. For example, it is believed that up to 25 processes in cloud layers are important influences on climatic modification, such as turbulence, rainfall patterns. The scattering of radiation already mentioned may critically depend upon the shape of the cloud and its composition, whether it is of rain droplets or of ice crystals for instance. It is beyond the capacity of most models to incorporate such complexity as well as overall calculations of greenhouse gas changes and radiative effects.

To be really effective, global circulation models should include oceans which don't absorb atmospheric carbon dioxide and heat in the same way as land surfaces. Oceans and other water bodies are very difficult to incorporate into models as changes of significance, e.g. warming currents, can occur at scales of a few kilometres or less - much too fine to be detected by simulated change measured at points 100 or more kilometres apart (Williams 1990b). Regional differences must also complicate any predictive modelling and predicted global average temperatures can be meaningless or even misleading for planning at a national or continental scale. Some critics of scientific research into global warming draw attention to the fact that in the 1970s scientific research seemed to promote the idea that the worlds' next climatic change would be a cooling and much publicity was given to concepts of a new Ice Age. They say that this latest concept of warming is being promoted by scientists to obtain funding for high profile projects in this field.

Despite suggestions that it will be ten years before models will produce adequate global climatic predictions, the Intercontinental Panel of Climatic Change (IPCC) estimate that atmospheric carbon dioxide will double by 2025-2050 at present rates of emission. This will lead to an estimated global average rise of 1 or 2°C over pre-industrial temperatures by 2020 and a rise of 3.5°C by 2070. Several research groups agree on a change of this order of magnitude, but some workers dispute such calculations and the debate is still ranging and will continue to do so.

If a time comes when the need to curb industrial activities is obviously necessary and not under debate, action taken then will have a lag time before its results are seen. This may make the action too late to reverse any detrimental climatic variations. This is why some commentators have said that we are already 'committed' to a degree of climatic change as not all the consequences of past emissions have yet been revealed as observable climatic disturbances and even whilst we seek to change our present activities' impact, the impact of past activities is still being processed in our weather systems.

3.3. The Ozone Layer.

One ozone molecule consists of three oxygen atoms and is therefore written in scientific notation as O₃. It is particularly important in the upper atmosphere where it reflects ultraviolet part of solar radiation back out into space as described in the previous section, thereby protecting inhabitants

from excessive doses from this end of the light spectrum. Ozone is attacked by various compounds in the atmosphere and, as with carbon dioxide, its balance is dynamically maintained by continual production and destruction in the air. However, synthetic compounds have been released through industrial processing which also destroy ozone molecules.

In 1926 the first aerosol propellants were developed, principally by Du Pont Nemours and Co., and were compounds of carbon and halogens and called 'freons' as a tradename (Elkington with Burke 1987). They are now more widely known as chlorofluorocarbons (CFCs) or chlorofluoromethanes (CFMs) depending upon their composition. As to their commercial uses: CFC11 (CFCl_3) and CFC12 (CF_2Cl_2) are used as propellants - that is they produce sprays from liquid in aerosol cans; CFC21 (CFHCl_2) and CFC22 (CF_2HCl) are used as refrigerants in fridges, freezers and air conditioners (Allaby 1983); CFC113 is used as a cleaner for electrical equipment and in clothes dry cleaning (Earth Matters No. 8 1990). Other types of CFCs are used in the production of plastic foam like that used in fast food packaging and other containers (Allaby 1983). CFCs are chemically very stable and persist in the environment for long periods because there are no natural predators to breakdown their molecules.

When released to the atmosphere via sprays, destruction of fridges or production of foam packaging, the CFC compounds can dissociate - atoms break off and become free to join other atoms. Free chlorine atoms liberated by this dissociation can attack and destroy ozone molecules by detaching individual oxygen atoms from the O_3 arrangement. This means that ultraviolet reflection by

ozone is reduced.

High CFC concentrations over urban areas were first pointed out by Lovelock in 1968 when he noted differences between European and Atlantic air compositions (Elkington with Burke 1987). In a 1974 paper, Rowland and Molina noted the effects of free chlorine atoms in ozone depletion due to their tipping of the balance between naturally occurring ozone destroyers and conditions for ozone creation. Due to the exposure of such links, the EEC froze CFC production in 1979 and set targets for 1981 production at 30% less than production in 1978 (ibid.).

The issue has been high profile for some time especially with measurements of the ozone 'hole' over Antarctica continuing to show alarming ozone depletion through the 1980s. Some measurements showed a 50% depletion over the South polar continent and 95% to 97% depletion 12 to 25 kilometres above the Earth's surface (the layer of ozone concentration in the atmosphere) (Sinclair 1989). Measurements of overall ozone depletion, and concentrations of chlorine causing the same, can be conflicting due to regional patterns of CFC production and interactions between ozone destruction and carbon dioxide increase. Suggested chlorine volumes are around 4 parts per billion (up from 0.6 ppb in 1959) which may be increasing by 5% yearly (ibid.) and up to 90% of ozone depletion may be due to CFCs (Hekstra 1989). Up to 3% of world ozone may have been lost over the densely populated Northern hemisphere since 1970, but the figure could be as high as 6% in polar regions (Earth Matters No. 8 1990, Sinclair 1989).

Because of the alarming rapidity of ozone change, the United Nations Environmental Programme in 1987 set up the Montreal Protocol on Substances that Deplete the Ozone Layer, which set a target of a 50% cut from the 1986 level of CFC production by 1998. Aerosol cans avoiding CFC propellants are now widely available but many of these still use propellants such as methyl chloroform, halon or HCFCs even when packaged and labelled "ozone friendly". Methyl chloroform, also known as 1,1,1 trichloroethane in the UK, is not a CFC but a solvent and cleaner with an ozone depletion potential 10% to 16% that of CFC11 (ENDS 1989 No. 176). An addition to the Montreal Protocol in June 1990 states that the use of methyl chloroform will end by 2005. However, HCFCs are not covered by this clause, despite their potential ozone depletion effectiveness. Although this is only about 2% to 10% that of CFCs (Earth Matters 1990 No. 8) it is still one thousand times as effective as naturally occurring ozone depletors such as carbon dioxide. The way to avoid all such propellants is to use solid forms or adopt pump action sprays which use air to push down on the liquid, producing a fine mist of droplets rather than a propelled spray.

3.4. Consequences of Climatic Change.

Sea level changes are likely if global temperatures increase as this will cause melting of ice caps, firstly those over the sea and secondly those over the land surface. Even if we were confident about the magnitude of future temperature change, regional differences would complicate sea level change predictions. Land uplift (isostasy) over continental scales

disrupts overall level rises as do relative levels of land and sea due to the weight of buildings, erosion, earthquake influences and so on (Hekstra 1989). The IPCC has estimated, based upon its 1°C to 2°C temperature rise, a 'best estimate' sea level rise of 20 cm by 2030 and of 45 cm by 2070 (Williams 1990b). Although these seem small, the area which might be flooded in such a case is enormous, with whole countries subject to drastic damage, e.g. the Maldivé Islands where the entire country is within a few metres of the sea. A sea level rise of one metre, according to some research, could affect some five million km² of land, or 3% of the global land area which carries about one-third of the global croplands and one billion people (Hekstra 1989). Many fragile habitats in the coastal zone will be disrupted such as mangrove swamps, reefs, estuaries.

Another consequence of climatic change relates to ozone depletion. With less ozone in the atmosphere, more ultraviolet radiation can penetrate through the layers and reach the Earth's surface and the skin of people exposed to sunlight. Such exposure to ultraviolet has been associated with malignant melanomas - skin surface blemishes which are evidence of skin cancers. Up to two-thirds of Australians are thought to be already affected, showing the dangers of close proximity to the particularly low ozone levels over Antarctica - the ozone hole may have reached Melbourne, South Australia back in 1987. A 3% rise in skin cancer cases is ascribed to ozone depletion by Friends of the Earth (Earth Matters 1989 No. 6) and they also predict that every 1% decrease in global ozone volume makes

100,000 people blind due to ultraviolet-B induced eye cataracts (ibid.).

The possible effects of climatic temperature changes upon atmospheric circulation e.g. more turbulence, changes in monsoonal patterns, are very difficult to determine due to the problems in regional accuracy inherent in the modelling systems used today (see Climate: Global Warming above).

4. Recycling.

4.1. Introduction.

Overall, we in the UK produce about 20 million tonnes of domestic waste every year (Department of the Environment 1990), which represents about one tonne per household per year or 280 kg per person (Myers quoted in New Internationalist 1989). The USA was the most wasteful nation, throwing away 203 million tonnes 860 kg per person) in 1985, but even in the less developed countries, the urban throw-away lifestyle is emerging rapidly: the population of Mexico City threw away 145 kg per person, that of Jakarta 135 kg and that of Singapore 244 kg (ibid.).

Waste takes energy to collect, remove and dump. Trace metals, pesticides, synthetic chemical compounds can leak into water systems and the atmosphere. At the same time, landfill sites are filling up with increasing quantities of rubbish and substitute areas are less easy to establish. And, of course, the actual production of all this rubbish involved extraction of materials like metals and wood from the environment without restoring them in any useful way. The Department of the Environment estimates that about half of all UK domestic waste is 'recyclable' but only 5% is actually recycled at present - about one million out of 20 million tonnes of waste (Department of the Environment 1990 p.190). As for industrial waste, of about 100 million tonnes disposed of per year on land, excluding liquid and airborne wastes, 27 million tonnes were recycled and worth about £2 billion (ibid.).

4.2. Paper.

'Virgin' or non-recycled papers are made mostly from the wood pulp of 90 million trees cut down every year. Whilst it is true that the paper industry plants more trees than it cuts down, the seedlings are not usually of a species appropriate to the planting environment, but of one appropriate to future paper, or timber, production. In addition, the landscape disruption caused by ploughing and planting can cause irreparable environmental changes and species depletion. In the Flowlands of Scotland, peat bogs have been stripped and replaced by stands of conifers on timber plantations, and the rich diversity of tropical forest may be replaced by single species eucalyptus plantations (Friends of the Earth 1989a).

Timber is prepared as pulp by either of two mechanisms. Chemical treatment breaks down the fibres and removes lignin (the tough, woody constituent of plant cells). The resulting substance is confusingly called 'wood-free' due to the lack of lignin and paper produced from it is less susceptible to yellowing and ageing. Mechanical treatment, which may involve heat to 'cook' the wood chips, produces so-called 'woody' pulp still containing lignin and this method extracts more pulp volume per tonne of wood than the chemical treatment. The energy consumed is about the same for the two treatments of virgin wood, but the pulping process for waste paper can use up to 50% less energy than these (ibid.).

The next step in paper production is the whitening of pulp.

'Wood-free' pulp is bleached with hydrogen peroxide, hypochlorite solution of chlorine gas, which is related to the production of significant amounts of dioxins (see Pollution: Water Pollution). Where such treated paper is used as food wrappings, the dioxins can migrate directly into the food which they surround (ENDS 1989 No.177, Moyle 1989a). New legislation in New Zealand bans the use of paper made from chlorine bleached pulp in milk cartons.

Recycled paper made from chlorine treated pulp waste is usually rebleached, albeit using weaker solutions than those used on the original virgin pulp. It is possible to separate off white, unprinted paper when the waste is first processed so that this type need not be rebleached at all. De-inking may be done using chemicals (not bleaches) or by the use of tiny air bubbles which push through the printed pulp waste (Friends of the Earth 1989a). The environmental effects of this process are not widely studied, but it is not always necessary, except where the paper is destined for high speed printing procedures.

It is possible to obtain not only recycled paper but non-bleached non-de-inked recycled paper which is suitable for most domestic uses. Recycled paper toilet and kitchen rolls, paper packaging and stationery of all levels of quality are now widely available to consumers, and about 20% of the pulp used in daily newspapers is from recycled waste, and up to 39% recycled for the Financial Times (Earth Matters 1990 No. 8).

It is worth noting here that some is recycled only from offcuts from paper produced of virgin pulp as it leaves the factory, paper which has been processed once but not used. It is better to recycle all kinds of waste paper, including 'post-

consumer' waste, not just the higher quality residues of manufacturing output.

4.3. Metals, Glass and Plastic.

The recycling of metals via resmelting and then reforming has been practised from the earliest metal-using civilisations, as the effort expended in the original extraction and production of ore was too great to merit a single formation and use. One of the commonest forms of metal waste today is that of cans. Food cans are made up of a steel casing with a tinplate lining which can be chemically removed for recycling and the remaining steel shredded and reused. British Steel is urging the recycling of 400 million of such cans per year in the near future. The European industry as a whole recycled about 31% of the steel tinplate it used, with countries such as West Germany and the Netherlands recycling over half. The UK recycled some 125,000 tonnes, or only 17%, out of a total consumption of 750,000 (Bowcott 1990).

The composition of the typical drinks can is somewhat different. Some cans are constructed of a steel cylinder with aluminium ends but 50% of UK cans (and 80% of cans in the world) are composed entirely of aluminium. This aluminium needs to be separated at source and, unlike steel, is not magnetic, so the use of a simple magnet allows the recycler to distinguish between the two. Only about 3% of aluminium cans used in the UK were recycled in 1985 but the Aluminium Can Recycling Association now estimates this has risen to 10% in 1990 (ibid.). Their aim is to

match the world average recycling level of 50% and some countries such as Sweden achieve recycling rates of 86%. The Can Makers group, representing the UK manufacturers of drinks cans, now operates 200 skips in 60 boroughs through their 'Save a Can' scheme which collects both aluminium and steel cans. Aluminium has an economic advantage: steel cans are worth about £40 per tonne at recycling plants whereas aluminium ones are worth £900 per tonne - about one pence per can - and can be collected by schools and other groups as a means of raising funds.

It is estimated moreover that resmelting aluminium cans uses only 5% of the energy of extracting aluminium from bauxite ore, its original source (Friends of the Earth 1989b). As four tonnes of bauxite has to be mined for every tonne of aluminium produced, recycling also reduces the landscape destruction inherent in mining and processing.

Metals from electrical batteries can cause problems in the environment (see Pollution: Metallic Pollutants) and some manufacturers are responding by removing cadmium and mercury from their batteries before sale or, where they are necessary to the operation of the product, e.g. in rechargeable batteries, by removing them when the batteries are returned under a postal arrangement. The metals extracted can then be used or resold through the market. The metal battery casing is largely unrecoverable and merely takes up landfill room.

Glass containers can also be recycled and every tonne reprocessed saves thirty gallons of oil compared to the production from newly extracted ingredients (Friends of the Earth

1989b). Another environmental advantage of glass is its easy reusability: containers can be cleaned, sterilised and refilled up to twenty times without any reprocessing, a procedure which uses only one-tenth of the energy of the production of twenty containers that can only be used once each. Milk bottles have been returned and reused on this premise for years. However, glass does consume more energy in transport due to its greater weight than, say, plastic bottles, and this may offset its energy savings in reuse terms. It is also necessary that a glass bottle is reused at least ten times or it will consume more energy for each usage than a plastic one (Hadsley 1990).

It may be easier to use plastic packaging and containers if the weight factor is important. Unfortunately, many plastic bottles are composed of several, different layers of plastic: this restricts the opportunities for recycling as only a limited range of low quality products can be produced from such waste. However, bottles made of only one plastic, such as PET (polyethylene terephthalate), can be entirely recycled into a much higher grade product because there is no mixture of materials as in commoner bottles. About 120 plastic bottle banks are now in operation in the UK (ENDS No. 188 1990) and trial recycling schemes for the one million tonnes of plastic discarded yearly are now being sponsored by Safeway. The store gives away around 400 million PET bags per year which amounts to 8000 tonnes of plastic (Bell 1990).

5. Energy.

5.1. Introduction.

The use of fossil fuels is fundamental to most industrial growth mechanisms in the developed and developing worlds. The burning of such fuels as coal and gas, in order to produce the steam which turns turbines and produces electricity, releases carbon dioxide into the atmosphere. This release has a potential influence upon global and regional climate (see Climate: Global Warming). Further, fossil fuels are not renewed on the same timescale as they are being consumed and so the supply is finite and will, at some point, run out. Although coal is reckoned to exist in sufficient quantities in the earth to supply present rates of use for some centuries yet, some studies have described the useable volumes of gas and oil as lasting only in terms of decades or a century. The actual lifespan of the supply is under debate, but at accelerating rates of use due to industrial growth, they will prove inadequate at some point.

Nuclear power has been cited by its supporters as a new source of energy with a longer lifespan, due to an abundance of uranium ore which is reckoned to last for 5000 years at current rates of extraction, and lower carbon dioxide emissions than the conventional fossil fuels. Its opponents have argued that nuclear power has its own special environmental problems, such as the need for toxic waste dumps, accidents and leakages, the effects of which are both long lasting and frighteningly unknown. In addition, fossil fuels are used in the construction of nuclear power stations and in refinement of uranium ore used in their

operation. It has been estimated that the proposed Sizewell pressurized water reactor station would release about 230,000 tonnes of carbon dioxide per year (Jackson 1990). Some economic evaluations have indicated that nuclear power will cost £20 per ton of carbon dioxide emissions saved, whereas fuel efficiency in the home can save over £10 per ton of carbon dioxide saved (ibid.). Economic arguments in favour of nuclear power are being increasingly discredited and the government was recently forced to withdraw this section of the energy industry from its privatisation programme, thus indicating that it was no longer "officially cheaper" than coal- or oil-fired power stations (Travis 1989).

Alternative ways of combatting some of these problems of use and carbon dioxide emissions are by energy efficiency and therefore conservation and by the use of renewable energy sources.

5.2. Energy conservation and efficiency.

56% of the UK energy consumption every year is due to buildings and this sector pumps out 300 million tonnes of carbon dioxide into the atmosphere. This represents 17% of all British emissions of the gas. 1% or 2% of the building stock is renewed per year, so there are opportunities for gradually redesigning heating systems. One way to do so is by introducing condensing gas boilers which increase fuel efficiency by 40% by using the heat which is normally vented from the house, such as via the domestic flues (Polan 1990). Such a boiler is more than 90% fuel

efficient compared to a typical domestic boiler which is only 65% fuel efficient (Cottrill 1990). Other measures in the home include positioning windows to receive the maximum warmth from sunlight and the use of insulation to trap heat within the house and prevent the heating systems heating the air outside as well. More research is needed into possible fuel savings during construction as the energy in that phase can equal the energy consumed in running the building for the first ten years (Polan 1990). However, research funding has suffered a 50% fall since 1986 (Vidal 1990) so expanding research is unlikely. Inertia in the construction industry and legislation only equivalent to that operating in Sweden in the 1930s mean that any change from within the industry is also unlikely.

Other areas where fuel efficiency could be improved include the use of energy efficient electrical appliances, such as fridges, washing machines and longlife light bulbs. These types of products are sometimes designed with fuel efficiency and therefore economy in mind. Examples are shorter cycles for washing using lower temperatures and less water or fluorescent bulbs which cost more initially but use less electricity to function and last up to 15 times longer than ordinary bulbs. Some studies have shown that energy efficient lighting can save £12 per ton of carbon dioxide emissions saved and energy efficient heating up to £8 (Jackson 1990). Overall energy efficiency, combined heat-and-power generation and using renewable energy could reduce carbon dioxide emissions by 46.5% of present levels by 2005 and every unit of electricity saved saves emitting 700 grams of carbon dioxide, 15 grams of sulphuric

acid and 4 grams of nitric acid (ibid.).

5.3. Renewable Energy Sources.

Some of the problems above relating to the emissions of gases such as carbon dioxide and the finite energy supply of fossil fuels can be approached through the development of renewable energy sources. Here, the kinetic energy driving natural actions, such as wave movement and solar radiation, can be caught and converted to electrical energy. Instead of fossil fuels burning to produce steam to turn turbines, the turbines can be directly rotated by the wind to generate electricity; solar panels can heat up under sunlight and transfer this captured heat to water in domestic systems; floating canisters can absorb the power in wave motion and generate electricity. Because the development of such power sources is not a direct consequence of purchasing power, the details of generation and funding are beyond the scope of the paper. However, it is worth making some points about the types of power with potential in the UK so that the practicality of sources can be assessed.

Wind power has been installed in California, USA, since 1981 and the 15,000 turbines now functioning have a capacity of 1,350 megawatts (MW) - the Sizewell PWR will have a capacity of 1,200 MW. The wind turbines generated enough power for 300,000 households (about 1,900,000 MW) in 1988, which is equivalent to the use of about 3.1 million barrels of oil. This may have saved the emission of 4,000 tonnes of sulphur dioxide, 2,400 tonnes of nitrous oxides and 800,000 tonnes of carbon dioxide (Rand 1990).

The UK has a potential capacity of 3,000 MW even outside sensitive areas such as the National Parks and the Areas of Outstanding Natural Beauty where there is a lot of wind, but so far there is an installed capacity of only 6 MW since 1981 (ibid.).

Wave power machines have taken various forms including Dr. Stephen Salter's Duck in the early 1980s, but most research was halted by poor reviews and cuts in funding. The 1982 budget for all renewable energy research was cut from £14 million to £11 million, with the remaining money concentrating on wind research. At the same time £200 million was allocated to nuclear power research (Jeffrey 1990). Hydroelectric plants are already supplying 2% of the UK's electricity and have a potential capacity of 500 MW.

The Watts Committee on Energy in 1987 estimated the costs of various sources of energy on the basis of pence per kilowatt hour, and some of these are given below (at the 1987 prices).

Table 1: Estimated Costs of Various Energy Generation Methods.

<u>Type of energy generation</u>	<u>Price (pence/kilowatt hour)</u>
Wind	2.26
Wave	3.17
Tidal (barrages)	3.23
Coal	3.5
Nuclear (minimum estimate)	6.3

source: Guardian 1990.

The technology for wind, hydro and tidal power is already developed; wave power needs time to recover from earlier setbacks; other potential sources, e.g. geothermal heat from granite rock layers and biofuels from the breakdown of organic waste, are less developed.

Renewable energy requires much initial investment in technological development and construction but this would be effectively returned as running costs are very favourable. Fuel supplies are not necessary, just the generating machines, and these can often be very smallscale, e.g. domestic solar panels in use in Greece atop each house.

The nuclear and fossil fuel lobbies have a great advantage in that they are established industries needing to protect jobs and communities and thus have considerable influence upon energy policy through government structures. It is unlikely that much support for renewable energy will be forthcoming from such quarters.

6. Organic Agriculture.

6.1. Introduction.

Conventional farming, as practised in the past few decades in the UK, uses inorganic inputs: these do not originate in plants or animals, but through extraction from rocks e.g. phosphates, by energy-hungry extraction from the air, e.g. nitrates, or by synthetic production, e.g. chemical pesticides. Environmental problems develop under this style of farming as it tends to feed the crop not the soil - the long-term resource upon which agriculture depends. This means that: soil health may deteriorate, increasing soil erosion and necessitating further artificial additives to maintain yields; excess fertiliser is washed into river systems and becomes polluting (see Pollution: Water Pollution); pesticide residues accumulate in crops, soils and atmospheric systems, eventually working up the food chain to humans (see Pollution: Other Forms of Pollution: Pesticides).

Organic agriculture seeks to avoid these problems by working with the environment in an ecologically balanced way which reduces environmental damage and improves soil health. This latter involves both structure - how well the soil is held together with adequate space within to bear water and air to plant roots - and fertility - the nutrients in the soil available to plants and necessary for their growth. The most important nutrients include nitrogen, potassium, phosphorus, sulphur, carbon, water and oxygen plus many different trace elements which are vital to plant growth but only in small quantities.

6.2. Organic methods.

All organic farmers adopt several guiding principles which distinguish their methods from those of conventional agriculture. (Most of this section is based upon information from the Soil Association and the Organic Farmers and Growers Standards.) The main fertilisers they use are composted animal manures and other organic wastes. Some processed fertilisers from non-waste sources are used, e.g. rock phosphates, liquid seaweed products, but these are not the primary nutrient inputs fed to the soil. Organic manures provide a balanced range of nutrients. Due to the organic matter within, they help to bind the soil, form stable structures to aerate it - which introduces essential oxygen into the air in the soil pores - and help prevent its erosion by wind and water. Stubble is also ploughed into the soil to help maintain structure rather than just burning it off and thereby losing organic matter and releasing carbon dioxide (see Climate: Global Warming).

Rotations are practised where the crop grown in a field changes every year, rather than growing the same crop in the same field, or even in all fields, every year as in conventional UK farming. Common rotations include pasture, a relief to the soil as it involves less traffic by ploughing and harvesting, and a beans or clover crop for one year. Leguminous plants such as beans have nodules on their roots where certain forms of bacteria exist. These bacteria can convert nitrite in the soil to available nitrate which can be taken up and used by plants for growth. This nitrogen is added as soluble fertiliser by

conventional farmers and up to half is lost to rainfall (see Pollution: Water Pollution).

The rotation of different crops also acts as a check to diseases as not all crops are susceptible to the same diseases and where the crop is resistant, so the spread of pests such as fungus, rust and mould is curtailed. Conventional agriculture practises monoculture, where one crop such as wheat is grown over many fields every year. This encourages the spread of disease as all the plants around are prey to the same pests and this necessitates the use of pesticides (see Pollution: Other Forms of Pollution). Pest control is rarely an issue for organic agriculturalists but where it is necessary, they aim to encourage natural predators to attack the pest populations rather than applying synthetic pesticides. Intercropping may also help where several species are grown in the same field in strips so that the spread of pests is cut off when they encounter resistant crop species. Cultivation practices, where ploughing overturns and exposes pests and weed seeds to the frost over the winter, may also kill pests.

Ploughing is usually only performed to a shallow depth of 4 to 5 inches to keep the soil friable and aerated. This also encourages breakdown of organic matter near the plant roots in the freely aerated topsoil, and the nutrients released by this breakdown can easily be taken up by the crop.

Most organic farmers also harbour a healthy respect for their livestock, keeping them in humane conditions and disdaining the use of growth promoting injections, other hormones or 'consumer additives' such as tartrazine (E102) which can be given

to chickens to dye the yolks of the eggs produced a deep yellow.

6.3. Economic considerations.

Overall, organic agriculture uses about one-third the energy of conventional agriculture (Pimental quoted in Gear 1987); is responsible for fewer chemical residuals, pollution and additives; requires less industrial production of fertiliser and pesticides, often from fossil fuel sources; uses waste more efficiently; safeguards soil health more effectively certainly in the long-term future of the soil resource.

Few of these arguments are denied by conventional farming groups, but they take issue with the economics of organic agriculture and its tendency to produce slightly lower yields. In addition, there is no incentive to change from conventional to organic methods in terms of financing, particularly over the two year transition period. Such a period is one of the conditions demanded by labelling schemes and during this time inorganic inputs cannot be used to ensure the normally high yields and no crops grown on the soil can be labelled organic and therefore sold at higher premiums. Organic farmers are not eligible for government monetary incentives or subsidies to help them over this financially difficult period, nor free advice from ADAS (Agricultural Development and Advisory Service) on organic methods. Yields on average from organic agriculture can be 10% to 20% lower than yields from conventional agriculture but there is a great range concealed behind such averages. Often the deficit in yield is made up by the higher premium on organic

produce in retail markets.

Several associations have been formed which are run by and represent organic farmers: the Organic Growers Association and the British Organic Farmers are two such national groups. The best known is the Soil Association which licensed its organic label to some 300 users in England and Wales in 1986. The farms in this scheme are all inspected by appointed Association members before the license is approved.

At first, produce was sold on a local scale such as from the farm gate where prices might be up to 35% higher than in high street outlets. Safeway was the first supermarket to become interested and has been stocking organic produce since the early 1980s. The organic produce market accounted for £1 million in 1985 in supermarkets, but the supermarket companies estimated in that year that the potential market may be around £13 million per year - this represents about ten per cent of all vegetable sales (Hill 1985). The problem at present is due to supply not demand. The smallscale of the farms means that the seasonality of the crop is strongly marked. Such limited availability is not suited to supermarket stocking as they aim to sell the same produce all year. Some 60% of organic produce sold in the UK is therefore imported to offset this seasonality in UK harvests (ibid.).

There is another label administered by Jordans Mills and called the Conservation Grade. This is not an organic scheme because it does allow the input of artificial fertilisers and pesticides, but in smaller quantities than usual and only of certain approved brands which are reckoned to be less environmentally damaging.

It is worth noting that no organic produce can truly claim to be pesticide-free as artificial pesticides such as DDT are persistent and widespread in the environment and no crop is really isolated from contact with them. However, organic agriculture does not add to this nonbiodegradable pool of chemical compounds, unlike conventional agriculture which depends upon chemical pesticides and fertilisers to maintain its yields and therefore its economic viability.

7. Habitat and Conservation Issues.

7.1. Tropical Forests.

The clearance or otherwise destruction of tropical forests is another high profile issue returning continually in the media. The areas generally referred to include Amazonia, Central and West Africa and Asian areas such as IndoChina especially Malaysia; these cover a variety of different types of climate and vegetative make-up. Sometimes moist forests are distinguished by the term rainforest, and this type occupies 6% of the global land surface but accommodates 50% of all species of life (Pearce 1989).

These forests of the lower latitudes have been described as the earth's lungs or a carbon sink due to the amount of atmospheric carbon dioxide they use up during photosynthesis, a process whereby plants take up carbon dioxide to release oxygen. They have thus been cited as an important regulator of carbon dioxide emissions and of the greenhouse effect (see Climate: Global Warming). Their partial or total destruction will affect the climate, but exactly how and to what extent is unpredictable. Some models estimate that total deforestation of the Amazon could increase average global air temperatures by between 1°C and 3°C, decrease average global precipitation by 20% and disturb rainfall patterns on a wide scale (Molion 1989).

The forests also protect the loosely structured and often nutrient poor tropical soils from erosion under intense tropical rainfall by both leaf canopy cover and root systems binding the soil together. Also, the trees hold and thus recycle most of the

nutrients of the plant-soil system and the removal of the trees means that the nutrients will not be released back into this system, through bacterial breakdown when the tree dies, but lost to the system altogether. The forests have also been described as a scientific resource due to the vast numbers of possible species as yet unknown and of medicinal potential (Pearce 1989). They are also, of course, a source of food, shelter and tradition for their indigenous peoples.

There are several kinds of commercial assets in the forests: crops harvested on plantations, such as bananas, or rubber drawn from living trees, minerals, such as gold, and timber. 20% of all deforestation is directly due to logging and this figure should be increased to include indirect clearance for roads and other constructions as well as the trees felled in order to clear a path to extract the logs of actual value (The Guardian 1989). Only 0.2% of the timber is produced from sustainable resources (Pearce 1989), that is, where replanting occurs.

Gold has been mined in Amazonia since 1600: the Tapajos region has yielded over 600 tonnes and now houses 100,000 prospectors over its 70,000km². For every tonne of gold mined, a tonne of mercury is used by the miners despite its being officially banned. There is no cheap and easy alternative to separate gold from earth and hence mercury pollution and contamination of fish and the local population has been going on for centuries and will continue to do so, bringing associated health risks (see Pollution: Water Pollution: Metallic Pollutants).

In addition, the land is cleared for plantations or cattle ranching - the latter is a particularly wasteful form of food production as it uses vast tracts of land to produce a relatively small volume of protein. In fact, it is only profitable because of incentives and credit made available by government agencies once enclosure of the forest is demonstrated (Hecht 1989). Burning forest to clear land for agriculture, ranching and so on releases two billion tonnes of carbon dioxide to the atmosphere per year, and the few nutrients released to the soil are rapidly consumed by plants, rendering the land unproductive after about ten years (ibid.).

As to the magnitude of the forest destruction: 7.3 million hectares were felled or cleared annually in the early 1980s and 4.4 million more were selectively felled - i.e. valuable trees only were felled and the rest left standing except where they obstructed the timber operations (Pearce 1989). 40% of all tropical forests existing in 1945 have gone and at present rates, not allowing for expansion of the industry, rainforests may no longer exist in Sri Lanka, Costa Rica or the Ivory Coast in 20 to 30 years and all may be gone from the globe in 170 years (ibid.). Amazonia lost a record 23.3 million hectares of forest in 1988 alone (Rocha 1990) and the World Bank estimates that about 12% of the Amazon has been cleared so far (Fearnside 1989). Fifty species of plants and animals are lost every day through this clearance, many of them never described by science.

The main products to reach Western markets from tropical forest consumption are: rubber; minerals; meat from cattle ranching (not from Amazonia as the Amazon region is a net beef

importer (Hecht 1989) but from Central America); hardwood timbers, mainly from South East Asia - a source which may become insignificant due to overuse by 2000 (Fearnside 1989). The latter are now beginning to have their source marked in order to inform consumers.

7.2. UK habitats.

90% of the original UK forests from pre-industrial times has been cleared. However, trees are now being replanted for aesthetic and leisure reasons or for timber plantations. Often these latter are of species inappropriate to the area, e.g. the North American Sitka spruce planted rather than native conifers in Scotland. Deer herds, as populations rise, are browsing on new seedlings and stopping regeneration (Boseley 1990).

Another UK habitat in jeopardy is that of peatlands. 2.5 million cubic metres of peat are dug out per year for commercial sales, principally to gardeners. Only about 100,000 hectares of wetland peat bogs remain and two-thirds of these are under extraction already (Pilkington 1990) and lowland bogs may be wiped out in the next twenty years. Despite legislative protection, the biggest single form of damage to Sites of Special Scientific Interest (SSSIs) in Britain in 1989 was due to peat diggings, which destroyed 900 hectares of SSSIs. Peat producing companies say that there are no adequate alternatives to peat for gardeners, but ecology groups urge the use of composted domestic waste, leaf moulds, straw and coir - a waste coconut fibre imported from Sri Lanka.

8. Concluding Remarks.

This paper has covered environmental issues maintaining a high profile in the public and media consciousness in the late 1980s and into the 1990s. Throughout, the intention has been to collate enough clear and balanced information as a background to discussions of environmental themes, particularly recent debates over the 'environmentally friendly product' concept. The often inconclusive state of academic environmental investigations (see: Global Warming) has been highlighted, as has the uncertainty of many models and predictions which rely upon them. Pro-environmental legislation is also fragmentary and under continual review, as government and industrial action is slow to emerge, despite information suggesting that environmental damage is a rapid process, accelerating even with rates of human activity and industrial expansion.

Much of the information elsewhere disseminated about green products, government legislation or commercial activities adopting an environmental stance, is deceptive, confusing or inadequate. There is a real need to address the problem of misinformation in the environmental debate to ensure that emergent public environmentalism is not smothered at birth by ignorance and disillusionment. Green consumerism and other expressions of public environmentalism are phenomena in which pro-environmental choices rely upon good information. Where this is not available, the phenomena must surely founder.

The environmental movement is one source of both information and direction to consumers, as its stance is not one of self-

interested observer but of watchdog and representative of the public and the environment. Its development and ideologies are dealt with in the second paper in this series, as is the two-way relationship between public environmentalism and organised environmentalism. The third paper deals specifically with some of the problems of misinformation already cited in looking at the response of industry and government to the emergent phenomena of green consumerism and public environmentalism as a whole. This last paper therefore examines issues in green marketing and product change, in recent government strategy statements (The 1990 White Paper on the Environment), in the implications of green voting, and the response from the environmental movement, which recognises the potential benefits and hazards inherent in green consumerism. Further research is also continuing into the motivations of green consumers as individuals integral to the continued growth and spreading influence of public environmentalism.

9. Bibliography.

- Allaby, M (1983) *Dictionary of the Environment*. 2nd edition.
London: The MacMillan Press.
- Boseley, Sarah (1990) *The Guardian* September 14 p.35
- Bowcott, Owen (1990) *The Guardian* February 9 p.27
- Brown, Paul (1989) *The Guardian* December 8 p.27
- (1990a) *The Guardian* January 12 p.27
- (1990b) *The Guardian* July 27 p.21
- CLEAR (Newspaper of the Campaign for Lead-Free Air) No. 14
(September), p.2
- Clouston, Erlend (1990) *The Guardian* March 16 p.25
- Commoner, Barry (1971) *The Closing Circle: Confronting the Environmental Crisis*. London: Jonathan Cape.
- Cottrill, Ken (1990) *The Guardian* March 2 p.23
- Cumming-Bruce, Nicholas (1990) *The Guardian* August 17 p.23
- Cummins, Joseph E. (1988) Extinction: the PCB threat to marine mammals. *The Ecologist* 18(6), 193-195.
- Department of the Environment (1990) *This Common Inheritance: Britain's Environmental Strategy*. London: HMSO
- Dunmore, Jane (1989) Clearing the Air - the Future Control of Car Exhausts. CLEAR (Newspaper of the Campaign for Lead-Free Air) No. 13 (May), p.3
- Earth Matters* (1989) No. 6 (Winter)
- (1990a) No. 7 (Spring)
- (1990b) No. 8 (Summer)
- ENDS (Environmental Data Services Ltd.) (1989a) *ENDS Report* No. 176 (September)
- (1989b) *ENDS Report* No. 177 (October)
- (1989c) *ENDS Report* No. 179 (December)
- (1990a) *ENDS Report* No. 186 (July)
- (1990b) *ENDS Report* No. 188 (September)
- Epstein, Samuel S. (1989) The Real Cost of Petrol. *The Ecologist* 19(4), 137-138
- Erlichman, James (1990) *The Guardian* March 2 p.23
- The Ethical Consumer* (1989) No.4 (September/October), 12-13
- Fearnside, Philip M. (1989) Deforestation in Brazilian Amazonia:

the rates and causes of forest destruction. *The Ecologist* 19(6) Nov./Dec., 214-218

Fisher, Paul (1989) *The Guardian* December 1 p.27

Friends of the Earth (1989a) Briefing Sheet: *Making Recycled Paper*. London: Friends of the Earth.

- (1989b) Briefing Sheet: *Why Recycle?* London: Friends of the Earth.

Gear, Alan (1987) *The New Organic Food Guide*. London: J.M. Dent & Sons.

The Guardian (1989) December 8 p.25

Guest, Ian (1990a) *The Guardian* February 2 p.27

- (1990b) *The Guardian* February 9 p.23

Hay, Alistair (1982) *The Chemical Scythe: lessons of 2,4,5-T and Dioxin*. New York: Plenum Press.

Hecht, Susanna B. (1989) The Sacred Cow in the Green Hell: Livestock and Forest Conversion in the Brazilian Amazon. *The Ecologist* 19(6) Nov./Dec., 229-234.

Hekstra, G.P. (1989) Global Warming and Rising Sea Levels: the Policy Implications. *The Ecologist* 19(1), 4-15.

Hill, Claude (1986) *The Future for Organically Grown Produce*. London: Food From Britain.

Hillier, Catey (1990) *The Guardian* August 3 p.21

Hodges, David (1985) Agriculture, Nitrates and Health. *Soil Association* (September), p.16-19

- (no date) The DBCP Horror Story. *The Soil Association Quarterly Review* p.10-11

Jackson, Timothy (1990) *The Guardian* July 6 p.27

Jeffery, Jim (1990) *The Guardian* February 16 p.25

Lewis, Damien (1990) *The Guardian* June 8 p.25

Longworth, Richard (1989) *The Guardian* December 8 p.27

Lutgens, Frederick K. and Edward J. Tarbuck (1979) *The Atmosphere: an introduction to meteorology*. New Jersey: Prentice-Hall Inc.

Manson, Jim (1989) *The Guardian* October 13 p.23

Martin, Hubert and Charles R. Worthing (eds.) (1977) *Pesticide Manual*. 5th edition. Malvern, Worcs.: British Crop Protection Council.

- Ministry of Agriculture, Fisheries and Food (1983) *Food Surveillance Paper Series Number 13: PCBs*. London: HMSO
- (1987) *Food Surveillance Paper Series Number 17: Mercury*. London: HMSO
 - (1989a) *Food Surveillance Paper Series Number 25: Report of the Working Party on Pesticide Residues 1985-1988*. London: HMSO
 - (1989b) *Food Surveillance Paper Series Number 27: Lead*. London: HMSO
- Molion, Luiz Carlos B. (1989) The Amazonian Forests and Climatic Stability. *The Ecologist* 19(6) Nov./Dec., 211-213.
- Moyle, Franny (1989a) *The Guardian* October 20 p.27
- (1989b) *The Guardian* November 10 p.27
- New Internationalist* (1989) No.23: Shopping for the Planet: The Green Consumer p.20-21
- Pearce, David (1989) *The Guardian* December 8 p.25
- Pearce, Fred (1990) *The Guardian* September p.34
- Pilkington, Edward (1990) *The Guardian* March 23 p.27
- Polan, Brenda (1990) *The Guardian* January 26 p.27
- Pryor-Jones, Hugh (1989) *The Guardian* November 10 p.27
- Rand, Marcus (1990) *The Guardian* January 26 p.25
- Rand, Marcus and David Elliott (1990) *The Guardian* June 8 p.27
- Rocha, Jan (1990) *The Guardian* June 8 p.25
- Ross, David (1990) *The Guardian* February 16 p.25
- Routledge, Lewis (1990) *The Guardian* March 16 p.25
- Russell Jones, Robin (1989) Lead and Health ... the Facts. *CLEAR (Newspaper of the Campaign for Lead-Free Air)* No. 13 (May), p.2.
- Seymour, John (1990) *The Guardian* September p.34
- Shankland, Alexander (1990) *The Guardian* January 26 p.27
- Sinclair, Jan (1989) *The Guardian* October 13 p.29
- Snell, Peter (1989) Pesticide Residues: The Scandal Continues. *The Ecologist* 19(3), 94-97.
- The Soil Association (1987) *Standards for Organic Agriculture*. Bristol: The Soil Association.

- (1989) Various information sheets. Bristol: The Soil Association.
- Tisdall, Simon (1989) *The Guardian* December 1 p.27
- Travis, (1989) *The Guardian* December 1 p.27
- Vidal, John (1990a) *The Guardian* January 26 p.25
- (1990b) *The Guardian* February 9 p.25
- (1990c) *The Guardian* February 16 p.27
- Warren, Andrew (1990) *The Guardian* July 6 p.27
- Warrick, Richard and Graham Farmer (1990) The Greenhouse Effect, Climatic Change and Rising Sea Level: Implications For Development. *T.I.B.G. N.S.* 15 (1), 5-20.
- Williams, Nigel (1990a) *The Guardian* February 9 1990 p.23
- (1990b) *The Guardian* May 25 1990 p.25