The
Ecologist

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Man and the environment ▪ The Quality of life ▪ Pollution ▪ Conservation

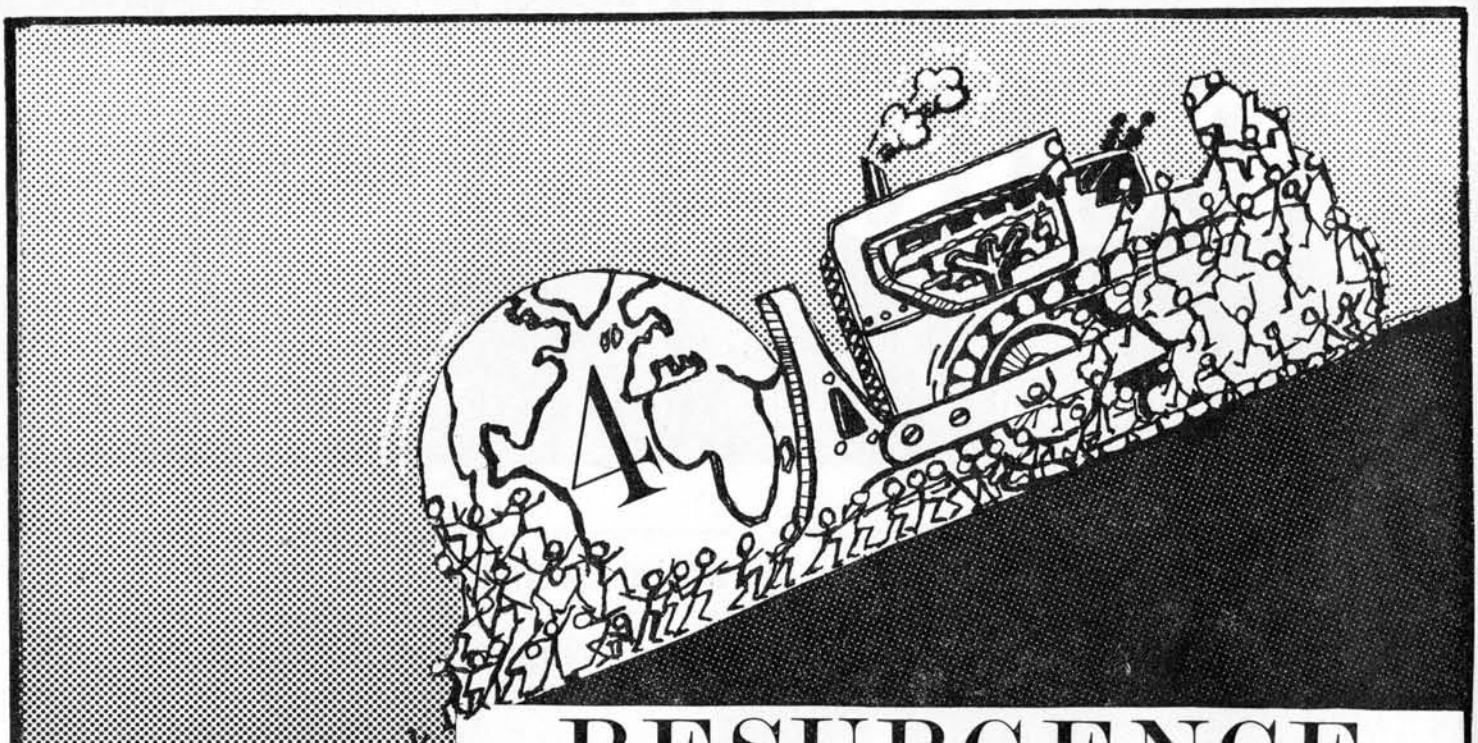
Vol. 2. No. 8 August 1972

Pollution and the individual ▪ Leading question

One-dimensional ecology ▪ York inner ring road

Education and Environment

by Walter P. Fenwick



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The Ecologist

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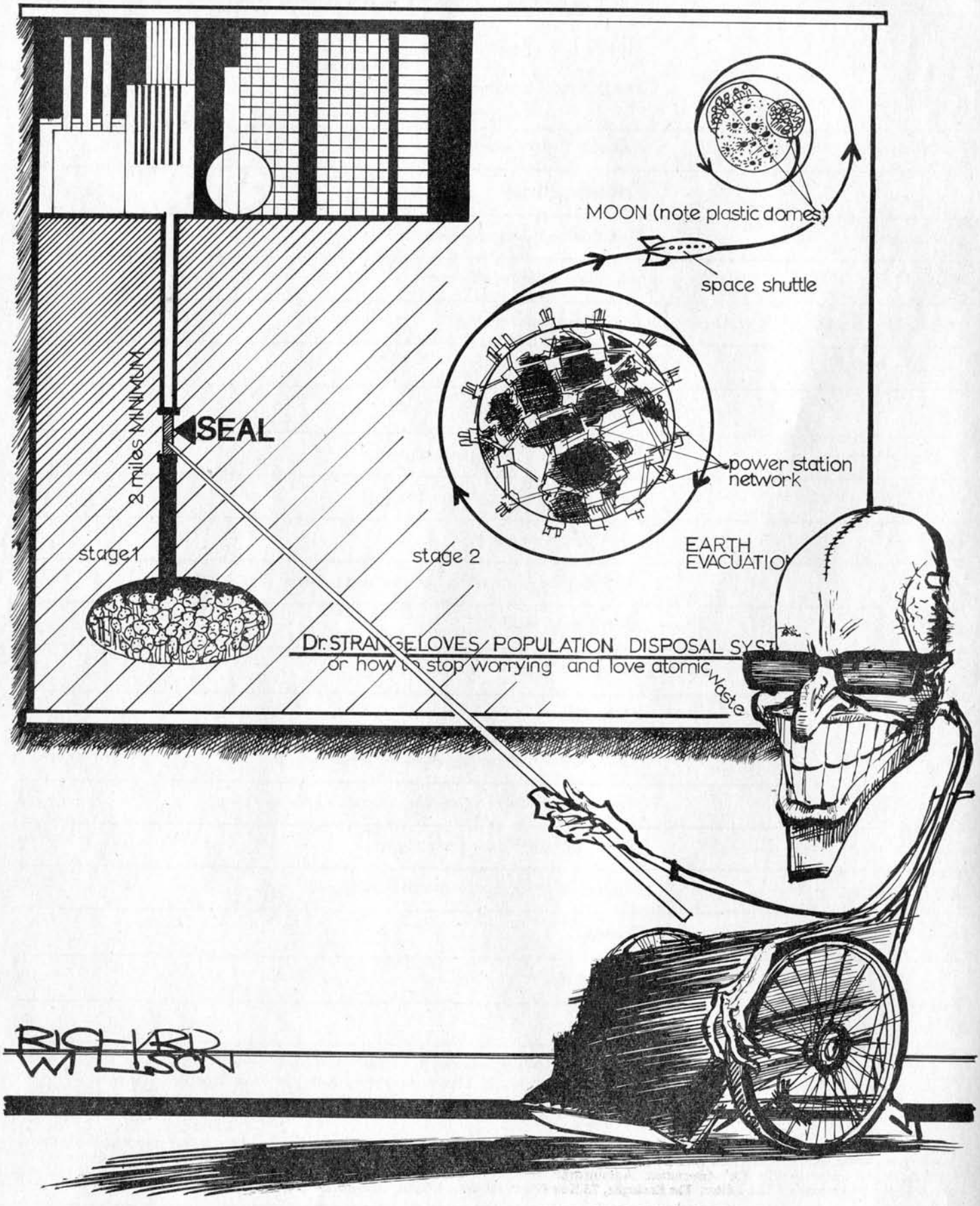


Clearly, gentlemen, the only way to guarantee the perfect functioning of our system is to dispose of people first of all

Editorial

Francis Arnold

Expert pollution

"In the UK", we learn from Sir Eric Ashby's report, *Pollution: Nuisance or Nemesis?**, "Strontium 90 is at the present time stored as a liquid in huge stainless steel tanks at Windscale in Cumberland. They have to be continuously cooled with water, since the heat given off by the radiation would raise the temperature to above boiling point. We shall have to go on cooling these tanks for many years, even if we build no more reactors. In effect, we are consciously and deliberately accumulating a toxic substance on the off-chance that we may be able to get rid of it at a later date."

The US Atomic Energy Commission (AEC) has also begun to wake up to the problems of high waste disposal. Until recently, they have relied solely on tanks similar to those at Windscale. However, in one reported incident, five of 149 containers showed signs of leakage within a few years of filling. The poisons in them have half lives of up to 25,000 years. They will have to be successfully isolated from the rest of the environment for at least 250,000 years, or some 50 times the length of recorded human history.

To solve this problem, the AEC began experimental dumping in deep salt mines. The first of these was recently abandoned in favour of the old above-ground system when it became apparent that leaks were a major risk here, too. European groups have used sea dumping, but there is evidence these containers break open.

Vitrification (conversion to glass-like solid) followed by burial is also under consideration; so far it has not been shown to be safe. In the face of these problems, and the growing public rejection of nuclear power plants all over the US, Dr James Schlesinger, Chairman of the AEC, recently produced a novel suggestion: if the worst comes to the worst, we could always shoot these wastes into the sun.

According to the MIT Study of Critical Environmental Problems, the US will have some 743,000 megawatts installed capacity of nuclear power plants, by the year 2000. These will be producing roughly 3.4 million gallons of high level radio-active, liquid waste, at some 10,000 curies per gallon. This is 34 million pounds, or 17,000 tons every year.

Let's suppose their payload for the journey is 50 tons, which is a bit better than is currently available. We also have to allow for the shielding; can't fry the ground crew. Perhaps only 90 per cent of the payload will be concrete, steel, plastic, and lead. If so, that gives us 5 tons of poison per launch, and 3,400 countdowns per year.

Out of deference to Dr Schlesinger, let's forget about the effects of this number of rockets on the atmosphere, and pretend that resources are no problem. They won't be. How long will it be before one comes down somewhere?

A rocket is a complex gadget. It can go wrong in at least as many ways as it has parts. Some will be trivial, others catastrophic. One major failure in 10,000 flights is at least an order of magnitude better than the records of US or USSR space programmes today. This works out at $10{,}000/3{,}400 = 2.9$ years between failures.

At up to 10,000,000 long-lived curies per mission, that would do some damage to the slogan "Nuclear Power is Clean Power". The actual effects would depend upon the velocity and point of impact, or whether the shield burnt up in the atmosphere. It is clearly impossible to predict these things.

The scenario of the solar trash basket owes less to common sense than to wishful thinking. Or perhaps Dr Schlesinger wishes *us* to think that he has some sensible technique lined up to dispose of the inevitable byproducts of the industry he controls. For without one the entire nuclear programme looks plain silly. It is also possible that Dr Schlesinger simply wasn't thinking, and has since decided that his suggestion was a mistake.

If so, it has added to the endless stream of expert pollution which makes it increasingly difficult to separate the myths from the realities surrounding major policy decisions. No doubt, it will join fusion, farming the (ever more polluted) seas, and photosynthesis in the test tube as "proof" that technology can solve any problem.

British Nuclear Fuels, who are responsible for high level waste disposal in the UK, are operating on the same Micawberish principle. When pressed on the question, they too retreat to "something will turn up". So do the AEA, the Nuclear Power Group, and the CEGB, when they are not claiming that it simply isn't their problem. But it is insane to pretend that nuclear power "works" without a permanent solution to its inevitable byproducts. All these groups have an interest in the pretence that it's all under control.

Before a single additional power plant is built, the public have a right to full and open discussion of all the hazards involved, including those which are hidden by official secrecy, or the shifting of responsibility to the most inaccessible places.

The heads of BNF, the AEA and the CEGB should be questioned immediately, on prime time TV, about their plans for further nuclear development, particularly over high level waste disposal, the safety of breeder reactors, and the dependence on South Africa entailed by going to her for uranium. We must all be on our guard against further examples of expert pollution by those responsible for public welfare and safety.

* *Pollution: Nuisance or Nemesis?*, A report on the control of pollution. HMSO.

Pollution and the Individual

by J. McLoughlin

The discharge of pollutants into the environment affects members of the public in many ways, both individually and collectively. If their interests are to be protected it is important that they be enabled to complain and protest effectively. In order to do that, however, they require full information regarding the pollutant discharged. This information may be denied them owing to an accident of legislation which brings the disclosure of information regarding industrial processes within Section 2 of the Official Secrets Act, 1911. The law must be changed, but at the same time the industrialist must be protected from his competitors.

Every discharge of a polluting substance into the environment affects some members of the public. The catalogue of damage effects is too long to be tested here "in extenso". Pollutants damage our health, rot our curtains, attack the very fabric of our buildings. They reduce crop yield as when ethylene discharged by a chemical works attacks potatoes; they affect the health of livestock as when cattle suffer from fluorosis. They "kill" the waters of rivers that once abounded in fish; they so pollute the waters round our coasts that the Ministry of Health and Social Security currently has 54 "Shellfish Orders" in force, each prohibiting the consumption of shellfish taken from some stretch of coast, or requiring a specified cleansing process before they can be eaten. And finally they so reduce the amenity of town and even country that it becomes almost a luxury to visit a place that is unaffected.

Considering this catalogue of damage it is surprising that so many provisions of our law prevent the authorities from informing the public of what is being discharged from works or premises. Indeed, in many cases it would be a criminal offence for an officer of the authority to do so, even though the discharge itself is criminal.

These provisions, in effect, prevent individuals and the public generally from benefitting from the protection that other rules of law seek to give them. At common law an occupier of premises is entitled to sue in nuisance for any unreasonable interference he suffers from polluting discharges, while a riparian owner can sue for any pollution of the waters that pass his land; but without information about the discharges and the persons responsible, they are both helpless. Both are entitled to complain to the relevant public authorities and ask for protection, but without precise information they cannot follow through their complaints.(1)

The statutory provisions preventing disclosure

One of the most far reaching of these provisions was passed for a purpose completely unconnected with pollution. This is Section 2 of the Official Secrets Act 1911, as amended, which was passed to prevent secrets about armaments and defence being given to an enemy. Indeed, the section appears under a heading "Penalties for Spying", and one would think it would be applied only to that purpose. Such sober and comforting thoughts have more than once been shattered. In 1962, for example, the Act was used to secure the conviction of a member of the Committee of 100 engaged on a political demonstration.(2)

The Section provides:

"Any person having in his possession or control any . . . document or information . . . which has been obtained or to which he has had

access owing to his position as a person who holds or has held office under His Majesty . . . communicates the document or information to any person, other than a person to whom he is authorised to communicate it, or to whom it is in the interest of the State his duty to communicate it . . . shall be guilty of a misdemeanour."

All civil servants, including members of the Alkali Inspectorate, hold office under Her Majesty. If, therefore, I ask an Alkali Inspector for information on the noxious fumes discharged from a factory chimney near to my house, he will commit an offence if he gives it to me without the consent of the owner of the factory. Likewise it can be an offence for a member of a MAFF Fisheries Laboratory to tell me what poisonous chemicals are being dumped at sea, or what is being discharged by a pipeline into coastal waters. The effect of the section has even been extended very recently by the Civil Aviation Act 1, of which s.61 provides:

"For the purposes of Section 2 of the Official Secrets Act 1911 (which among other things relates to the wrongful communication of information) a member and employee of the authority (British Airports Authority) shall be deemed to hold an office under Her Majesty."

The airport employee, therefore, may commit an offence if he gives information on flights, flight paths or noise levels.

All this may have been an unfortunate accident of legislation, but other provisions have been consciously directed to preventing disclosure of information about processes or discharges. The earlier ones were clearly bona fide attempts to protect manufacturers who had been compelled to give information about their processes. The Alkali etc. Works Regulation Act 1906 s.12 provides:

"The owner of any such work shall, on the demand of the chief inspector, furnish him within a reasonable time with a sketch plan, to be kept secret, of those parts of the work in which any process causing the evolution of any noxious or offensive gas . . . is carried on".

Later however provisions became a little more general. The Clean Air Act 1956 s.25 provides:

"If any person discloses any information relating to any manufacturing process or trade secret . . . which has been furnished to or obtained by him under this Act or in the execution thereof, he shall, unless the disclosure is made

(a) With the consent of the person carrying on that undertaking, or

(b) in connection with the execution of the Act, or

(c) for the purpose of any legal proceedings arising out of this Act or of any report of such proceedings, be guilty of an offence."(3)

"Information relating to any manufacturing process" has a wide meaning, and does not necessarily refer to a trade secret. It can include information very relevant to an action at law for nuisance, or to a complaint about unnecessary pollution.

A distinct change came, however, in the legislation relating to river pollution. The Rivers (Prevention of Pollution) Act 1951 contained no restrictions on the giving of information. When the Bill which was to become the Rivers (Prevention of Pollution) Act 1961 was presented to Parliament, that likewise contained no restrictions. During the course of its passage through Parliament, however, industry persuaded the Government to introduce a new clause which, despite protests in the House of Lords on the extent of protection given, became s.12 of the Act. The Section provides:

"If any person discloses any information

(a) which has been furnished to or obtained by him in connection with an application for consent, or the imposition of conditions, under this Act or the principal Act . . . or

(b) which is derived from a sample of effluent taken for the purpose of this Act or the principal Act, he shall be guilty of an offence unless the disclosure is made

(i) with the consent of the person by whom the information was furnished or from whom it was obtained or, in the case of information derived from a sample of effluent, of the person making the discharge in question; or

(ii) in connection with the execution of this Act or the principal Act; or

(iii) for the purposes of any proceedings arising out of this Act or the principal Act."

The offender can be imprisoned for a period of three months. In contrast, no imprisonment can be awarded for a first offence under the Act of actually polluting the river, however dangerous and deliberate the pollution.(4)

This was followed by a similar provision in the Water Resources Act 1963 s.114, while the Nuclear Installations Act 1965 s.25 (5) simply provides:

"Any person who, without the authority of the Minister, discloses any information obtained in the exercise of powers under this Act shall be guilty of an offence."

There is a strong argument in favour of protecting secrets about nuclear processes and techniques but neither the prohibition nor the Minister's discretion is limited to preventing disclosure for those purposes.

In addition to these statutory restrictions or disclosures, it also appears to be the policy of government departments, and in many cases of public authorities which come under their supervision, to treat information about discharges as confidential. Rightly, they hope to gain the confidence and co-operation of industry and feel that if there were a risk of disclosure, industry would not be as frank with them. There is some truth in this, although there is evidence that even so industry is not entirely frank with public authorities.

It is clear that there is here a conflict of interests which must be resolved. A balance must be struck between those on the one hand who are compelled by law to give information to officers of public authorities, and who may thus have their trade secrets revealed to competitors at home or abroad, and the general public on the other hand, who suffer damage to health, property and amenity from the discharges, and who cannot assert their rights at common law or be sure that they are properly protected by the public authorities charged with that duty unless they have information about discharges and those responsible. Both groups of people merit consideration.

The case for non-disclosure

Enthusiasm for environmental protection must not lead us to forget that industry contributes a great deal to our prosperity and welfare. In making this contribution industrialists face keen competition at home and abroad. Any measures which weaken their position could bring repercussions in the form of unemployment for which the public would give no thanks.

Many pollution prevention statutes give powers to officers of public author-

ites to enter premises and demand or otherwise acquire information about processes and discharges. The law requires this for a particular purpose, enforcement of the penal provisions of the Statute. There is an objection in principle to authorities gaining information by legal compulsion for one purpose, then applying it to another. If the information is to be made available to the general public, including individuals who may sue the discharger, then the statute should expressly so provide, in which case different limitations on the powers of the officers, and different safeguards for the industrialists may be warranted.

In deciding whether or not the information should be made available either to the public generally or to particular people, the need to give some protection to those who have been compelled to give information must be balanced against other public and private interests which are in need of protection.

The need to protect trade secrets clearly provides a strong reason for non-disclosure. Other information about processes could also be useful to trade competitiors, and to that extent provides justification for the pre-1961 provisions above.

Information about discharges, however, falls into a different category. As we have seen, the discharges may constitute criminal offences and may do considerable damage to persons and property. The reason normally given for prohibiting disclosure is that information on discharges can confer a useful advantage on trade competitors.

There undoubtedly are some cases in which competitors can gain an advantage from quantitative and qualitative information about effluents. A firm may be engaged in research and development work, in which case a discharge can reveal valuable information. Some firms use catalysts in their production process, in which case these are revealed in an analysis of the discharge. There are even cases where discharges can give significant information to a potential "take-over bidder". But these comprise only a small fraction of the discharges into rivers, and can hardly justify the blanket cover given by Section 12 of the 1961 Act.

The case for disclosure of information on discharges

A more significant result of s.12 is seen when we look at the common law rights of people downstream. Any riparian owner has a right of action if water passing his land is in any way diminished in quantity or quality.(5) Moreover, there is authority for the view that it is no defence to prove that the river was already so polluted by others that the discharge caused no actual damage.(6) Industry is well aware of these rights, and it is hard to escape the inference that it welcomes s.12 as a cover, without which it would be exposed to actions in the civil courts.

In some cases information is given by industrial firms voluntarily, and not under compulsion, as when an application is submitted to a river authority for consent to discharge. Persons owning interests downstream are still not entitled to know any details of the application even though their interests might be seriously affected.

In a comparable situation under the Town and Country Planning Act certain proposals to develop land must be published and people who might be affected are given a right of objection.(7) Both logic and equity demand that the same right should be given in the case of proposed discharges to rivers. As long as s.12 stands this is impossible. Admittedly the River Authority takes riparian interests into account when considering the application. But this is very different from the individual vigorously protecting his own interests, and does not expose the applicant to a searching cross-examination at an enquiry.

If the application is refused, the applicant has a right of appeal to the Minister.(8) There is no right of appeal against the grant of consent by a person affected, nor can there be as long as s.12 remains.

A further objection to the Section is that a person who complains to the river authority about excessive pollution can get no information about the discharge which damages his interests. This means that he cannot pursue his complaint with any particularity, nor can he satisfy himself that it has received proper attention.

This may be so even when the discharge constitutes a criminal offence. Presently a substantial proportion of dischargers into rivers are regularly exceeding their consent conditions, that is to say are regularly committing offences under the Acts. River Authorities do not prosecute if they can secure improvement by other means. This may well be a sensible and practical approach, but it has the unfortunate result that the members of the public who suffer cannot be given information about the offending conduct which damages their interests—unless the person responsible himself consents.

Reform needed

Although information about discharges is often obtained by officers of public authorities exercising powers of compulsion, and although in some cases industrialists need protection for trade and commercial secrets, there is a strong case for permitting disclosure in the majority of cases. The effect of the Official Secrets Acts is in this field an accident of legislation, the other provisions are the results of policy decisions that now merit reconsideration.

The obvious and fair solution is to permit disclosure, subject to an application for non-disclosure. The application could be considered in the first place by the pollution control authority, subject to a right of appeal either to the Minister or to the Courts. With them would lie the task of balancing the conflicting interests involved.

References

(1)—For an explanation of the common law rights of the citizen and of the powers of the various public authorities see *An introduction to the Law Relating to Pollution,* J. McLoughlin, Manchester University Press.

(2)—Chandler v DPP (1962) 3 All ER 142. See also Lewis v Cattle (1938) 2 KB 454.

(3)—The Radioactive Substances Act 1960 s.12 contains a similar provision.

(4)—There is no statutory restriction on giving information on the terms of the consents themselves, but the only persons entitled to that information are persons appearing to the authority to be "interested in the outlet or in the land or premises" to which the consent relates. See Rivers (Prevention of Pollution) Act 1951 s.7 (7).

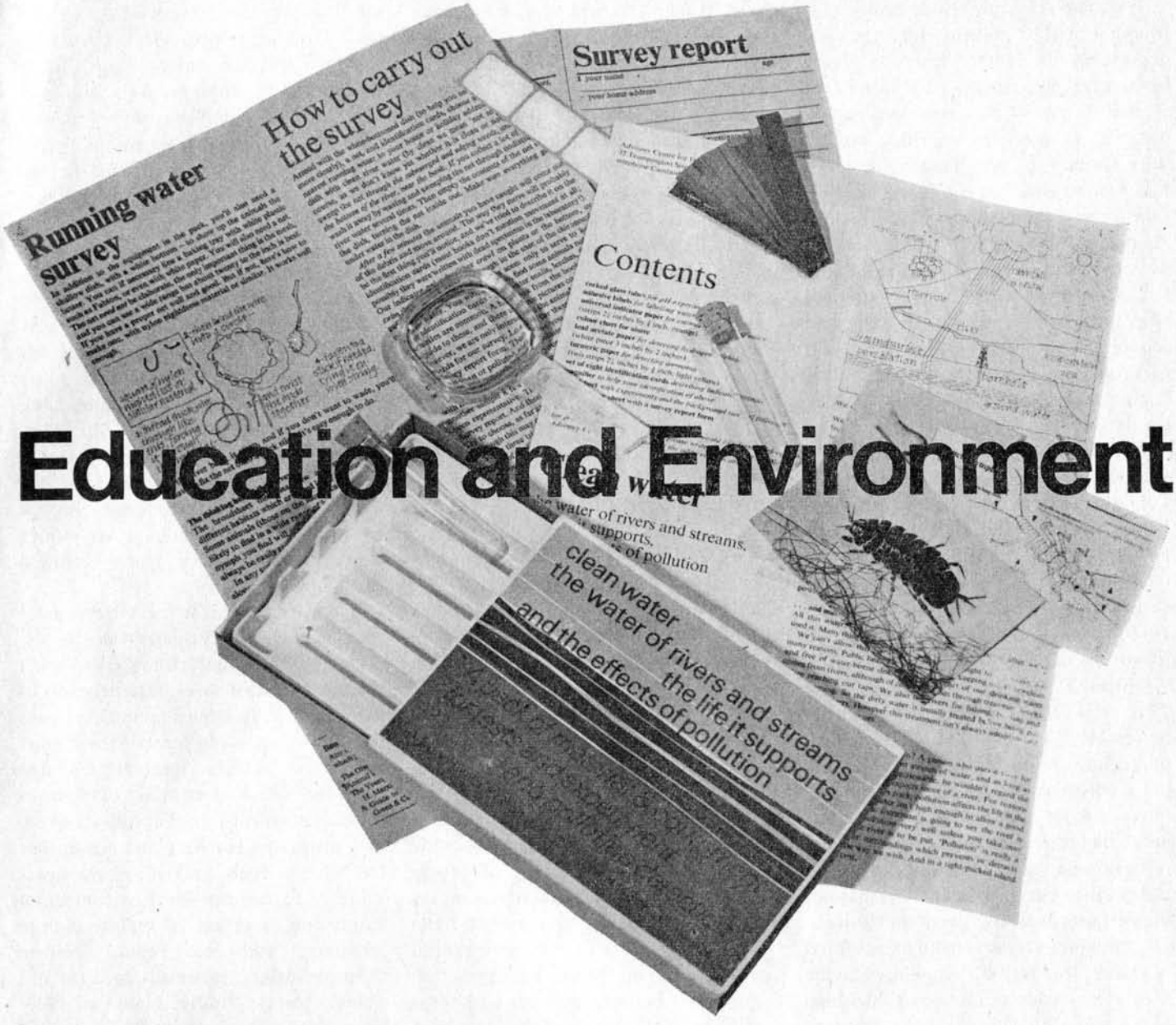
(4)—There is no statutory restriction on giving information on the terms of the consents themselves, but the only persons entitled to that information are persons appearing to the authority to be "interested in the outlet or in the land or premises" to which the consent relates. See Rivers (Prevention of Pollution) Act 1951 s.7 (7).

(5)—John Young v Bankeer Distillery (1893) AC 691 at 698.

(6)—Crossley v Hightower (1866-67) 11 Ch. App. Cas 478 at 481-2.

(7)—Town and Country Planning Act 1971 s.26.

(8)—Rivers (Prevention of Pollution) Act 1961 s.6.



Education and Environment

by Walter P. Fenwick

The need to introduce environmental studies into schools curricula is too obvious to need stating. Yet the story of the attempts that have been, and are being made to do so is a sad one, of the struggle of a small number of enthusiasts in the face of official apathy and parsimony. It is a long story, beginning in the days of "rural studies" and "nature study" and it will have no happy ending until the Department of Education and Science and the Schools Council recognise the need for finance and encouragement.

The story of the efforts to establish Environmental Studies in the English education system is one of the continual struggles of a few enthusiasts in the face of the apathy of the Department of Education and the Schools Council and the intransigence of the subject organizations. The history can be traced back at least to the early years of the century when both "nature study" and "rural studies" were popular, particularly in rural areas and Dr Jan Cerovsky of the IUCN speaking last December in Zurich pointed out the debt we owed to these first environment teachers.

"Sometimes the field now called Environmental Education is presented as something new. I do not agree, for I am thinking about a certain generation of countryside teachers who during the second half of the nineteenth century and at the beginning of the twentieth spread understanding, appreciation of the natural environment and enjoyment among school children of many European countries. They were, in fact, true environmental generalists in their local situations; in this capacity they taught the younger generation wise environmental management."

The School Nature Study Union was founded in 1902 and provided the only expression of these interests (very limited at this time) until after the second world war when local associations of teachers of rural studies were formed in some areas. These too had limited aims but eventually in 1960 they formed the National Rural Studies Association which grew rapidly in the next ten years. Rural Studies gradually tended to move away from its original twin pillars of vocational training and school gardens during this time and eventually in 1971 the national association widened its views to include the whole of environmental education as the National Association for Environmental Education.

The modern movement towards Environmental Studies in schools can be dated from the acceptance of this definition and from the Conference of educationists at Keele University in 1965 when a major weakness that still plagues efforts to establish Environmental Studies became evident. This was the inability of teachers representing various school subjects to appreciate the inter-disciplinary nature of environmental problems and to move from entrenched positions defending their own interests. It is a sad reflection on teacher attitudes that even today the Geographical Association, which has a working party on environmental studies (and which has prepared a paper for formal circulation), the Historical Association which has also given some consideration to environmental studies, the Association for Science Education which has at least one group actively concerned with environmental science and the National Association for Environmental Education who are wholly committed, have never once met to discuss the problems together.

The Keele Conference was hurriedly assembled by the organisers of the "Countryside in 1970" Movement when they realised that many of the problems of the countryside, with which they were specifically concerned, could only be solved in the long run by education. At this conference resolutions were adopted urging the establishment of suitable courses in schools, research into education needs and the provision of increased facilities for teacher training in rural studies. (In fact however a request by the NRSA for a small grant to help the only research project that then developed was refused by every organisation involved.) This research however led to the NRSA accepting a definition of Rural Studies that was distinctly environmental, and from which the Environmental Studies Syllabus now available at CSE and "O" level have developed.

> A study of the countryside, that is—The Landscape—its topography, geology, pedology and climate; The ecological relationship of the plants and animals naturally present; Man's use of the natural environment through agriculture, horticulture, forestry and other forms of land management; The development of an awareness and appreciation of the natural surroundings.

"The countryside in 1970"

The final "Countryside in 1970" Conference in November 1970 was also provided with pious resolutions (often repeating the 1965 resolutions which says something about the lack of progress) in a paper provided by the Nature Conservancy—not by the Department of Education. Once again the government was urged

> "to recognize that Environmental Education should form an essential part of the education of every citizen . . . further investigation is required to define and evaluate the objectives of Environmental Education and thus to determine appropriate content methods and techniques including suitable examinations . . . there is an urgent need for more emphasis on Environmental Education in the training of teachers . . . Local Education Authorities should appoint advisory officers to assist the development of Environmental Education."

There were two results of this conference (i) a realization by some teachers that countryside concerns were only symptoms of the environmental problem—that it went both wider and deeper than the removal of hedgerows or the protection of wild flowers, and (ii) the setting up of the Council for Environmental Education under the Chairmanship of Jack Longland on which all the educational associations concerned have representation.

Unfortunately, but typically, the Department of Education found themselves unable to supply any money at all and was only last year that an absolutely minimal grant was provided for this major national forum for education about the environment! (It is interesting to compare this situation with the half a million pounds a year granted to Sports Organizations by the DES.) The result has been that the Council has become a talking shop for vested interests rather than a driving force for inter-disciplinary development. Some good has come of the devoted efforts of its activists which include Mr G. V. Cooke, County Education Officer of Lindsey and Mr C. W. Mellowes, retired County Education Officer of Northumberland, a pioneer in Environmental Education. Their enthusiasm and often personal expenditure ensures that at least the representatives of the various subject organizations do meet and are slowly beginning to lose their mutual suspicions.

Even within the Environmental Studies camp (as distinct from the larger Environmental Education area) there are at least three organizations at work, mutually inclusive and not even on regular speaking terms—the largest body the NAEE, recently renamed from the NRSA, now aware of environmental problems in the widest sense, and attracting teachers and educationists at all levels and of many disciplines; the Society for Environmental Education, a group of mainly college lecturers; and the School Nature Science Society, renamed from the old School Nature Studies Union of 1902. The NAEE has repeatedly failed to bring the three together. This fragmentation weakens their case greatly and adds financial burdens to each of them.

The danger of this situation is that while those few educationists actively involved in serious curriculum development in environmental studies are moving rapidly towards clearly defined objectives and valid content, most of the education world is confused by the variety and weakness of the propagatory organizations and is not yet awake to needs that were defined as urgent in 1965.

CSE, O and A levels

The position of CSE examination syllabuses provides an example of this situation. The CSE examinations reflect the needs of "average" pupils at 16. They are teacher controlled, although too few teachers take advantage of the opportunities offered to construct and

assess their own courses. Only one of the fourteen boards (East Anglian) has an Environmental Studies panel and an open examination available. Another (Metropolitan) has a large group of 38 schools working together on a syllabus of Environmental Science under the Science panel. None of the other twelve have as yet any similar organizations. The new East Anglian examination will be controlled directly by teachers of Environmental Studies, regardless of their traditional discipline backgrounds.

Strangely enough it proved easier to convince some independent "O" level boards of the need for syllabuses and a number were constructed fairly quickly. One of these (Associated Examining Board) is designed as a two year sixth form course and takes Environmental Studies a step further than most towards a concern with the social environment as well as with the biological and physical environments. The examinations are controlled by committees representing all the disciplines that are represented in Environmental Studies.

In 1970 a group of teachers in Hertfordshire, representing a wide range of subjects, came together to construct an "A" level syllabus for the abler sixth formers. Their work followed on a series of efforts by individual teachers over five years that failed to gain acceptance. This time their local authority came to their aid and began by calling a conference of university representatives who set them out on a curriculum development project, the results of which have been published by the prestigious National Foundation for Educational Research. The syllabus has now been accepted by the London University Board who set up an Environmental Studies "A" level Committee and in May 1972 will be submitted to the final arbiter, the Schools Council. That body however is still organized in separate subject committees and although the Council for Environment Education and others have urged the point, so far no separate Environmental Studies Committee exists, so that there are fears that academic prejudices may still hold up its development. A separate "A" level effort has been made by the NAEE local association in Wiltshire, and it is hoped that other Boards will take this up or prepare their own syllabuses soon.

All these syllabuses at "O" or "A" level followed a similar course based on the planetry model with local and immediate examples and fieldwork. They cover the processes and systems of the natural environment and the limits of the resources base; the ecosystem; the interaction of Man and the environment including population pressures, environmental problems and planning, pollution and conservation. All over the country groups of Heads and teachers have been meeting during the last two years to discuss what steps they might take—such conferences, followed by working parties, have been held in Lincolnshire, Durham, Dorset, Devon, as well as Hertfordshire and Wiltshire. The large urban authorities have been strangely inactive however.

A small group of HMIs have struggled to help. They have travelled endless miles on endless weekends to give encouragement and advice. But they can produce no money, no hope of the necessary resources or facilities or teacher-training courses that are urgently needed. Their voices seem to be ignored in the decision-making levels of the Department of Education and Science.

For example the teachers in the NAEE together with the college lecturers concerned have actually financed from their own pockets a leaflet on teacher opportunities in this field, circulated it to every Careers Officer in the country and sent a thousand copies out in response to enquiries. They were refused a grant from the DES for this. Nothing like this has ever happened in any other area of education. However, Main courses in some forty colleges of education do exist, divided into some colleges teaching "rural studies" and others teaching "environmental studies" which sometimes appears to be little more than an Amalgam of history and geography. B.Ed. degrees are now obtainable.

New courses being formed

A major step was taken recently when the NAEE persuaded a range of interested bodies to set up a Joint Working Party and produce an agreed document outlining the types of courses needed in schools and the teacher training this involved. It is typical of the situation that no money was available and only by the help of the Bedfordshire Education Authority was the work carried out and a report published.

Other Authorities that have given a lead in this field are Wiltshire and Hertfordshire, whose teachers have produced syllabuses and curriculum development plans, and Northumberland, where field study centres have existed for many years.

Courses in Environmental Science and Environmental Studies at university and polytechnic level are slowly growing. There are different points of view about their value. How much specialization is needed at this level before integration becomes worth while? Nevertheless the door has been opened and new courses are being formed. The newly-formed Institution

of Environmental Science will no doubt help to further this development.

Throughout Europe, the USSR and North America, Environmental Education is a growing movement, but the ease and skill with which new material may be introduced to the educational system varies very much in different countries. In the USA—whatever may be felt about their possible over-reaction—the President has provided 40 million dollars in his budget for the development of Environmental Education. In countries such as Sweden with a centralized secondary school curriculum it was possible for the content required to be prepared and tested before being "written in" for widespread use in a matter of three years.

The International Union for the Conservation of Nature and Natural Resources held a working conference on Environmental Education in Zurich in December 1971 at which 21 countries from both east and west were represented. In almost every case, except the UK., representatives included senior Inspectors from their Ministries of Education. Britain was represented by Dr Tom Pritchard of the Nature Conservancy and a number of supporters from various organizations including the NAEE. There was remarkable agreement on what sort of objectives should be aimed at in the various levels of education and an outline syllabus for secondary schools was adopted. This compared closely with the syllabuses already in use in Britain but extended their content into economic, social, political and ethical considerations.

Need for impetus from the top

So the framework has been set up by the enthusiastic few. What is needed now is a major impetus from the top. If anything like the same support could be given to establishing Environmental Studies as has been given in the past to such matters as, say, the concern to introduce Technical Drawing in the 60s, a revolution could occur before impetus was lost.

The Schools Council has in fact set up two projects in Environmental Education. However these have been very minor concerns. One, dealing with learning from the environment, was based in Wales and had a very local and rural interest, the other, still in being, has been set in Newcastle-upon-Tyne but provided with such limited funds (£4,000 over three years) that its two members are very much constrained in what they can do from such a remote centre. As a comparison some of the science projects have received sums like £200,000. It is unlikely that this project can do more than support the developments now going on. By comparison the Humanities Project based at Leicester has been supplied with five or six times as much money and a large staff and has been able to make a tremendous impact on schools throughout the country. In introducing any new course to the education system it is important that, in addition to contributing its own content and information it also develops its own educational methodology. For example the humanities course relies on open-ended non-authoritative discussion of relative modern topics and while this aroused natural fears in some teachers at the outset it has had measurable success in devloping pupils' judgement and tolerance, as well as their powers of expression and their understanding of complex human situations.

Environmental Studies too, has over the years developed its unique educational methods. These rely largely on providing the pupils with first-hand experience through fieldwork in whatever environment they are studying and allowing them to make their own investigations of open-ended situations. In the "A" level syllabus for example one quarter of the time is devoted to field studies of a situation involving the environmental impact of some industrial undertaking.

In Environmental Studies the teacher is urged to work with his pupils as their guide and mentor rather than to direct their efforts from above. Such an attitude is of course now more widespread but was certainly pioneered by environmentalists and is still regarded by them as fundamental to their area of teaching. Furthermore they would feel that an essential part of the Environmental Studies attitude is to see the inter-relationships within any situation and between physical, biological, social and other considerations as they may exist rather than to look for examples of any theory or explanation within a particular discipline.

In his speech to the British Association of September 1969, Mr S. T. Broad, County Education Officer of Hertfordshire and now President of the Association of Education Officers said,

"The concept of the conservation of nature and natural resources should merit recognition in a permanent rôle as a co-ordinator of the curriculum in our schools. I believe that this should no longer be disputed and that the value of such basic education in achieving an integration of subjects in bringing some kind of unity to the learning process in the minds of the learners is a justification in itself. Moreover, for teachers to defer for much longer the acceptance and implementation of environmental studies as a basic requirement for all pupils could be tantamount to committing suicide, because the loss of the natural environment of this world for the generations to come is unlikely to be replaced by acceptable environments on the moon or on Mars.

"The Schools Council, which might be expected to have seriously considered a matter which is of such importance, is of course itself subject-based and there is no Standing Committee for Environmental Studies. Pressure was exerted many years ago to establish some kind of enquiry and a working party was eventually set up . . . and I am hoping that . . . the appropriate committee of the Schools Council will, . . . have set in motion a project for a full investigation based upon a university and adequately financed. For until this is done the Examining Boards, always inevitably far behind in meeting the needs of educational development, will continue to look askance at proposals to examine in a field which has, as yet, no adequate validity in their eyes, and they will look even more askance at suggestions of examining by course assessment rather than by traditional means which would certainly take off examination pressures without lowering standards."

How long before the Department of Education and the Schools Council realize their responsibility for encouraging and financing urgently needed environmental education research and curriculum development? Even in the decentralised English education system we have seen how central support can stimulate urgently needed innovations. Surely the efforts of those teachers who have proved themselves aware deserves recognition and the urgency of the problem deserves immediate attention.

One-Dimensional Ecology

by Paul R. Ehrlich and John P. Holdren

"Whatever his personal aims, values, and prejudices, when a scientist speaks and publishes openly—presenting facts, interpretations, and conclusions—he has done service to the truth. For science gets at the truth not so much by avoiding mistakes or personal bias as by displaying them in public—where they can be corrected."
Barry Commoner, *The Closing Circle*, p. 87

In his recent book, *The Closing Circle* (Cape, 1971), Barry Commoner presents his views of the origins of man's environmental predicament. Commoner has gained great prominence as a spokesman on the environment and has made extensive contributions to debates on the issues ranging from the dangers of atomic fallout to the ecological consequences of man's intervention in the nitrogen cycle. His book contains much interesting material on the misuse of technology by industrialised societies, and it is written in a powerful and appealing style. Certainly he summarises the dilemma beautifully when he states (p. 122): "We come, then, to a fundamental paradox of man's life on the earth: that human civilisation involves a series of cyclically interdependent processes, most of which have a built-in tendency to grow, except one—the natural, irreplaceable, absolutely essential resources represented by the earth's minerals and the ecosphere." Nor will many students of these problems deny that "The lesson of the environmental crisis is ... . If we are to survive, ecological considerations must guide economic ones". (p. 292)

It is especially unfortunate then, that so prominent and articulate an advocate for the environment should have written a book as inexplicably inconsistent and dangerously misleading as *The Closing Circle* proves to be. The book's principal defects are three. First, Commoner implicitly assumes that environmental deterioration consists only of pollution; this oversimplification leads him to discuss the environmental crisis as if it had begun in the 1940s. Second, in his zeal to place the blame for pollution on faulty technology alone, he resorts to biased selection of data, unconventional definitions, numerical sleight of hand, and bad ecology; only thus can he explain away the contributions of population growth and increased affluence. Finally, his misconceptions concerning certain aspects of demography lead him to draw erroneous

conclusions about the "self-regulation" of human poulations and viable strategies for population limitation. Because of the importance of these issues —and especially the possibility that uncritical acceptance of Commoner's assertions will lead to public complacency concerning both population and affluence in the United States—we have documented the errors in *The Closing Circle* at some length in the three sections that follow.

Environmental Deterioration and "Pollution"

Commoner writes (p. 126) "So long as human beings held their place in the terrestrial ecosystem—consuming food produced by the soil and oxygen released by plants, returning organic wastes to the soil and carbon dioxide to the plants—they could do no serious ecological harm". Yet only a few lines later he cites erosion, deforestation, and destruction of fisheries as serious ecological problems, apparently unaware that he is contradicting himself. Far from starting in the 1940s, as Commoner implies, serious ecological harm has accompanied man's activities ever since the agricultural revolution some 10,000 years ago. In fact, it may date from even earlier; in the period of intensive hunting and food gathering preceding the advent of agriculture, men may have contributed to a dramatic reduction in the number of species of large mammals inhabiting the earth.[1]

Whatever doubt there may be about the impact of human activities prior to farming, man's ecological transformation of the planet since that time has long been recognised.[2] The earth has been badly scarred by the results of ecocatastrophes which predated by centuries the faulty technologies that have attracted Commoner's attention. Perhaps the most frequently cited is the conversion to desert, or desertification, of the lush Tigris and Euphrates Valleys, a process that started more than two millenia before Christ and was completed before Columbus sailed.[3] The destruction of that rich, ancient granary was a direct result of problems with irrigation, a difficult and ecologically risky operation even under the best of conditions. Often irrigation involves a constant battle against silting and salinisation (the accumulation of salts in the soil as water evaporates—a problem not present when the water is "distilled" as it is in normal rainfall). The battle was lost in Mesopotamia, and silting and salinisation are growing problems today as population growth forces mankind to bring more and more land under irrigation.[4] These difficulties are not confined to underdeveloped countries, as abandonment of large salinised areas in California's rich Imperial Valley clearly shows.

Another major aspect of environmental deterioration long recognised by ecologists is the desertification of the vast areas of the world through overgrazing, and, in some cases, faulty agricultural practices.[5] The Sahara still marches southward at a rate of a mile or more a year, thanks in part to pastoral peoples exceeding the carrying capacity of the range and to inadequate soil husbandry by farmers. Much of Europe, Asia and Africa have been deforested, overgrazed and overfarmed, and subject to heavy soil erosion as a result of the activities of preindustrial men.[6] Even in North America the environment has been degraded through the activities of pastoral peoples. Carl Sauer wrote[7]: "The present desolate shifting-sand area that lies between the Hopi villages and the Colorado River was such good pasture land late in the eighteenth century that Father Escalante, returning from his Canyon exploration, rested his travel-worn animals there to regain flesh. The effects of Navaho shepherding in little more than a century and mainly in the last sixty years are well documented."

The destruction of the environment by preindustrial man is not limited to relatively arid regions. In tropical forest areas a shifting "slash-and-burn" or "milpa" agriculture is widely practiced. The success of this system is utterly dependent on restricting the size of the clearing and allowing a sufficient recovery period before an area is cut over again and planted.[8] The relationship between population growth and environmental deterioration here is direct; increased population density produces extreme stress in a milpa agricultural system. When fields are made too large or farmed too frequently the soil becomes depleted and is eroded away. Yields per unit area drop, forcing even more frequent and extensive clearing in a vicious cycle. Such a trend is suspected as being at least in part responsible for the collapse of the classic Maya civilisation[9] as population densities increased around growing urban centres. A trip to many tropical forest areas in the world today will reveal to the most casual observer the extent of destruction wrought by milpa agriculture and wood-cutting in areas where the population density has exceeded the carrying capacity of the land. Furthermore, those who predict the facile transplantation of "modern" agricultural technologies to wet lowland tropics are simply displaying profound ignorance of tropical ecology.[10] Indeed, the very ecological imperatives that Commoner so often invokes indicate that achieving population control as rapidly as possible is a necessary prerequisite for avoiding an irreversible lowering of the human carrying capacity of the tropics.

Commoner's preoccupation with pollution almost to the exclusion of other forms of environmental deterioration leads him to give but scant attention to the general problem of ecosystem simplification. While clearly recognising that the integrity of the ecosystems of the planet must be preserved, he does not seem aware that the reduction of the diversity of life and thus of the complexity of those systems may pose the most lethal threat of all.

It is the complexity of the natural ecosystems that is primarily responsible for their stability.[11] Ecosystems are simplified by the extinction of populations and, more irreversibly, by the extinction of species. The very practice of agriculture on a large scale, with its substitution of monocultures (stands of single crops) for natural communities rich in species, is a potent force towards the destabilisation of the global ecosystem. Because of its dependence on faulty technologies (such as the ritualised application of persistent biocides), modern agriculture has become an even more powerful simplifying force.[12] Although this point supports Commoner's argument, he largely neglects it.

Of course, man paid the price of the creation of large unstable monocultures long before the first DDT molecule was manufactured. The Irish potato famine is the best known example of an ecocatastrophe entirely traceable to ecosystem simplification (and with no "faulty technology" component à la Commoner). When the potato monoculture in Ireland collapsed under the onslaught of the fungus *Phytophthora infestans*, "in four years 1,500,000 people had died, over one sixth of the population. A million had emigrated, and millions more were to emigrate over the coming decades until Ireland's population was cut in half. The Irish countryside was never the same again; the old customs and pleasures that had lightened the traditional poverty of the Irish peasant withered away."[13]

Clearly, the Irish did serious harm to their environment even though they were living within the rules set down by Commoner (quoted at the beginning of this section).

Curiously, one of the most serious aspects of environmental deterioration is a "faulty technology" that has nothing to do with pollution. The continuance of high-yield agriculture is dependent on man's ability to select strains of plants that not only produce the desired yields but are resistant to the attacks of their enemies. That is, it depends on a genetic technology. There is no such thing as a strain that is permanently resistant to a pest or disease, because the plants and the organisms that attack them make up coevolving systems.[14] Unless the plant breeder has available to him the requisite genetic variability to use in producing new resistant strains when the biochemical or mechanical defences of the old strains are breached (as they inevitably are), the whole basis of modern agriculture could be destroyed.

It is ironic that the very success of programmes to develop extremely productive crops to feed mankind's burgeoning numbers is now threatening the diversity in the gene pools of some of the most nutritionally important plants. "Miracle" crops are now rapidly replacing large numbers of traditional strains as the high yield varieties are eagerly adopted by farmers. The genetic treasurehouse is being rapidly depleted, and not nearly enough is being done to arrest the process.

To the extent that success in plant breeding leads to loss of variability, the genetic technology can be described as "faulty".[15] This leads to the ultimate in ecosystem simplification; not only does greater uniformity increase the vulnerability of crop monocultures to widespread disaster, it also reduces the chances of recovering from disaster.

The foregoing are by no means all of the serious forms of environmental disruptions having their origins long before World War II. Another is the injection of dust and smoke into the atmosphere in connection with agricultural burning and the removal of protective plant cover by cultivation or overgrazing. The latter aspects of the problem are especially severe when food producing activities are extended to marginal land, as population pressure makes inevitable. Agricultural hazes are already an important climatic perturbation in parts of Africa and Asia,[16] and man's contribution to the global atmospheric dust burden is rising steadily. Measurable effects on global climate are thought to be possible within 30 years if this long-established trend continues.[17] A major reason for concern here is that global agriculture is dependent on crops highly adapted to present climatic conditions. Because global climate is determined by a balance of many opposing factors, it is possible that a destabilising input by man at some leverage point in this rather poorly understood system could cause a sudden change rather than a gradual one—with disastrous consequences for food productivity. Carbon dioxide from the combustion of fossil fuels and heat dissipated when man uses energy of any kind are also potential influences on climate on a large scale.[18]

Another serious form of environmental impact with a long history is the disruption of salt marshes and estuaries that serve as "nurseries" for much of the life in the sea. Salt marshes are continually being lost to landfill operations; the salinity and temperature of estuaries are affected by irrigation projects upstream.[19] Most of the productivity of the sea occurs on the continental shelves or in areas of upwelling relatively near the shore.[20] The long standing threats to the estuaries and salt marshes sheltering many of the creatures at the base of these food chains, combined with the more frequent hazards of industrial and agricultural pollutants and overfishing, jeopardise one of mankind's principal sources of protein.

Obviously there is no basis whatever on which to conclude, as Commoner does, that man was only an innocuous environmental force prior to 1940. The sorts of human activity being carried on even then were steadily and probably irreversibly eroding the capacity of the planet to support human life. That the world now supports a considerably larger population than it did in 1940 is hardly proof that the environmental impact of this population, or even the 1940 population, could long be sustained. As zoologists know well, animal populations often considerably overshoot the carrying capacity of their environment—a phenomenon invariably followed by a population crash.

Environmental deterioration since World War II

Having assumed that man's adverse impact on his environment was negligible before 1940, Commoner then alleges that "pollution levels" increased by an explosive 200 to 2000 per cent between 1946 and 1968, and that neither population growth nor rising affluence had much to do with it. His argumentation purporting to prove this hypothesis is a house of cards supported by the flimsiest of props: the misleading use of percentages, data and definitions tailored to fit the foregone conclusion, and stubborn refusal to confront the mechanisms by which population growth can cause disproportionate increases in environmental impact.

Consider first the matter of percentages. Commoner admits that the factors contributing to environmental impact

are multiplicative rather than additive, offering (in a footnote to pp. 211-212) the equation pollution = (population · (production/capita) · (pollution emission/production).

Here the second factor on the right, production per capita, is in some sense a measure of affluence, and the last factor, pollution per unit of production, is a measure of the relative environmental impact of the technology that provides the affluence. For compactness, let us rewrite this equation:

$$I = P \cdot A \cdot T \qquad \text{Equation (1)}$$

where I is for impact (a better word than "pollution" for reasons already explained), P is for population, A for affluence, and T for technology. Let us also assume for a moment that the variables P, A and T are independent, i.e., that a change in P does not cause changes in A or T, and vice versa. We shall later find that this is not true, but it is the simplest assumption and the one most favourable to Commoner's hypothesis.

Within this framework, an objective discussion of the relative importance of the three factors on the right of Equation (1) would attempt to assign numerical values to all of them, rendering the comparison self-evident. Commoner does not do this. Concentrating on the period from 1946-68, he cites increases of 200 per cent or more in various pollutants (claimed to be indicators of the impact, I), and he notes that population in this period grew "only" 42 per cent. Thus the reader inexperienced in such calculations is left with the impression (40%/200% = 1/5) so affluence and technology must have accounted for the other four-fifths. But this is not so, because the causative factors are multiplicative.

To make this phenomenon perfectly clear we rewrite Equation (1) in the form $I + \triangle I = (P + \triangle P) \cdot (A + \triangle A) \cdot (T + \triangle T)$, where $\triangle P$, A and T are the changes in the population, affluence and technology factors over a specified period of time, I is the corresponding increase in the kind of impact being examined, and P, A, T, and I are the initial values of these factors. Obviously, the actual magnitude of the environmental deterioration engendered by an adverse change in technology depends strongly both on the initial levels of population and affluence and on such changes in these levels as may occur simultaneously with the change in technology. A corollary is that population and affluence would be important factors in environmental degradation even if they were not growing. A change for the worse in the technology of production is more serious environmentally if it occurs in a populous, affluent society than if it occurs in small, poor ones.

In reality, of course, population and affluence in the US have both grown. To examine more closely how Commoner's use of percentages has obscured the importance of the growth of these factors, we rewrite the impact equation to express all quantities as multiples of their initial values.[21]:

$$1 + \frac{\triangle I}{I} = \left(1 + \frac{\triangle P}{P}\right) \cdot \left(1 + \frac{\triangle A}{A}\right) \cdot \left(1 + \frac{\triangle T}{T}\right) \qquad \text{(Equation 3)}$$

Then $(\triangle I/I)$ times 100 is the percentage increase in environmental impact, $(\triangle P/P)$ times 100 is the percentage change in population, and so on. (Note that an increase of 100 per cent means a doubling of the initial quantity, an increase of 200 per cent a tripling, etc.) Now let us put some typical numbers into the equation and see what happens. Population increased 42 per cent between 1946 and 1968[22] so $P/P = .42$ and the population factor in Equation (3) is 1.42. Let us assume that the affluence factor in this hypothetical example—say, per capita consumption of a commodity whose production entails significant environmental impact—has increased at the same rate as GNP per capita, or 59 per cent between 1946 and 1968, corrected for inflation.[23] Then $\triangle A/A = .59$, and the affluence factor in Equation (3) becomes 1.59. Suppose, finally, that a change in technology has led to a 33 per cent increase in environmental impact per unit of production, i.e., $\triangle T/T = .33$, so the technology factor in Equation (3) is 1.33. Then the equation gives $1 + \frac{\triangle I}{I} + 1.42 \times 1.59 \times .33 = 3.00$, or a 200 per cent increase in environmental impact. In this hypothetical example, none of the causative factors is unimportant, and no single one accounts for a large fraction of the increase. It is the multiplicative effect of the three moderate increases occurring simultaneously that yields a dramatic increase in the total.

Yet, of the four relevant figures, Commoner invariably presents only two: the total increase in some index of impact and the increase in population. If he were reporting the example just given, he could cite 200 per cent and 42 per cent as the relevant numbers, leading the casual reader to believe that population was a minor factor. Nor is the deception less when the role of factors other than population is larger. Consider a case where total impact of some kind can be shown to have increased 400 per cent while population increased 42 per cent. Are the other factors then ten times as important as population, as Commoner repeatedly asserts? Hardly. The simple algebra of Equation (3) shows that an actual increase of 400 per cent would have been only 252 per cent (more than one third smaller) if population had stayed constant: the product of the technology and affluence factors is 3.52:

$$\frac{\triangle I}{I} = 4.00; \quad 1 + \frac{\triangle I}{I} = 5.00 = 1.42 \times 3.52$$

If, in this hypothetical example, we again assume that the affluence factor increased in proportion to GNP per capita, we would find that the combination of the population and affluence factors was of equal importance to the technology factor:

$$I + \frac{\triangle I}{I} = 5.00 \qquad \underbrace{1.42 \times 1.59}_{2.26} \times 2.22 \qquad \begin{matrix} P & A & T \end{matrix}$$

These somewhat tedious arguments have been based on nothing but elementary algebra and arithmetic; we have as yet invoked no cause-and-effect relationships between population size and the nature of the technology needed to support it, nor questioned the validity of the indices Commoner chooses to describe "pollution". Examination of the basic mathematics alone, irrespective of the definitions and analysis between the numbers Commoner presents, shows that the relationships are not what he claims.

Next to the misleading use of percentages, one of the cornerstones of Commoner's argument is his dismissal of the role of affluence. Like most students of these problems, he is not happy with the strict use of GNP per capita as a measure of affluence. In one sense GNP includes too much (e.g., the costs of war and crime), in another sense too little (e.g., it omits part of the "cost" of our decaying cities, a cost paid not in dollars but in misery by those who must live and work in them).[24] Unfortunately, Commoner's

indicators of affluence are, if anything, more superficial than GNP.

First, he confines his attention almost entirely to production of goods (thereby omitting services, many of which are surely part of affluence and almost all of which generate environmental impact through the use of energy). He does mention a dramatic increase in passenger miles of automobile travel per person and on p. 176 ascribes it to affluence. With this exception, Commoner apparently would have us believe that affluence in the US has not risen since 1946. He supports this view by dividing affluence into "necessities" (food, shelter, clothing) and "amenities" (everything else). He notes that per capita availability of calories fell 4 per cent between 1946 and 1968, grams of protein per capita fell by a smaller amount, pounds of fibre per person—representing clothing—rose 9 per cent (figures for 1950-1968 only), and housing units per capita rose 10 per cent.[25]

Having thus "proven" that affluence as measured by necessities has not changed much in the post-war period, Commoner deals with amenities mainly by ignoring them. He concedes that "If affluence is measured in terms of certain household amenities, such as television sets, radios, and electric can-openers and corn-poppers, and in leisure items such as snowmobiles and boats, then there have been certain striking increases, but", he adds, "again, these items are simply too small a part of the nation's over-all production to account for the observed increase in pollution level" (p. 139). This is precisely the reductionist pitfall that Commoner solemnly deplores several times in his book, but that he cannot himself avoid. No single factor can explain all of the increase of all of the indicators of environmental impact, but the rising per capita availability of amenities plays an important (and multiplicative!) role in explaining part of the increase in some of them.

Commoner's general conclusions later in the book are clearly based on a redefinition of affluence that excludes amenities altogether (see, e.g. page 176). Yet, curiously, he does not mind fattening his list of dramatically increasing kinds of production (p. 143) with items that are obviously affluence-related amenities (air conditioner compressor units up 2,850 per cent between 1946 and 1968; electric housewares, up 1040 per cent). Apparently, Commoner thinks he can offer affluence of some kinds as a symptom without admitting affluence of any kind as a cause. He cannot have it both ways.[26]

Even if one accepts Commoner's narrow view of affluence, however, his conclusions do not follow. The statistics he has used for clothing and housing per capita are utterly inappropriate to an assessment of changing affluence. Specifically, his figures for housing units per capita are taken directly from statistics kept by the US Department of Commerce,[27] which uses the following definition: "A 'household' comprises all persons who occupy a 'housing unit', that is, a house, an apartment or other group of rooms, or a room that constitutes 'separate living quarters'." Obviously, the most important aspects of affluence in housing—namely, the type of housing people have and its quality—are not reflected in the statistic quoted by Commoner at all. By his measure, a country whose population all resided in one-room flats would be judged as affluent as one where each family lived in an eight-room ranch house—as long as the number of people per "household" were the same in each country. In the post-war United States, growing affluence manifested itself as a steady increase in expenditures per capita on housing—from $149 per person in 1946 to $235 in 1960[28]—and in the fraction of the population dwelling in houses as opposed to apartments (most new dwelling units built since the war have been single-family houses[29]). This affluence in housing, in turn, was translated into environmental impact in the form of increased resource consumption (wood, metals, plastics), the overrunning of fertile farmlands by sprawling suburbs, and the increasing use of automobiles attendant upon spreading out the population.

A somewhat different set of defects underlies Commoner's discussion of clothing per capita. He has used the statistics for pounds of fibre produced per capita as a measure of supplies of clothing, in the face of three good reasons not to do so: first, a great deal of fibre is used for non-clothing purposes such as carpeting, furniture and tyre-cord. Second, statistics for the production of clothing itself are readily at hand in the same source.[30] Third, the US is increasingly a net importer of raw textiles and clothing (admitted by Commoner in a footnote to p. 138), so consumption considerably exceeds production. According to the actual figures, just the production of apparel per capita increased 23.5 per cent between 1950 and 1968, versus the 9 per cent claimed by Commoner. Imports of clothing per capita jumped 2.5-fold between 1960 and 1968 alone.[31]

Evidently, Commoner has appreciably understated the growth of "affluence" in post-war America, even within the confines of his unconventional definition of the term. But if one includes in the accounting the amenities that most Americans surely regard as part of their affluence, the magnitude of Commoner's underestimate grows even larger. In Table 1 we present the figures for a few of these items. The reader may now judge for himself whether Commoner is misleading his public when he writes, on p. 177, "The economy has grown enough to give the United States population about the same amount of basic goods, per capita, as it did in 1946".

Commoner's selection of indicators of environmental impact is no more objective than his treatment of affluence. He has simply taken from the

industrial statistics for the United States over the past 25 years a "representative" list of items, and ranked them according to percentage increase in production during this period. Table 2 gives the first 18 items on Commoner's list from p. 143 of *The Closing Circle*. Several questions must be asked concerning this tabulation: Are the top items—those that grew more than 500 per cent—sufficiently representative of the sources of environmental impact to justify Commoner's repeated assertions that "pollution" in the postwar United States grew 10 times as much as population or, indeed, 10 times as much as GNP?[32] What important part of the increases must be attributed to affluence, what part to population, and what part to those changes in technology which were a direct result of rising population and affluence?

The first item on the list, non-returnable soda bottles, is a good example of the misleading use of numbers. Obviously, a dramatic percentage increase in production of an item does not necessarily mean that present production is enormous in absolute terms; it may only mean that initial production was very small. Nor does a large increase—or even a large absolute level of production—automatically mean that an item is an important index of environmental impact. Nonreturnable soda bottles illustrate both points: while they may represent a waste of energy, they are neither a major fraction of US glass production nor an ecologically significant pollutant.[33]

The second thing one notices is that several of the items on Commoner's list are closely related to each other: he tabulates separately synthetic organic chemicals, pesticides (the most dangerous of which are a subset of the synthetic organics), chlorine (the principal use of which is the manufacture of synthetic organics), and the mercury used in the production of the chlorine. There is no doubt that these items support, in this instance, Commoner's notion of "the technological flaw"—i.e., that considerable environmental impact has resulted from changes for the worse in technology. The interesting point here is that Commoner has padded his list of dramatic increases with four different aspects of essentially the same flaw. Since few sources of pollution have really increased enough to justify Commoner's general conclusions, he apparently intends to get maximum mileage out of those that have.

The figures for mercury deserve closer examination. Commoner has cited two particular uses of mercury that have increased dramatically, without noting that total consumption of mercury has changed relatively little. US mercury consumption between 1930 and 1970 was 63,000 metric tons, or an average of 1,575 tons per year; the 1968 figure was 1,827 tons, only 16 per cent above the 40-year average.[34] Furthermore, there is good reason to believe that other sources of environmental mercury may be more important than industrial production of the metal. Mercury occurs throughout the earth's crust and is released continuously by out-gassing. The global rate for this process, which is accelerated when man disturbs the earth's surface by mining, agriculture and urbanisation, has recently been estimated as at least 25,000 metric tons per year.[35] For comparison, world industrial production of mercury in 1968 was 8,800 metric tons.[36]

Degassing during the roasting of sulphide ores contributes perhaps an additional 2,000 metric tons of mercury globally per year,[37] while the input from burning fossil fuels may be as much as 20,000 metric tons annually[38]. It is apparent then, that the numbers presented by Commoner have little relevance as indicators of the overall level of mercury pollution or its rate of increase since World War II. The major sources have been increasing far more slowly than those he cites, and are rather well explained, it seems, in terms of increases in population and affluence (as measured by total fossil fuel consumption and, possibly, disruption of the land). It is not our intention, of course, to disparage the importance of chlor-alkali plants and paint manufacturing as local sources of mercury—such sources should be controlled wherever possible. However, the evidence simply does not support the use of mercury as an example of pollution increasing many times faster than population or affluence.

What of the other items on Commoner's list? Air-conditioner compressors and electric housewares represent affluence by any definition but Commoner's, so these figures do not support his case. Also, with air conditioners, as with non-refillable bottles, the percentage increase is so dramatic largely because the initial production was so small. Synthetic fibres,[39] plastics, and aluminium also rose from small initial values, and they are now produced in quantities that are significant in absolute terms. Since these

Table 1. **Amenities and Affluence in the Postwar US**
(abbreviation "p.c." stands for "per capita")

Item	*Initial value*	*Final value*	*% increase*
1. automobiles in use p.c.[a]	.208 (1940)	.416 (1968)	100%
2. telephones in use p.c.[b]	.165 (1940)	.560 (1968)	227%
3. automatic heating units in use p.c.[c]	.042 (1946)	.133 (1960)	217%
4. ranges in use p.c.[d]	.242 (1951)	.305 (1960)	26%
5. water heaters in use p.c.[e]	.122 (1950)	.177 (1960)	45%
6. percentage of households with air conditioners[f]	0.2% (1948)	13.6% (1960)	6700%
7. refrigerators in use p.c.[g]	.145 (1946)	.277 (1960)	91%
8. clothes dryers p.c.[g]	.0013 (1949)	.053 (1960)	4000%

a. US Department of Commerce, 1970, *op. cit.*, p. 544. b. *Ibid.*, p. 491. c. Landsberg, H., Fischman, L. and Fisher, J., 1963, *op. cit.*, p. 733. d. *Ibid.*, p. 742. e. *Ibid.*, p. 744. f. *Ibid.*, p. 747. g. *Ibid.*, p. 748.

Table 2. **Commoner's Selection of Postwar "Growth" Items**[a]

Item	*Percentage increase quoted*
1. nonreturnable soda bottles	53,000%
2. synthetic fibres	5,980%
3. mercury used in chlorine production	3,930%
4. mercury used in mildew-resistant paint	3,120%
5. air conditioner compressor units	2,850%
6. plastics	1,960%
7. fertiliser nitrogen	1,050%
8. electric housewares	1,040%
9. synthetic organic chemicals	950%
10. aluminum	680%
11. chlorine gas	600%
12. electric power	530%
13. pesticides	390%
14. wood pulp	313%
15. truck freight	222%
16. consumer electronics	217%
17. motor fuel consumption	190%
18. cement	150%

a. *The Closing Circle*, p. 143.

commodities are at least plausible indices of environmental impact—the fibres and plastics because they are not easily degraded in nature, the aluminium as a major consumer of electric power—we should examine the relevant data more closely. First of all, all three commodities grew by replacing or supplementing more conventional ones; plastics for wood and steel, aluminium for wood and steel and copper, synthetic fibres for cotton and wool. To this extent, the evidence supports the proposition (with which few would disagree) that technology has often dramatically changed the way man meets established wants and needs, sometimes with serious side-effects. What Commoner has failed to prove, however, is that such changes are not stimulated by the demands of a growing population or by perceived advantages of the new technology over the old, aside from cheapness.

Consider the fibres. The relevant data are presented in Table 3, in a form somewhat more enlightening than Commoner's percentages.

It is apparent that providing today's total demand for fibre without the man-made ones would amount to nearly a doubling of the 1945 consumption of both cotton and wool. What would have been the cost of doing it this way in terms of pounds of pesticides and fertiliser applied to cotton fields, the fossil fuels burned in cultivation, planting, harvesting, and ginning, the side effects of irrigation projects, the extra land devoted to monoculture, the overgrazing and subsequent erosion of grassland? Has the environmental cost of meeting the increased demand with synthetics been greater? This is the real issue: not whether the environmental impact of non-cellulosic fibres in 1968 is 70 times their impact in 1945, but whether the impact of alternate means to provide the 1968 number of people with the 1968 level of affluence would have been any less. Commoner admits he does not know (see his footnote to p. 160), but the uncertainty is forgotten when he draws his conclusions.

Consider aluminium. It is a popular misconception that most aluminium goes into beer cans. Actually, containers of all kinds account for 10 per cent of aluminium consumption, while the building and construction industry uses 23 per cent, the transportation industry uses 20 per cent and the electrical industry uses 13 per cent.[40] In the building industry, aluminium is replacing wood for siding, window frames, awnings and other applications, not simply because it is cheap, but because it is durable and maintenance free. Many people believe low maintenance is part of affluence. Aluminium is costly in energy, but meeting the demands of a growing population for better housing with wood alone would put an additional demand on forests already being too intensely exploited. (Need we remind Dr Commoner that "there is no such thing as a free lunch?") In transportation, aluminium replaces iron in automobile engines and steel in aircraft. Aluminium is about five times as costly in energy as steel to produce, but lighter cars and aircraft burn less fuel. In the electrical industry, abundant aluminium is replacing scarce copper as a conductor of electricity. This is not coincidence or technological frivolity—it is the classic example of the sort of substitution that is inevitable when a growing, affluent population presses on a finite resource base.

Plastics have replaced wood in some applications, such as furniture, and steel in others. Often they are more durable than wood and need less maintenance (affluence again), and their production requires only about a fourth as much energy per ton as steel.[41] Their persistence as a pollutant is a liability. Again, however, Commoner can offer no comparison of the environmental impact of the observed increase in production of plastics since 1946 with the impact of producing from other materials the same goods for the same number of people.

It is clear, then, that the population growth and rising affluence can stimulate qualitative changes in the technologies of production, and that mere comparison of percentage increases in the new technologies with those of population and GNP does not clarify the relationship. Another mechanism by which population and affluence generate environmental impact far out of proportion to their own percentage increases is diminishing returns. This term refers to a situation in which the additional output resulting from each additional unit of input is becoming less and less. Here "output refers to a desired good such as food or metal, and "input" refers to what we must supply—say, fertiliser, energy, raw ore or labour—to obtain the output. If the diminishing returns prevail, the per capita consumptions of input needed to provide the fixed per capita level of outputs will increase. Since environmental impact is generated by the inputs as well as by the outputs, per capita impact will also increase.

Consider the problem of providing non-renewable resources such as minerals and fossil fuels to a growing population, even at fixed levels of per capita consumption. More people mean more demand, and thus more rapid depletion of resources. As the richest supplies of these resources and those nearest to centres of use are consumed, it becomes necessary to use lower-grade ores, drill deeper, and extend supply networks. All these activities increase the per capita use of energy and hence the per capita impact on the environment. In the case of partly renewable resources such as water (which is effectively non-renewable when groundwater supplies are mined at rates far exceeding natural recharge), per capita costs and environmental impact escalate enormously when the human population demands more than is locally available. Here the loss of free-flowing rivers and other economic, aesthetic and ecological costs of massive water-movement projects represent increased per capita diseconomies directly stimulated by population growth. These effects would, of course, also eventually overtake a stable population that demands more than the environment can supply on a perpetual basis; growth simply speeds the process and allows less time to deal with the problems created.

Commoner implicitly acknowledges the possibility of diminishing returns (p. 133), but declares that this phenomenon cannot explain the increases in environmental impact that have occurred. As we have already noted, no single factor can explain all of the increases, but Commoner's rejection of diminishing returns as a significant contributing factor is based on his evident misunderstanding of the term's economic meaning. Specifically, he restricts attention to productivity, or "value produced per unit of labour used in the process" (p. 134); since this quantity has increased since 1956, he argues, diminishing returns have not been important. Actually, the only justifiable conclusion from this datum is that diminishing returns with respect

to labour have not been important. The reason, of course, is that the rampant technology that Commoner deplores has reduced the importance of labour in comparison with other inputs, such as energy, machinery and raw ore. It is with respect to these non-labour inputs that diminishing returns have occurred[42] and it is the non-labour inputs which generate the sorts of environmental impact with which Commoner concerns himself.

Perhaps the best known example of diminishing returns is the use of nitrogen fertiliser in food production—a situation which Commoner himself describes with admirable clarity on p. 85 of *The Closing Circle*. The essence of the matter is that feeding an extra increment of population from a fixed or dwindling amount of good quality land requires inputs of fertiliser far out of proportion to the increase in yield.[43] That the amount of agricultural land is dwindling is of course partly a consequence of other demands being made on the land by a growing and affluent population—freeways, subdivisions, airports, reservoirs, and so on. It is ironic, then, that one of the centrepieces of Commoner's argument—the dramatic postwar increase of nitrogen fertiliser—is so revealing as an illustration of what he has overlooked, namely, that there are striking cause-and-effect connections between the size of a population and the nature of the technology needed to support it.

There are far more aspects of the causal relation among population size, affluence and per capita impact on the environment than we have space to describe here.[44] However, those we have mentioned should suffice to show that such connections are important factors in man's rising environmental impact, and that they cannot be defined or wished away.

Having considered the items which are on Commoner's list, we will now turn to an even more instructive exercise, an examination of some that are missing. Probably the most accurate indices of a society's impact on its environment are the production and consumption (production plus imports minus exports) of energy. Commoner discusses electricity (it has grown much more rapidly than energy consumption as a whole, partly by replacing direct uses of fossil fuels in home heating, cooking and industry) and motor fuel consumption (one of the few increases he is willing to attribute partly to affluence). He says almost nothing about energy production or consumption as a whole, however, perhaps because it would damage his case to do so.

Of course, no single statistic now kept by society is designed to measure environmental impact, but the figures on energy at least tend to average out substitutions. Thus they are not subject to the limitations of measures such as aluminium or plastic production, as already discussed. Using energy production or consumption also avoids the pitfall of redundancy into which Commoner has fallen in the case of synthetic organics. Most important, all of man's environmental impacts involve his production and consumption of energy, and virtually all the energy he commands, except that which drives his own body, is accounted for in the statistics.[45] Our judgment that the energy figures are appropriate indices of environmental impact is confirmed by the prestigious MIT-sponsored Study of Critical Environmental Problems.[46] Of the five global environmental problems given most attention by the study—oil in the oceans, CO_2 and particulate matter in the atmosphere, heavy metals, eutrophication and pesticides—the first three are direct consequences of energy production (the relationship of the heavy metal mercury to energy problem is discussed above.) US energy production in 1969 was 2.4 times that in 1940[47]. Population increased 53 per cent in this period, and energy production per capita increased 57 per cent ($1.53 \times 1.57 = 2.40$). Thus, in purely arithmetical terms, population growth and increased production per capita accounted for almost identical shares of the total increase. US energy consumption increased 2.75-fold between 1940 and 1969, corresponding to an 80 per cent increase in consumption per capita ($1.53 \times 1.80 = 2.75$). Again, even ignoring the interdependence of the factors, the contribution of population growth is hardly unimportant.

Another spectacular omission from Commoner's "representative" list of indices of postwar production is the number of automobiles manufactured (discussions of some of the individual impacts of the automobile are scattered through *The Closing Circle*, but identifying automobile production as the very informative index of resource wastage and environmental degradation it is, does not suit Commoner's purpose.) Between 1940 and 1968 the production of automobiles increased 2.37-fold[48] while population grew 1.52-fold. Per capita production rose 1.56-fold ($1.52 \times 1.56 = 2.37$). Population growth thus "caused" about half of the increase while affluence (as reflected in the increased number of cars per person) "caused" the rest.

Commoner argues (p. 170) that "in a sense, the increase in automobile travel during the last twenty-five years is also a counterecological consequence of a technological change—in the distribution of residences and places of work." We will leave for the reader to decide whether the commuting syndrome is best described as a "technological mistake" or as a complex situation resulting partly from increases in population concentration, which are highly correlated with population growth, and from increased affluence. After all, increased affluence is what permits flights to the suburbs.

Commoner correctly points out that one of the major impacts from the automobile, the production of nitrogen oxides, has increased since 1946 because of a technological mistake. That mistake was raising compression ratios, which increased average emissions of oxides of nitrogen in the exhaust from 500 parts per million to 1200 parts per million (a 2.4-fold increase) between 1946 and 1968. Commoner notes further that total nitrogen oxide emissions increased 7-fold in the same period. Application of the simple mathematics of impact to these figures shows that the combination of population growth and affluence accounts for a larger portion of the nitrogen oxide problem than does the technological "error"; $PA = 2.9$; $I = 2.4$; $T = 2.9 \times 2.4 = 7.0$. Commoner also neglects to point out an obvious trade-off. The error of raising compression ratios had an effect beyond increasing nitrogen oxides—it reduced the emissions of hydrocarbons, dangerous pollutants implicated in causing cancer. Here, as in many other places in *The Closing Circle*, Commoner seems to have forgotten what he calls "The Fourth Law of Ecology": there is no such thing as a free lunch. Many of the technological flaws we all deplore will not be easily corrected, for the alternatives, too, are full of defects. Switching from today's automobiles to electric vehicles would simply shift part of the environ-

mental burden of personal transportation from the air over highways to the air over electric power stations. Changing from fossil-fuel to nuclear fission electricity generation replaces the problems of strip mining, oil spills and air pollution with an accident hazard of indeterminate magnitude and a burden of radioactive wastes to be stored virtually in perpetuity. Regulating trash burning to minimise air pollution maximises the burden of solid wastes. The sad fact is that most attempts to eliminate man's impact on his environment only shift and redistribute it. Obviously, some technologies are better than others, and approaches that promise to minimise environmental impact should be vigorously pursued. It is well to admit, however, that barring a repeal of the laws of thermodynamics, no technology can reduce the impact of population and affluence to zero.

The demographic transition misunderstood

On page 237 Commoner points out that the demographic transition is a tendency for population growth to "level off" as a natural social response to prosperity. On page 242 we are told that population growth in the developing nations should be "brought into balance by the same means that have already succeeded elsewhere—improvement of living conditions, urgent efforts to reduce infant mortality, social security measures, voluntary contraceptive practice." He then states: "It is this view with which I wish to associate myself." If it were only that simple! A casual look at the statistics[49] would reveal the most fundamental flaw in Commoner's thesis. Even after the completion of the demographic transition the developed countries still have high growth rates. Contrary to Commoner's beliefs, the reduction in birth rates associated with the demographic transition was not adequate to compensate for the even more dramatic fall in death rates that preceded it. In the industrial areas of the world the transition was essentially over by 1949.[50] A quarter of a century later, birth rates in Europe, North America, the USSR, Australia, New Zealand and Japan were still, on the average, almost double the death rates. This is, to varying degrees, a result of the age composition of the population as well as of excess fertility. Nonetheless an examination of net reproductive rates (NRR)[51] from the 1920s to today in the industrialised nations gives little reason to assume that there is an automatic process of population regulation leading to stationary (i.e., constant-sized) populations. Indeed it seems at least as likely, assuring death rates do not rise. that industrial nations could fluctuate over the long term at growth rates of about 0.5—1.0% annually, thus doubling their populations every century or so. Let's examine, however, what would happen if demographic transitions started immediately in underdeveloped countries (in most cases there is little or no sign of such an event) and followed a pattern similar to that experienced by the developed countries (DCs) in the past. It would be perhaps eighty years before one could expect growth rates in under-developed countries (UDCs) to be in the relatively low range now found in developed countries.[52] To see that such a demographic transition in the UDCs cannot solve the problem in time, it is only necessary to examine a much more optimistic projection. Demographer Nathan Keyfitz has recently calculated the possible results of a population control miracle (which we might call a "super demographic transition").[53] He calculated, in essence, what would happen if family size dropped precipitously in UDCs so that around the year 2000 reproduction had reached replacement level. If that should occur (and no competent demographer thinks there is the remotest possibility of it occurring) the size of the population of a typical UDC would be 2.5 times its present size when it eventually stopped growing.[54] That means, for instance, that the population of India would be some 1.4 billion people, that of China perhaps 1.7 billion, Brazil's 240 million, Indonesia's 310 million, and so on. Remember, these are estimates based on wildly optimistic assumptions about population control. Since most underdeveloped nations are in the tropics, one need only mesh this information with that on the ecology of the tropics to see why Commoner's invocation of the demographic transition as a "cure" is a tragic mistake.

Unfortunately, he also perpetuates the myth that population control can be achieved in part by dropping infant mortality rates (pp.236, and elsewhere). Laudable as the goal of reducing such rates is on grounds of compassion, it would in many cases result in temporarily rising growth rates, since the projected declines in birth rate will not compensate for the lowered death rates.[55] There is virtually no evidence that depressing infant mortality rates anywhere would result in drops in growth rate until at least a generation had passed.

It is, of course, not at all clear that UDCs would undergo a classical demographic transition, even if they should be industrialised. The social and economic conditions are so different in those countries today in comparison to those in the now developed countries in the last century that prediction is difficult.

Commoner's "Optimistic outlook" (p.240) can only be based on his ignoring of the rate and magnitude of the problems outlined above combined with a misplaced faith on man's ability to industrialise instantly without environmental damage. An examination of statistics on the consumption of energy and materials needed to industrialise the underdeveloped countries[56] reveals the difficulties of achieving even partial industrialisation of the UDCs without vast damage to the ecosphere. Mankind's only chance for improving

the lot of the poor significantly lies in diverting energy and other resources from extravagant affluence in the DCs to necessity-orientated uses in the UDCs.

Conclusion

Although Commoner gives perfunctory acknowledgement to some of the many deficiencies in his argument,[59] he manages to ignore these considerations completely in reaching his conclusions. Thus he writes on p.176 that "the increase of population accounts for from 12 to 20 per cent of the various increases in total pollutant output since 1946," the "affluence factor . . . accounts for 1 to 5 per cent," and the "technology factor . . . accounts for about 95 per cent" (except in the case of passenger car travel, when Commoner admits the contribution of affluence is larger and that of technology smaller). The charitable reader may wish to overlook the point that the lesser of these figures add up to 108 per cent of the problem. In no event is an allocation of "blame" remotely like the one Commoner gives justified by the data and arguments presented in his book.

Yet, as several glowing reviews of *The Closing Circle* bear witness,[57] Commoner has produced a tract quite capable of persuading the naive that he has a calm, "scientific" view of the ecological crisis. In fixing the blame for environmental deterioration on faulty technology alone, Commoner's position is uncomplicated, socially comfortable and, hence, seductive. Apparently, people want desperately to believe that questions as knotty as how to control population and how to redistribute wealth need not be confronted. But there is little purpose in deluding the public about these matters; the truth is that we must grapple simultaneously with over-population, excessive affluence, and faulty technology. Commoner himself understands that US resource consumption must be curtailed (p. 299), but he misleads his readers into believing that this can be accomplished by ecological reform alone, without population control or a reduction in what most Americans perceive as their high standard of living.

Of course, facing honestly the need for population control and de-development[58] exposes one to the painful criticism of being both anti-people and anti-poor, but the fact is that these unpopular measures offer man's only hope for averting unprecedented misery. It is better to tell the rich that they will have to share to survive, and to tell those who want large families that the price is mortgaging their children's future, than to offer false hopes of an easy way out.

The fallacy in Commoner's one-dimensioned approach is perhaps best illustrated by his oft-repeated analogy[60] that pressing for population control "is equivalent to attempting to save a leaking ship by lightening the load and forcing passengers overboard". Needless to say, if a leaking ship were tied up to a dock and passengers were still swarming up the gangplank, a competent captain would keep any more from boarding while he manned the pumps and attempted to repair the leak.

NOTES

1. See, for instance, P. S. Martin and T. E. Wright Jr., eds., 1957 *Pleistocene Extinctions: The Search for a Cause.* Yale Univ. Press, New Haven.
2. One of the earliest comprehensive treatments of that transformation was by George Marsh who, in 1864, wrote *Man and Nature; or Physical Geography as Modified by Human Action.*
3. Thorkild Jacobsen and Robert M. Adams 1958. "Salt and silt in ancient Mesopotamian agriculture." *Science,* 128: 1251—1258.
4. UNESCO 1961. "Salinity problem in the arid zones." *Proc. Teheran Symposium.* UNESCO, Arid Zone Research in 14, Paris. See also Harold E. Dregne, ed., 1970. *Arid Lands in Transition.* AAAS Publ. 90, Washington D.C.
5. A classic paper is Carl O. Sauer, 1938. "Theme of plant and animal destruction in economic history." *J. Farm Economics* 20: 765–775. See also numerous articles in William L. Thomas Jr. ed., 1956. *Man's Role in Changing the Face of the Earth.* Univ. of Chicago Press, Chicago; and M. Kassas, 1970. "Desertification versus potential for recovery in circum-Saharan territories." In *Arid Lands in Transition,* pp. 123–142.
6. See, for example, H. C. Darby, 1956. "The clearing of the woodland in Europe" in Thomas loc. cit., pp. 183–216.
7. "The agency of man on Earth" in Thomas op. cit., p. 60.
8. Betty J. Meggers, 1957. "Environment and culture in the Amazon Basin." Pan American Union Social Science *Monographs* 3: 71–89.
9. Jeremy A. Sabloff, 1971. "The collapse of classic Maya civilization" in John Harte and Robert Socolow, eds. *Patient Earth.* Hold, Rinehart and Winston, pp. 16–27.
10. The best concise summary of the enormous ecological problems of attempting to intensify farming of the tropics is Daniel H. Janzen, 1970. "The Unexploited Tropics." *Bull. Ecological Soc. America,* Sept., pp. 4–7.
11. For an excellent, simple explanation of this phenomenon and some exceptions to the rule see E. O. Wilson and W. A. Bossert, 1971. *A Primer of Population Biology.* Sinauer, Stamford, Conn. A collection of technical papers indicating the intricacy of the relationship will be found in "Diversity and Stability in Ecological Systems." *Brookhaven Symposia in Biology* no. 22, BNL 50175 C–56),; 1969.
12. See P. R. and A. H. Ehrlich, 1970. *Population / Resources / Environment.* W. H. Freeman & Co., San Francisco, Chapter 7.
13. Allen H. Barton, 1969. *Communities in Disaster: A Sociological Analysis of Collective Stress Situations.* Doubleday & Co., N.Y., p. 20. For a more detailed description see G. L. Carefoot and E. R. Sprott, 1967. *Famine on the Wind: Man's Battle against Plant Disease.* Rand McNally & Co., Chicago.
14. See P. R. Ehrlich and R. H. Raven, 1965. "Butterflies and Plants: a study in coevolution." *Evolution* 18: 586–608. D. H. Janzen, 1966. "Coevolution of mutualism between ants and acacias in Central America. Evolution 20: 249–275; P. H. Ehrlich, 1970. Coevolution and the biology of communities." *Proc. 29th Biology Colloquium,* Oregon Univ. Press. Corvallis.
15. Graham Chedd, 1970. "Hidden Peril in the Green Revolution." *New Scientist* 22 Oct.; O. H. Frankel and E. Bennett, eds., 1970. *Genetic Resources in Plants —Their Exploration and Conservation.* F. A. Davis Co., Philadelphia; H. Garrison Wilkes, 1971 "Too little gene exchange." *Science,* 171–965.
16. Reid A. Bryson and Wayne M. Wendland, 1970. "Climatic effects of atmospheric pollution," in *Global Effects of Environmental Pollution.* S. F. Singer, ed., Springer Verlag, N.Y., p. 130.
17. J. Murray Mitchell, Jr., 1970. "A preliminary evaluation of atmospheric pollution as a cause of the global temperature fluctuation of the past century," in *Global Effects of Environmental Pollution* op. cit., p. 139. Mitchell points out that man's contribution at this time is small compared to the 120-year average figure for dust of volcanic origin, but is already large compared to the natural "baseline" figure between major eruptions. It is known that volcanic eruptions have affected global climate.
18. See, e.g., *Man's Impact on the Global Environmental Problems* (Study of Critical Environmental Problems), M.I.T. Press, Cambridge, 1970, and J. P. Holdren, 1970. *Global thermal pollution in Global Ecology,* J. P. Holdren and P. R. Ehrlich, eds., 1971. Harcourt, Brace, Jovanovich, N.Y.
19. Institute of Ecology, 1971. "Man in the Living Environment" (The Institute of Ecology Report of the Workshop on Global Ecological Problems), Madison.
20. John Ryther, 1969. *Photosynthesis and fish production in the sea.*
21. The result follows by dividing Equation (2) by Equation (1).
22. US Dept. of Commerce, 1970. *Statistical Abstract of the United States,* US Govt. Printing Office, Washington D.C., p. 5.
23. US Dept. of Commerce, 1969. *The National Income and Product Accounts*

of the United States, 1929–1965. US Govt. Printing Office, Washington D.C. and US Dept. of Commerce, 1970, op. cit., p. 312.

24. For a good discussion see A. A. Berle, Jr., 1968. "What GNP doesn't tell us." *Saturday Review*, Aug. 31, and reprinted in *Global Ecology*, op. cit.
25. For some reason, Commoner used the 1966 rather than the 1968 housing figure, leading him to compute a somewhat smaller increase.
26. It is informative, though, to see what conclusions one would reach about affluence levels in different countries, using Commoner's "necessity-only" definition of affluence. Taking United Nations figures, (United Nations, 1969. *1969 Statistical Yearbook*. UN Publications Office, N.Y.) for calories, protein, and housing units per capita, tabulating them all as multiples of the US figures, and taking a straight average as our level of affluence à la Commoner, we reach the following conclusions: New Zealand is more "affluent" than the US, Greece is more "affluent" than Japan, and Ireland is more "affluent" than Sweden, France, Denmark and Japan.
27. US Dept. of Commerce, 1970. op. cit. p. 36. The definition of "housing unit" is on p. 3.
28. H. Landsberg, L. Fishman and J. Fisher, 1963. *Resources in America's Future*. Johns Hopkins University Press, Baltimore, p. 549. Figures are in 1960 dollars.
29. Arnold B. Barach, 1964. *USA and its Economic Future*. MacMillan, N.Y., p. 39. The trend towards single-family dwellings seems to have ended, or been temporarily interrupted, in the early 1960s.
30. US Dept. of Commerce, 1970. op. cit., p. 696.
31. US Dept. of Commerce, 1970. op. cit., p. 782.
32. See, eg., p. 146 of *The Closing Circle*. Commoner confuses the issue further for most readers by his use of the wording "at a rate about 10 times faster than the growth of GNP" (emphasis added). Most people think of a growth rate as the annual percentage increase. Since GNP, corrected for inflation, grew at an average of 3.7 per cent per year between 1946 and 1968, an annual rate 10 times faster would be 37 per cent per year. This, in turn, leads to the absurd conclusion that pollution in 1968 was over 1,000 times as severe as in 1946—1.37 multiplied by itself 22 times is 1018.
33. Since glass bottles are recyclable with little loss, they do not in principle represent an important drain on resources other than energy. Moreover, refillable bottles require more energy in their manufacture from raw materials than do the thinner nonrefillable ones, complicating the trade-off. Discarded bottles and broken glass are a visual nuisance and a hazard to bare feet, but not to the functioning of the biosphere.
34. SCEP, 1970. *Man's Impact on the Global Environment*, op. cit., p. 262.
35. Hubert V. Weiss, Minuro Koide and Edward D. Goldberg, 1971. *Science* 174: 692.
36. Ibid.
37. Ibid.
38. A figure of only 1600 metric tons per year was computed by K. K. Bertine and Edward D. Goldberg (Science. 173: 2333, 16 July 1971) but they assumed 90 per cent of the mercury in the fuel is trapped in bottom ash and does not reach the environment. The fraction trapped in bottom ash is reasonable for coal, but not for oil. Moreover, the ash is often stored outdoors, where the mercury may be leached out by rainwater. Since no mercury is reclaimed in connection with the use of fossil fuels, it seems prudent to assume that the entire content of the fuel reaches the environment by one pathway or another. Repeating the calculation under this assumption, and using a newer figure for the mercury content of coal (O. I. Joensu, 1971. *Science*, 171: 1027) than that employed by Bertine and Goldberg, one obtains the figure of 20,000 metric tons of mercury per year.
39. By "synthetic" Commoner means only the non-cellulose man-made fibres such as nylon. Rayon and acetate, by contract, are man-made as fibres but they are cellulose based.
40. US Dept. of the Interior, 1969. *Minerals Yearbook 1968*. Vol. 1–D, p. 155.
41. A. B. Makhijani and A. J. Lichtenberg, 1971. "An assessment of energy and materials utilisation in the USA." Memorandum No. ERL–M310, Electronics Research Laboratory, University of California, Berkeley, p. 10.
42. The phenomenon has become sufficiently dramatic to show up the very coarse index, energy consumption per dollar of GNP (corrected for inflation), which has been increasing since 1965 (US Dept. of Commerce, 1970, op. cit., p. 5 and p. 311).
43. See also "Man in the Living Environment." Institute of Ecology Report of the Workshop on Global Ecological Problems, 1971, p. 16, for a quantitative discussion of diminishing returns in fertiliser use and in other facets of supporting a growing population.
44. See, e.g. P. R. Ehrlich and J. P. Holdren, 1971. "Impact of Population Growth." *Science* 171: 1212–1217.
45. Whether production or consumption is a better indicator of environmental impact could be the subject of a lengthy paper in itself; one of the important considerations is what geographical universe one wishes to consider. Rather than examine this at length we give the figures for both; the conclusions to be drawn from either are similar.
46. *Man's Impact on the Global Environment*. M.I.T. Press, Cambridge, Mass.
47. US Dept. of Commerce, 1970. op. cit., p. 506.
48. US Dept. of Commerce, 1970. op, cit., p. 544—we are using factory sales as a measure of production.
49. See either the Population Reference Bureau *1971 World Population Data Sheet*, available from the Bureau, 1755 Massachusetts Ave., N.W., Washington DC or any recent annual volume of the *United Nations Demographic Yearbook*.
50. Ansley J. Coale, 1969. The decline of fertility in Europe from the French Revolution to World War II. In S. J. Behrman and Leslie Corso, Jr., eds, *Fertility and Family Planning*, pp. 3–24 Technically the demographic change is the change from a high death rate, high birth rate regime to a low death rate, low birth rate regime, such as has occurred historically in the developed countries. Most of these countries have had low birth and death rates since the 1920s, and now have birth rates well above death rates. For instance in 1971 Northern Europe had a birth rate of 16 per thousand and a death rate of 11. The birth rate in North America was 18 and the death rate was 9 (incidentally, that is below the 10 to 12 per thousand Commoner describes as the "minimal death rate" on p. 238. In 1971 more than fifty nations had death rates below the Commoner "minimum", some such as Singapore and Taiwan being as low as 5!). Some demographers feel, even though there is no evidence for it, that somehow the demographic transition is an automatic process leading to a stationary population, and the older literature on animal population dynamics also is replete with such fanciful ideas. Even if this were the case, the obvious lagtime would make depending on such processes a dangerous policy at best.
51. NRR is a measure of whether or not a population will be growing, stationary or shrinking—when and if the age composition stabilises, and if age specific vital rates remain constant. See, for example Nathan Keyfitz and Wilhelm Fleiger, 1971. *Population Facts and Methods of Demography*. W. H. Freeman & Co., San Francisco, p. 55.
52. See, for example, Donald J. Bogue, 1969. *Principles of Demography*, Wiley, (N.Y. fig. 3–3, p. 59).
53. On the momentum of population growth *Demography* 8: 71–80, 1971.
54. It is important to remember that in a young, growing population, achievment of replacement reproduction (NRR = 1) does not lead to a stationary population (ZPG) until many decades later. For instance, even if the US reaches NRR = 1 this year, it will be well into the next century before our growth stops. (See Tomas Freyka, 1968. "Reflections on the demographic conditions needed to establish a US stationary population growth." *Population Studies* 22: 379–397.)
55. This conclusion has recently been conconfirmed by the computer simulation work of Donella Meadows at MIT based on data from Indian villages.
56. Some limiting figures are given in P.R. Ehrlich and A. H. Ehrlich, 1970. *Population/Resources/Environment*. op. cit., pp. 61–62.
57. See, e.g., Michael Crichton's review, *New York Times Book Review*, Oct. 17, 1971; *Time Magazine* Nov. 1, 1971.
58. P. R. Ehrlich and J. P. Holdren, 1971. "Technology and de-development." *Saturday Review*, July 3, pp. 46–47. For a longer discussion of the problems of reducing affluence and simultaneously alleviating the plight of the poor, see P. R. Ehrlich and R. L. Harriman, 1971. *How to be a Survivor*. Ballantine, N.Y. p. 58ff.
59. E.g., he notes the failure to consider textile imports (footnote to p. 138); the failure to consider quality of housing as part of affluence (p. 138): the environmental trade-offs complicating the choice between natural and synthetic fibres (footnote to p. 160).
60. Given verbally before the President's Commission on Population Growth and the American future, at the meetings of the American Association for the Advancement of Science in December 1970, and on p. 255 of *The Closing Circle*.

Leading Question

by Lawrence D. Hills

How serious is the problem of toxic metal residues in sewage? "The Battle of Beaumont Leys", over lead residues in garden soils, caused public alarm. Lawrence Hills argues that this case was exceptional and that with proper treatment and use sewage need present no health hazard. The major source of lead in the environment is industrial and automobile air pollution.

Leicester has one of the finest Municipal Compost and Sewage Treatment plants in Europe, where 25 per cent of the digested sludge is composted with dustbin refuse for sale to gardeners, market gardeners and sports ground contractors, and the other 75 per cent is distributed by tanker at the rate of about 12,000 gallons an acre to farmers over a wide area. There is no difficulty in disposing of this high nitrogen and high phosphorus 3 per cent dry matter sludge as a free fertiliser for grass, grain and kale, and Scottish farmers even pay for it, finding 6,000 gallons an acre value for money.

Before the Wanlip works came into operation in 1964, Leicester ran a sewage farm at Beaumont Leys which was started in the 1890s when this disposal method was fashionable. This involves pumping a thicker sludge (4 to 6 per cent dry matter) at the rate of 300,000 gallons an acre on to fields divided into lagoons by earth banks, every five or six years. There is no crop the first season, and a favourite rotation is two years grass, with baled hay sold, two years grain with straw sold, and potatoes with a balancing dressing of a potash fertiliser before sludging again.

At Nottingham, where a 1,569 acre mixed farm is run on this system with the sludge from 454,000 people, the profit from the pig and dairy farm reduces the annual cost of sewage treatment to 75p per ratepayer, perhaps the lowest in Britain. This is only possible for Authorities who bought their farms in the 1890s when land was cheap, for enough level land within pumping range of an expanding city is now costly and hard to find.

The worry of every Borough Engineer with a sewage farm, however, is the build-up of toxic metals, for sludge from an industrial area can contain zinc, copper, chromium, lead, nickel, boron, cadmium and arsenic. Though many of these are present naturally in the soil, and some, like copper, are essential for plant growth, when they are present as more than traces they could make cropping impossible, and the crops poisonous.

In 1971 Leicester proposed to develop the 2,000 acres of Beaumont Leys farm as a New Town to hold 40,000 people in houses built by private developers. From an agricultural view it was a sin to use such land for housing, with three and even four ton an acre wheat crops often harvested, but today every Corporation with even a thousand acres of level land that the town has grown around, is tempted to solve the local housing problem and pay for a new sewage works by selling the old sewage farm for building land.

The result was what the *Leicester Mercury* called "The Battle of Beaumont Leys", with protest meetings and a campaign led by Mrs Janet Setchfield, a Labour Councillor, and Mr Greville Janner, Q.C., Labour M.P. for Leicester North West, that brought a public enquiry, with Professor Derek Bryce-Smith of Reading University, a leading soil chemist, as an expert witness.

The Council had taken over 1,000 soil samples which showed from 120 to 1,197 parts per million of lead, and such quantities of assorted minerals that Professor Bryce-Smith suggested that the mining rights should be sold to Rio Tinto Zinc, and gave it as his considered opinion that the land was unsafe for houses and gardens.

The Daily Telegraph gave the story scare headlines on 22 November with "Poison Threat to 40,000 Homes Site", and an even more alarmist "Cancer Risk in Soil Warning by Chemist" on the 23rd. *The Observer* on the 21st had "New Homes Face Poison Earth Risk", bringing in the case of Croydon, where a sewage farm at South Norwood is one of the last unused housing areas in urban London.

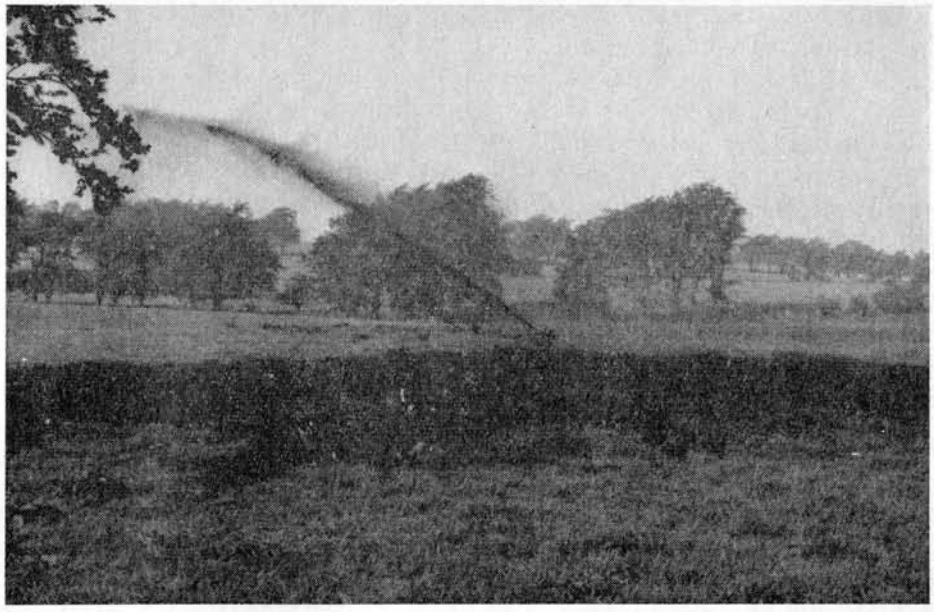
Here the levels varied from 300 to

6,000 p.p.m., when the normal average for British soils is under 100. Dr S. L. Wright, Medical Officer of Health for Croydon stated that the lead contamination was low enough for normal houses with gardens on 11 of the 75 acres of the site, and on the remaining 28 acres with planning permission so far, there could be flats, gardenless maisonettes, offices, a school and playing fields.

The danger that especially alarmed Professor Bryce-Smith was the risk of toddlers putting soil in their mouths, for though heavy liming keeps sewage farms cropping normally by locking up the toxic minerals out of root reach to a great extent, the human stomach produces hydrochloric acid which releases the lead. This is a cumulative poison acting on the central nervous system, particularly dangerous to children because of their lower body weight. Crops however take up relatively little, roots least and leaf vegetables rather more. Dr Wright of Croydon recently carried out tests on six men who had grown and eaten their own vegetables for many years on allotments on the Norwood site, with at least three times the normal lead in the soil. "In every case the result was entirely satisfactory, being well below the average level of 30 micrograms per 100 grams of blood", Dr Wright was quoted as saying in *The Daily Telegraph* on 12 February 1972.

The "Cancer risk" of the headlines was based on a paper by Dr Allen-Price (*Lancet* (1960)-1-1235) dealing with the increased rate of this and a number of other diseases in areas with a high natural mineral level. Research by the Royal College of General Practitioners confirms these findings. Yet they do not relate to sewage farms, and there is no evidence whatsoever that anyone has ever suffered lead, or any other toxic metal, poisoning from the use of sewage on the land. The quantities involved are tiny compared with those from leaded petrol and industrial pollution.

Dr R. B. Martin of Bristol University, as reported in *The Daily Telegraph* (10/2/72) has found 90 parts per million of lead in elm tree leaves six miles away from the Avonmouth plant of the Imperial Smelting Corporation. Whelks from the Severn Estuary near the discharge point of effluent from the smelter con-



Top: *Irrigation gun spraying digested sludge over one-third of an acre.*
Centre: *Sewage is run into lagoons at 300,000 galls. per acre. When dry it is ploughed and cropped for five years.*
Bottom: *Original 19th Century irrigation channels have been replaced, but the system still grows good crops.*

tained 3,100 p.p.m. of zinc, 425 p.p.m. of cadmium, and 27 p.p.m. of lead. A single whelk held as much cadmium as the 1 lb of rice a day that has given Japanese peasants the deadly disease of "Itai-Itai", which involves a very painful softening of the bones. It is the ability of some shellfish and plankton to concentrate metals that can make dumping at sea dangerous to human beings as well as seabirds.

Peterborough has an excellent sewage farm, sludged for nearly a century, and its soil has reached 383.55, about 25 per cent higher than the Norwood Allotments. Land across the road, which has never had sludge, is 275.83 p.p.m., from sharing the same industrial air pollution. An even more striking example comes from the trial ground of the Henry Doubleday Research Association where cabbages have been grown for four years in replicated plots in an experiment to test the effects of toxic metals from dried sludge. These plots had 14 lb a square yard of sludge a year, the others 14 lb of compost and the control 8 oz of Growmore. The soil of the sludge plots averaged 240.3 p.p.m. of lead, which was only to be expected, and the compost 67.2, well below average. The analysis of the cabbages is shown in the table:

Lead Content of Crops

	Dry Matter p.p.m.	Fresh Weight p.p.m.
Cabbages—Compost		
Outer Leaves	16.19	1.724
Inner Leaves	5.64	0.505
Cabbages—Growmore		
Outer Leaves	10.31	1.208
Inner Leaves	4.68	0.524
Cabbages—Sludge		
Outer Leaves	14.54	1.460
Inner Leaves	4.79	0.412
Potatoes—Peterborough		
Unpeeled	3.40	0.663
Peeled	2.50	0.742
Potatoes—Leigh		
Unpeeled	3.07	1.02
Peeled	2.50	0.52
Potatoes—Commercial		
Skin	3.07	0.48
Peeled	1.91	0.41
Potatoes—Compost		
Peeled	2.04	0.52
Potatoes—Harpenden		
Peeled	2.09	0.54

The cabbage plots were beside a road with heavy traffic and presumably the stronger, compost-grown cabbages had a larger collecting area in their leaves, the outermost of which took in rather more of the 6,000 tons a year of lead from petrol that makes every car a miniature Avonmouth. The dust beside our main roads now averages 2,000 p.p.m. and a child has only to swallow half a gram a day to risk lead poisoning, so it is possible that our custom of growing cabbages in our back gardens, rather than in front among the tetra-ethyl lead fumes, is our protection. As our petrol consumption is likely to double in the next 10 years, measuring the width of the danger strips beside our roads, and the weather and traffic type (heavy lorries burn leadless diesel oil) that extends it, at £2 per analysis figure, is rather more important than measuring the DDT level in birds' eggs.

According to Professor Bryce-Smith, 1 lb of food a day containing 2 p.p.m. of lead adds up quickly to danger to children, even though this is the statutory level for adults. So if a child of between six and eight ate 1 lb 2 ozs of raw cabbage a day for several weeks, this could mean lead poisoning and permanent brain damage. It would not be possible for any child to eat this quantity even cooked (some of the lead would be lost in the cooking water), but cabbage grown six miles from the Avonmouth smelter could be fifty times as dangerous, and the three-quarters of an ounce to give the same dose is less than a normal serving even for a two-year-old toddler.

The potato danger level for small children is 4 to 6 lb a day, which is obviously impossible, even for adults, eating potatoes grown on sewage farms like Peterborough and Leigh with lead levels 3 to 4 times normal. Their lead was only about a third higher than the three Control samples, with Harpenden about a mile from a main road and the Compost sample from Bocking 150 feet from one. It is this low extraction rate by roots that produced the 30 microgram lead levels for the Norwood allotment holders.

Any danger from sludge is strictly limited to the few sewage farms that survive from the 1890s, for there is a difference between dressings of 6 to 12,000 gallons an acre and 300,000 at up to twice the strength. One is piling up the metals in the soil to what may not be danger level now, but may well reach it in another 90 or even 50 years. The other keeps the metals as trace elements and spreads the plant foods thinly for maximum value in fertility. The normal dried sludge dressings of 1 to 2 lb a square yard add no more lead to the soil than some basic slags which have been used for over a century in safety.

The answer for existing sewage farms is to go on farming them, with grass, grain and kale fed to cattle or sold for stock-feed. Cats from Leigh were only a third higher at 3.46 p.p.m. lead, against 2.25 p.p.m. for commercial samples, and the vastly greater body weight of a cow gives a far higher safety factor. Beef cattle slaughtered at 2 to 3 years have too short a toxicity build up period for any danger from meat, and milk does not appear to carry lead. This concentrates in liver, kidneys, brains and bones, so a check at abattoirs would prevent the sale of offals in the case of elderly cows, should the level rise.

It is unlikely that Leicester and Croydon are the only towns to have replaced their sewage farms with more modern systems. There may well be a number of housing estates built on disused sewage farms even in the 1930s, where ratepayers have been living without any of the consequences feared by Professor Bryce-Smith. Or with until now inexplicable ill-health to justify a permanent building ban on these coveted and valuable sites. The need is not emotive headlines, but research.

The greatest long-term need for this is in the field of sludge disposal, not from rural areas like Eye in Suffolk with 2 p.p.m. lead (a record low that would make a sewage farm *reduce* the lead content of the soil), but where smelting, paint, plastic and chemical plants have put the toxic metal levels well above the Ministry of Agriculture safety standards.

The Henry Doubleday Research Association is working on a possible process that would concentrate the zinc, lead and cadmium into a slurry strong enough to be sent by tanker to smelters to recycle these useful metals. Before this becomes an industrial possibility, the Association must ask the hundreds of thousands of enthusiastic Anti-Pollutionists a leading question, "Are you prepared to contribute the cost of a pop LP record each, or even that of a fashionable sheepskin coat, towards the research involved?" Protest is not enough. It is time Youth got off the band wagon and gave a hand with the work.

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The Dilemma of a Linguistic Minority

The present dilemma of the Welsh Nation is that in spite of 400 years, first of proscription and then of various types of repression, the Welsh language still survives, both as an oral vehicle of communication and as the repository of an unbroken literary tradition stretching back over many centuries. By any logical calculation, a language that had been declared invalid for all transaction of public business as long ago as 1536, and the use of which rendered an individual liable to severe penalties, should have died long ago. By a succession of historical improbabilities combined with the dogged persistence of small minorities at various points in time, the Welsh language did not die. (It may also perhaps be suggested that its survival was to some extent caused by the total inadequacy of any early attempt to teach the Welsh the English language, so that during the 16th Century a peasantry bereft of its nobility and bereft at the same time of the massive cultural patronage it had once received from its Cistercian monasteries, was left to fend for itself linguistically and in most other ways.) Without tracing the history of this remarkable survival in all its peculiarities from 1536 to the present day, the plain fact is that at the 1961 census, 26 per cent of the population was still tabulated as Welsh speaking. This compares with the 1.64 per cent of the population of Scotland that was tabulated as Gaelic speaking, and the minimal population that is reckoned to be genuinely Irish speaking in Ireland even after 50 years of political independence. Although this percentage is regarded by many as an insignificant minority within the pattern of European culture, the fact remains that 565,000 people in Wales still regard Welsh as their first language, not to speak of what might be roughly estimated as a further million people in England and over various parts of the globe who also speak the language. It is unlikely that in terms of actual numbers there was ever a time in history when the number of people who spoke Welsh was appreciably greater than this.

The dilemma now lies in the fact that at a time when the preservation of national identity is widely regarded as of increasing importance in a world threatened by superficial uniformity, the only effective symbol of identity that the Welsh possess is the Welsh language. At a time when the vast majority of a small population spoke Welsh (the 1896 census indicated that 75 per cent of the population was then Welsh speaking), the language was still actively discouraged as a medium of expression and its importance as a cultural medium was not recognised. During this century, there has been a growing sense of its importance, a heightened appreciation of the richness of Welsh literature and a real concern that the language should be re-established as a genuine medium of communication, effective for the purposes of modern life. Ironically, this sense has never quite kept pace with the negative pressures that have made the survival of small languages all the more difficult.

Situated on the fringes of a world culture, bombarded by all the vast resources of a world language through its mass media, the Welsh language has encountered vast problems during this century, different in intensity and quality from those it previously faced during the centuries of repression, so that we now arrive at a situation where education authorities and many national institutions are not only sympathetic towards the survival of language, but also prepared to take active measures to conserve at least its present position. But they do this in a situation where the majority is not now Welsh speaking, and moral and sociological problems are therefore continually emerging.

It is now widely recognised that a language is so interwoven with an individual's emotional make-up, both in his present intercourse with his fellows, and in his sense of belonging to his roots in the past, that the loss of it creates widespread psychological problems over generations for individuals, and a cultural impoverishment for the society at large the extent of which is difficult to measure. This impoverishment, cutting off the present from the past and the individual from certain areas of emotional security, is just the kind of thing that has led to moral degeneration among some minority cultures in other parts of the world. One thinks particularly of the extreme example of the Eskimo in certain parts of Canada and Scandinavia and of the Red Indian in the United States of America.

One thinks also of the bitter problems of loss of identity suffered by the negro populations of the West Indies who are neither English, French, American nor African, but a peculiar and unsatisfactory amalgam of all of these. They have no language except a derided oral patois and their roots are too far away, both in time and place, to give them any sense of belonging. That this sense of isolation has not yet afflicted Wales as a whole is solely the result of that haphazard survival of the language which I have already referred to.

But the problem remains. The minority, including a large proportion of the nation's intellectuals whether they themselves speak Welsh or not, are now convinced of the value of the language as a moral as well as a cultural instrument and of the general worthwhileness of retaining and developing minority cultures. The Royal Commission investigating the situation a few years ago recommended legal parity for both English and Welsh in Wales; the Television companies in Wales operate a bilingual policy in the programmes they themselves are responsible for, as opposed to those they receive from the national networks; the Welsh Arts Council subsidises literature in the Welsh language more heavily than it does Welsh literature written in English; a county as Anglicised as Glamorgan has established many Welsh-medium Primary Schools and also two large bi-lingual comprehensive schools; two of the federal national university's colleges have appointed members of staff to teach certain subjects specifically through the medium of Welsh. And yet it is doubtful whether all of this has been enough to arrest the statistical decline. The doubt, and a feeling that a lack of any real urgency was being shown by those in authority, resulted some years ago in the establishment by a group, mainly of the student generation, of the Welsh Language Society. Beginning as a ginger group that

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intended to spur authority into action to preserve the language, it has moved out into areas of protest and civil disobedience that have resulted in prison sentences and widespread public controversy. It is their belief, and that of some academics, that the cultural identity that all agree should be preserved, can only be fostered and developed if the Welsh language within Wales is given a very considerable priority over English, bearing in mind its national disadvantages and the great linguistic pressures in favour of English that pour in from outside. But some members of this Society are aiming, one feels, not at bilingualism but at recreating a nation that is mono-lingually Welsh. And there lies the rub.

The majority of the population, although more aware of the existence of the Welsh language than they were 20 or 30 years ago, and probably on the whole more sympathetic to the idea of preserving it, are broadly speaking no more interested either in language or literary culture than any other modern industrialised population anywhere else in the world. It is inevitable that the average factory worker on the Treforest Industrial Estate or in the Steel Company of Wales does not consider the preservation of the Welsh language and Welsh culture to be of any direct relevance to the mental and moral development of himself and his family, and while he may accept a certain gentle injection of something that appears strange and alien in the name of a patriotism that comes to life for him mainly on the Rugby field, if there is any danger of this constituting any risk to the material prosperity and comparative affluence that he has fought so doggedly to achieve, then he will certainly sacrifice it at once.

The more pressure that is exerted therefore by the Welsh Language Society to achieve totally bi-lingual road signs, official application forms, driving licences and all the other minutiae of a modern state, and the more they have to resort to civil disobedience in order to achieve this in the face of the usual bureaucratic inertia, the more the ordinary citizen is going to identify Welshness with fanaticism and civil disobedience, and, in our present climate, in his irrational way with long hair, hippiedom and all other kinds of irrelevant evils, and the more he does this the more will his sympathy be eroded.

And so this is the dilemma. It is clear that even more energetic measures have to be taken if the national identity incorporated in the language is to be preserved. And yet these measures have to be taken within a context where three-quarters of the population do not speak the national language and many of them know little about it. As a fundamental principle of social justice, no measures taken to preserve the minority language would be acceptable if they discriminated against a majority which was not Welsh speaking, and yet a dispensation which gives full scope for wide use to the Welsh language on the one hand while on the other hand always providing complete alternatives in English for those who do not understand Welsh is an extremely costly operation. Can a materialistic society be persuaded that the cost is worthwhile in terms of the quality of human life, and if in theory it can be persuaded of this, are the present methods of persuasion the most effective, or are they counter-productive? In many ways, the language problem has injected a vitality into the social patterns of Welsh life that may well be creative and constructive in the long term, and even at present the picture is far from that of a depressed and desperate enclave. The problems are great, but they are the problems created by a civilised awareness that there are social values other than purely material ones and by a genuine attempt at last to do justice to a people and a culture that have suffered much injustice over the centuries, and who should by rights be extinct. With a broadening awareness of the problem and a greater willingness in many places to think more deeply about it, there is some hope that a solution may be arrived at that will ensure some kind of perpetuation for the idea of Welshness within the wider framework of a new Europe. Before that happens there will clearly be more controversy and more unrest, but at least there is a greater consciousness than ever before of the existence in Welsh Wales of an ethos that is of real value, and the future is not without some hope.

R. Gerallt Jones

Elitist AA would be serious Eco-loss

The Architectural Association is one of the country's most important centres of constructive thinking on ecological and environmental matters. It is being seriously hurt by the Department of Education and Science woefully dragging its feet on the question of student grants for the coming year.

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The school has a long and sometimes stormy history of radicalism in the teaching of architecture. The present difficulties began last May when the Local Authorities Association decided not to pay full grants to incoming students. The DES was approached to make up the difference and has not been heard from since. Well past the middle of July over a hundred students are still waiting to know whether their grants will be paid or not. The planning of staff and teaching arrangements for the coming year is impossible. The delay by the DES is doubly inexcusable in that the AA as well as being the largest and best known school of architecture in the country provides a full architectural education at something like half the rate it currently costs the taxpayer in the polytechnics.

The AA can in fact survive perfectly well on its own. But it would be a very different school to what it is today. Its students would come only from rich families in this country or from America and the Continent where the AA's reputation is enormous. Effectively the AA would become an elitist establishment removed from the mainstream of British architectural thought and activity.

This would be a grave loss, not to the AA itself which would doubtless show its old ability to survive and define a role for itself, but to Britain's architectural education. Far sooner than the polytechnics and the university schools of architecture the AA has detected the huge swing against conventional notions in architecture and begun to respond to the new situation. It has been called the only architecture school with the courage not to teach architecture. And if this means that it refuses just to purvey the conventional wisdom this is largely true.

The failure of contemporary architecture to cope with the real problems of planning urban existence, environmental despoliation, resource depletion and ecological reality is producing an immense reaction both inside and outside the profession. But in too many schools the attitude has been to become more technological and narrow in vision; to put faith in bigger computers and more machines; to refine further and further the traditional design methodologies which have led us where we are. The feeling seems to be that it is in the details of implementation rather than the whole philosophy that the present disasters of our towns and cities are rooted.

The AA has never believed in the technological approach to education. Its teaching spaces and equipment are minimal compared with the lavishly furnished new polytechnics and universities. But it is a laboratory of ideas where staff and students are involved in fundamental debate, questioning and exploration.

Among last year's students a number stand out. Colin Moorcraft's third year thesis has been published commercially. It is the book *Must the Seas Die?* Graham Caine's "ecological" house, an urban dwelling totally self-sustaining and recycling in terms of food, waste and energy, is being built. It is a serious exercise in the ultimate possibilities of urban existence and points the way clearly towards fundamental reconsiderations of urban design values. A Novel Resources Group investigated the possibilities in domestic and small-scale applications of wind, water and solar power. It also began systematic study of the problems of resource depletion and the changing parameters of design arising from the situation.

There is no longer any doubt we are heading into a period of rapid change in contemporary values. Most of this will be unpleasant and bewildering. It will demand flexibility of thought and an ability to break free of the conventions and traditions of current architecture and planning. The need to replace these with ordered and comprehensive alternatives is urgent. But doing so is far from easy.

The AA in its own idiosyncratic way is deeply into the task. This is not earning it friends among those who like education to be tidy, conventional, orderly and the same as when they were growing up. It may indeed be at the root of its present difficulties with the DES. None of this alters the relevance of the job being done.

The AA has been treated shabbily but however the DES decision goes the school will get by. But it will be a sad and grave loss if it is forced into an elitist position and prevented by this from exercising the stimulating and creative influence it has on the thought of this country. One can only hope that Peter Walker, who has shown a greater awareness than most of the need for radical thinking on questions of where, we are heading, will use his influence with his governmental colleagues to ensure the creative energies which the AA contains are deployed for the benefit of the people of this country. Few readers of *The Ecologist* will need any persuading we are going to want all the help we can get in the increasingly gloomy looking decades ahead.

Gerald Foley

York Inner Ring Road

Even planners are becoming aware of the self-defeating aspects of urban motorways—"Building roads is like feeding the pigeons", said Donald Insall in his Conservation Report on Chester, "the more you give the more will come." It is unnecessary here to enlarge upon the well-known facts about noise and air pollution, environmental damage, disruption of communities, blight and human misery which are inherent in these motorways built for the "relief" of urban traffic problems.

In the light of present knowledge building such a road in *any* city is unforgivable—building one in such a city as York adds to the crime of vandalism on an enormous scale.

York is a city which is slow (on the whole, mercifully) to take up new ideas. Regency houses were still being built here ten years after they had gone out of date elsewhere. Ring roads were a new idea before the war, when York first considered one—and now, over 30 years later, and as usual years out of date, the idea has come to monstrous fruition. The City Council proposes to construct a 4-lane dual carriageway inner ring road, comparable in size to London's Westway, complete with roundabouts, underpasses, pedestrian rabbit-holes, high-mast lighting, and all the other hideous trappings of the court of King Car.

It is proposed to build the ring road in three stages over a period of about 6 years—in effect, one part of York would be in an uproar of road-building, with the resultant disturbance to people and to traffic, during all the time between 1974 and 1980. In the early 1990's it is foreseen that the road would be saturated and additional

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lanes would be needed and/or severe traffic restrictions. Civil engineers assure us that the radial roads feeding the motorway would also have to be widened very soon, to prevent congestion at the junctions. This is barely touched upon and not costed in the Council's consultants' report.

For about a third of its approximately 6 km. length, the proposed route (design speed 60 kph) runs by the old City Walls, at times as close as 12m from them, and very near indeed to two of the four historic City gates or Bars. There would be a large intersection within 4m of Walmgate Bar's barbican (the only one of the four which has survived the Goths of a previous century); the buildings clustered round Monk Bar, which give it scale, would have to be demolished. As their foundations are known to be minimal, how long before the City Walls are shaken down?

Lord Mayor's Walk, a fine avenue of ancient lime trees, is likely to lose half of them to the motorway; the road cuts across Bootham School playing fields through the grounds of Bootham Park, more old trees and passing within 125m of Bootham Hospital. Crossing Bootham itself, the road destroys the sequence of one of the two finest entries into York.

The road rises to a high embankment to cross the river at a bridge twice as wide and twice as high as any of the present bridges. Here it would be prominently visible over the treetops from the City Walls and the Yorkshire Museum.

South of the river and behind the railway station the motorway ploughs its way, with embankments, tunnels and two huge roundabouts through a most attractive residential area of mainly eighteenth and nineteenth century houses. The new 4-lane link road to carry the A64 from Leeds into York, passing in part under some of Mill Mount Grammar School's buildings, crosses Blossom Street obliquely near its junction with The Mount, thus interrupting the sweep of the other most beautiful entry into York.

Re-crossing the river on another 4-lane bridge, the motorway passes very close to Fishergate Primary School. A little further on another great roundabout replaces 15 houses and a bowling green. A few hundred yards further on, and close to the Walls now, we arrive back at the great traffic-lighted intersection at Walmgate Bar.

The catalogue of environmental damage, given in detail, could fill three articles of this length. In brief, over 340 buildings, most with a longer potential useful life than the motorway, would be demolished; countless others would be so near the road as to have their amenities destroyed by visual, noise and air pollution. This is for the ring road alone—the number of buildings necessarily demolished in widening the radials has not yet been counted. Taken to its logical conclusion, this plan would lead, by the year 2000, to a York consisting of a tiny gem-like central core, preserved from traffic by being entirely surrounded by concrete—a moat-erway round a museum.

Almost all informed opinion accepts that we want to preserve the central core, that part of the city that lies within the walls, by keeping as much traffic as possible out of the narrow medieval streets, and turning many into foot-streets. The "highwaymen" claim this cannot be done without the motorway, "the cars must have somewhere else to go". This is certainly not proven. In fact, far from being essential, an inner ring road would attract more traffic close to the City Walls; would attract, more than likely, even traffic which should be on the outer bypass, since vehicles, unrestricted, will always choose the shortest possible route; would isolate the centre from those places where most of the citizens live and work, and lay waste some areas which are among the chief glories of York.

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What other ways of dealing with the traffic were considered by the consultants? What evaluations did they do of the cost-benefits of various different schemes, with more emphasis on public transport or traffic management or one-way systems, etc? In a word, None. They were not asked to do so—they were asked only to evaluate the best/cheapest route for a 4-lane ring road. No efficient businessman would consider a scheme, were it to cost only a few thousand pounds, whose promoters had given so little consideration to alternative methods of approach. Yet, apparently, when spending upwards of £10 million and planning to change the appearance of a uniquely beautiful city for ever and for the worse, no such evaluations are required.

The Inner Ring Road proposals were presented by the consultants, R. Travers Morgan and Partners, in association with Land Use Consultants, in a professionally-produced report, with a soothing green cover, in March 1971. Apart from a few people who felt that doing anything about the traffic, however awful its effects, was somehow meritorious, nobody was very happy about it. The York Georgian Society and the York Civic Trust were both very concerned about the original intention to have The Mount area roundabout actually *on* The Mount, in place of the 16 listed Georgian houses at present occupying the site. However, for some unfathomable reason, the executive committees of both societies were prepared to accept, albeit "reluctantly", the philosophy of an urban ring motorway for York. Once the "offset" roundabout, which saved most of The Mount, at the expense of 20 extra houses elsewhere, from demolition (though not from the shadow-blight occasioned by being on top of or very close to the road), was passed by the Council, the Georgian Society at first subsided altogether, and the Civic Trust more or less, although still rumbling gently that it was very unhappy about the siting of a great deal of the rest of the route.

The attitudes of both these societies have since been modified in special general meetings called by dissenting members. The Georgian Society has now said it will object "violently" to that part of the route which runs through Bootham Park. The Civic Trust, slightly more radically, has changed its attitude from "we must accept the road, but we object to several details of it" to "unless our objections to these details can be met, we cannot accept the road". Although this does not go as far as many of the Civic Trust members wish, it is in fact a complete reversal of the former position.

That the Civic Trust should be prepared to accept the road even as a supposed "necessity" is all the more surprising when one reads its representations to the Council while the consultants were still at work; the last section of this document begins: "We hope that no citizen will be in the slightest doubt as to the enormity of the works proposed. Four lanes of fast-moving traffic ringing the City with all the hideous paraphernalia of the motorway; the signs; the bollards; the concrete and all the discordant accoutrements of modern road engineering. It would be sheer self-delusion to imagine that the operations will not constitute the greatest degradation of the city's amenities for many centuries." Fighting words, one would have thought—but only one local amenity society, the York Group for Promotion of Planning, came out unequivocally against the ring road from the beginning.

From the time the consultants' report was published the protest began to grow up in various little groups all over the city, most of them unconscious that anyone else was doing anything. Two or three different petitions against the road were got up; two of them, with 14,835 signatures between them, representing as well as "outsiders" about 13% of the York electorate, were presented to the Town Clerk, a few days before the Planning and Development Committee of the Council took their decision.

Some Councillors were impressed by this evidence of their electorates' feelings; others said it should be disregarded, people would sign anything. Personal experience in the petitioning suggested this was not so—in about 1 in 4 of those approached would not sign, pleading ignorance, indifference, fear of reprisal, or even, occasionally, being in favour of the road. No doubt, many of the signers did not fully understand all the facts, and had not read the consultants' report (price £2.50); but they knew they did not want a motorway in York.

Gradually people from the separate groups began to get together, and as a result of a public meeting in September, the nucleus of a Committee was elected, to think of ways to fight the ring road proposals. This Committee expanded itself by co-option, divided itself into working parties and got down to business.

We were an amorphous group to start with—it is doubtful that any two of us shared quite the same reasons for being against the motorway. One felt that he could not accept the lack of any comparative evaluation; perhaps the scheme was right, but how could he tell on the meagre evidence? Another felt that the scheme was uneconomic, another that it was technically imperfect and unlikely to work. Several felt in one way or another that it was anti-human, anti the kind of place they had chosen to live in, above all anti the York they loved. Some deplored most the loss of trees, others the loss of buildings, some the dividing of communities, others the misery caused to evicted families.

Little by little, as we read much and discussed more, and as though we had been put into a stone-tumbler, all our points of view rubbed off on each other, until today our attitudes are far more homogenous, more informed, and more hardened against the motorway. We are more sure that it would be an irretrievable disaster for York—and worse, a totally unnecessary one, since there are so many other, and reversible, solutions to try.

At last, after 2½ months of, it seemed sometimes, non-stop committee meetings, we were all of a sudden a legally constituted amenity society called York 2000, to express our feelings that planning should be truly for the future, and to stress that we are not "only" preservationists.

We felt it was vitally important that York 2000's fight to save York should not become a "middle-class, elitist" campaign, and therefore the membership fee is only 10 pence, so that nobody who wants to have a stake in York's future need be prevented from joining for financial reasons. This was undoubtedly a right decision, for the society truly represents a cross-section

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of York's citizens. Our less well-off members are by no means the least well-off in their concern for their city or in their social conscience.

There is no question, of course, of enough money being raised from these 10 pence subscriptions alone—we must beg and earn several thousand pounds to pay for preparing our case. Meanwhile, the Council fights *its* case for the motorway with *our*, the ratepayers', money; a distressing anomaly of justice that occurs wherever ordinary people are fighting the Establishment's plans for them.

Our lawyer advised us to spend as much as we could on our planner/expert witness, and put legal help in second place. Professor Lichfield and Mrs. Honor Chapman of Nathanial Lichfield and Associates have taken on the case.

York 2000 had its inaugural meeting of the 21 founder members on 8 December, and its first public meeting 8 days later. On 11 January this year we opened a centre for information, discussion and the recruiting of members. At first this was in an empty shop, which the City Council generously let us have at a charity rent—our charitable status being charmingly described as "educational". And indeed we are trying very hard to get across to the public what is happening, and find, usually, that knowledge overcomes apathy. Six weeks later we moved to an even cheaper though smaller site, at 142 Micklegate, where we are open Tuesdays to Saturdays, 10 a.m. to 4 p.m.

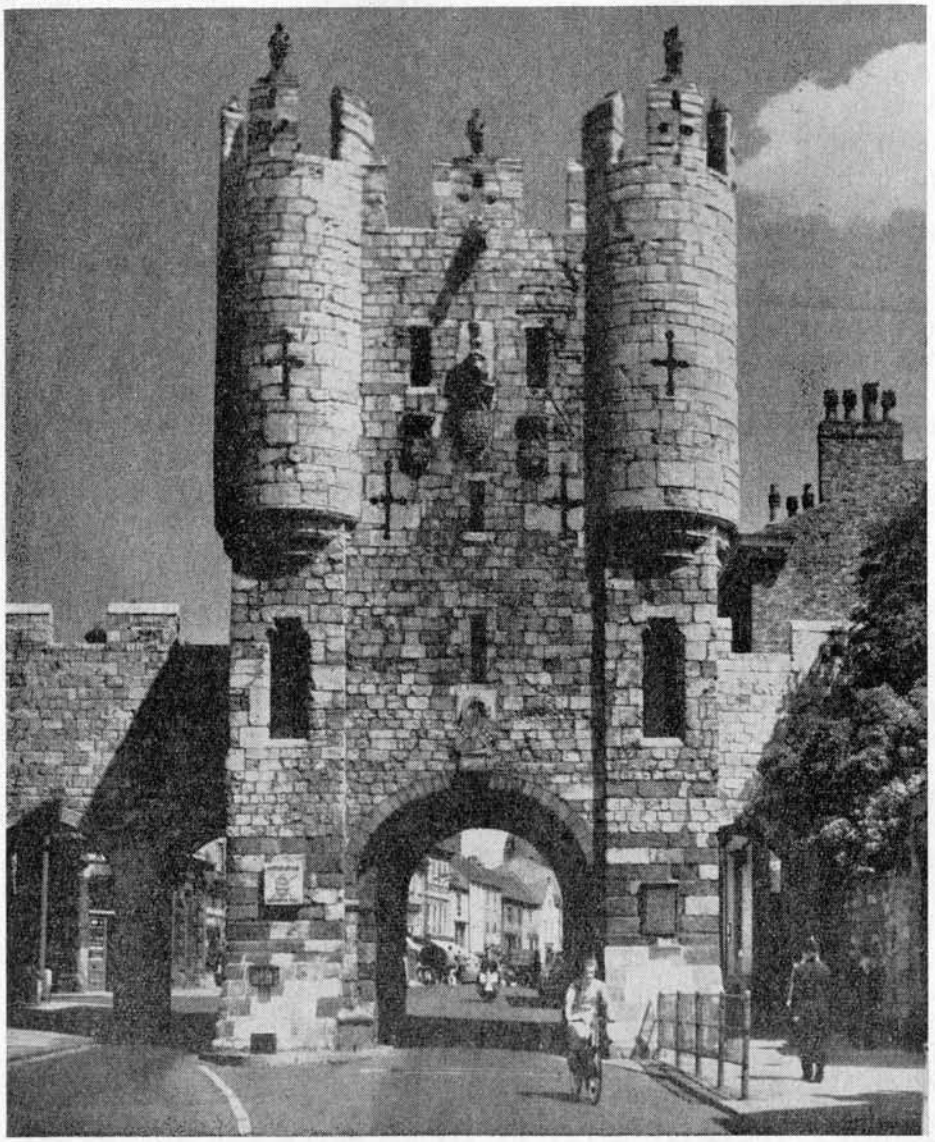
On 11 January we had 635 members. By 16 March, when our objection was sent to the Department of the Environment, it was supported by 3,729 members. We continue to grow daily, and our members are by no means only York citizens. Support for what York 2000 is trying to do comes from as near as neighbouring villages and from as far as emigrant Yorkshiremen in Australia. York, like our other rapidly vanishing historic and beautiful places, is a national and even international concern.

We welcome the support of all who are prepared to give it—public opinion *must* count for something. If the Department of the Environment, after the public enquiry, refers this scheme back to the City Council for reconsideration, an important blow will have been struck for the principle that the needs of human beings, the environment, and the conservation of historic cities matter more than the needs of the motor vehicle. Such a predicament should help all other places threatened by major roadworks.

It would be very fitting if York, long ago the capital of the North, should lead the way once more, by saying No to the insatiable anti-city invader. This Pilgrimage of Grace should have a happier outcome than the last—and be by bus!

By Peta Rée.

Micklegate Bar, York



National Association for Environmental Education

The work of the NAEE has always been well supported by the work of local associations, either based on Counties or Cities. One of the most exciting tasks which an Association can undertake is to act as hosts to the NAEE for its Annual Conference this year to be held at Crewe College of Education, Cheshire.

Demands for conference time are made by the National body for meetings, like the AGM, whilst the local organisers provide a varied programme of lectures, discussions and visits which reflect the character of the locality. This event is always well supported by about 250 of those who believe that one contribution towards "tomorrow's society" is to ensure that they are educated to survive. An invitation is extended to any reader of *The Ecologist* who may wish to meet the educators; details from NAEE General Secretary, County Hall, Bedford.

A great deal of support for the NAEE comes from "in service" training courses for teachers, arranged

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by Local Education Authorities. Recently, such courses have been held in Durham, Hertfordshire, and Nottinghamshire; others are planned by several LGAs for the next academic year. One Conference to be held in September of this year marks a significant step forward in this area of education. The five adjacent Counties of Bedfordshire, Buckinghamshire, Cambridgeshire and Isle of Ely, Hertfordshire and Oxfordshire, have co-operated in the production of a programme for a one-day Conference for Heads of Secondary Schools, entitled "Educational Responsibilities and the Environment". For this, the first and most important Conference, Buckinghamshire Education Committee will be host to the four other counties.

Geothermal power

It is obvious that someone one day would think up the bright idea of blasting the earth's crust apart to get to all that geothermal energy going to waste. And that is precisely what has been done. The American Oil Shale Company and the United States Atomic Energy Commission have prepared *A Feasibility Study of a Plowshare Geothermal Power Plant* in which they concluded that artificially stimulated geothermal power "may prove to be competitive, five to 7 mill/Kwh, under certain conditions".

The details make good reading, and they make one realise just to what lengths man may be prepared to go to energise his power-hungry society. In one method "an array of bombs"—and by that the proposers of the project mean H-bombs—will be exploded in the rock so that the resulting fractures connect together. A power station, which operates on superheated steam obtained by injecting water into the hot rocks, is then built over the breach in the earth's core.

Or, to make the station last longer than the usual 30 years, the power plant could be strengthened or "hardened" so that explosions could be set off beneath it every 10 years. Alternatively, the power station could be mounted on a barge and towed off to a safe distance whenever the rocks need another jog to liven them up.

Fantasy? Read the report.

Peter Bunyard

ECO-cartoon show

A remarkable exhibition has been mounted by a group of environmentalists in Kent, and is now on tour.

Entitled "The World We are Making", it consists of a collection of nearly a hundred cartoons—the original full-size art work—contributed by nationally famous cartoonists, national newspapers and magazines. Pertinent statistics are set out alongside many of the cartoons, so that the exhibition is educational as well as pungent. The numerous artists, each with his own slant and characteristic style, have between them covered the whole field of the global dilemma. Congestion, pollution, depletion of resources, urban degradation, the concrete jungle, the despoiled countryside, threats to wildlife, factory forests, social stresses, intensive farming, and the cult of "growth"—they are all there; often mirrored amusingly or with powerful satire.

Not so funny are some horrific reflections by Ralph Steadman, previously of *The Times*, and the stark drawings of one or two others including Edward McLachlen. Keith Waite of the *Daily Mirror* offers much in a witty and frolicsome mood—the laugh-at-any-cost stoicism of Mr Suburbman, and Fiat of England, advocating the little car, takes a rise out of Mr Superman (in his big car).

Punch has contributed profusely; and from the national press JAK, Garland, Mel Calman, Haro, Mahood, Heath, Larry, Papas, Les Gibbard, Raymond Lowry and Trog are all there—with many others. What an extraordinary response for a cause!

The crescendo, we are delighted to report, is a magnificent panel of the original art work by Richard Willson for the cartoons which appear every month in *The Ecologist*. The quite enormous drawing showing Peter Walker as Canute (the reduction of which appeared in the June issue) forms the centrepiece, and is the one to stand and reflect on before leaving this unique exhibition—a noteworthy contribution towards environmental communication.

The exhibition comprises 65 feet of display (269 sq. ft.), and is easily erected. It is not fully booked for the rest of the year and may be borrowed for environmental occasions on application to Roger Webster, The Roundels, Pennington Lane, Southborough, Kent. Transport at running cost undertaken within 30 miles of Tunbridge Wells (say £2). An ingenious "public opinion poll" panel where voting is carried out by putting plastic coins through slots against subjects, is a means of raising money for societies, and is available with the exhibition.

Classified Adverts

THE ECOLOGIST regrets the delay in sending out the Stockholm ECO sets ordered; they are behind picket lines at London Docks

Ecotechnics

by Arthur J. Puffett

The Case for Improved Insulation

On page 68 of *The Consumers Guide to the Protection of the Environment* are eight lines of text, sandwiched amongst other facts, which should be written in red and underlined.

> "One of the best ways of reducing heating requirements is by properly insulating your home. The first consideration should be to insulate the walls and roof. Only then consider double glazing, since in an ordinary house windows account for only 10-20 per cent of heat loss. It is much cheaper and more effective to insulate walls anyway. This can easily be done with double-walls which are found in most houses built since 1930".

It is a fact that more heat is wasted in domestic premises than is consumed by the whole of British industry.

It is also a fact that the approved Building Regulations recommend a roof insulation level for domestic premises of one inch, whilst for a pig-sty the figure is two inches.

Companies within the Insulation field have been campaigning for some 25 years to increase the insulation levels for new domestic properties. Trade organisations, one of the most active being Eurosol-UK which represents the Association of British Manufacturers of Mineral Insulating Fibres, have been producing fact sheets on energy misuse and abuse for the information of government departments and local authorities.

Britain holds the dubious record of building her houses to the worst thermal insulation standard tolerated by any Western European nation. Because of the considerable heat loss resulting from inferior insulation standards, an unnecessarily large proportion of our national resources is, quite literally, going up in smoke.

Well, just what can the individual do to conserve this energy, how effective will it be, and how much will it cost?

Estimations, taken from a variety of Trade sources, of heat losses through different parts of a house work out as follows:

heat loss through windows—15 per cent

heat loss through walls—up to 35 per cent

heat loss through roofs—up to 30 per cent

These figures are quite an accurate guide, as the old Ministry of Public Buildings and Works estimated that only about 25 per cent of domestic heating should be regarded as effective in heating a house. Of course, conversely it means that 75 per cent of your heating costs are totally wasted!

As the above figures show, the place with the least heat loss, through windows, is usually the first place in the home to merit attention. This, I feel, is directly attributable to either glib salesmen, or the fact that because a window is draughty means, to the average housewife, that heat must be lost in the process (Well dear, windows feel cold, walls don't!). Pressure or ignorance, either way it is by far the most expensive way of reducing heat loss.

Adding an extra inch of insulation to the roof of a house will cost around £5, reducing the heat loss by an average 50 per cent.

Wall insulation is usually carried out by experts, who pump the cavity between the bricks full of urea formaldehyde, a foam which dries to give a texture similar in appearance to polystyrene, but which has many more air pockets to a given area. As this process necessitates drilling holes in the outside walls to force the foam in under pressure, and making the surface good after the job is complete, it is, not surprisingly, more expensive. My own house, an average size of three-bedroom semi-detached with three external walls, cost £80 and took about half a day to complete. However, once again you recoup 75 per cent of the heat which would otherwise escape to waste. Wall insulation has the added benefits of preventing damp from entering through the brickwork, keeping the house cooler in hot weather and improving the value of the house. The cost of this type of insulation is naturally reduced if it is carried out during the building operations, before the roof is fitted.

In the final analysis, therefore, roof insulation is the best value for money, followed by reduction of heat loss through walls.

What, you might ask, is the attitude of Government towards this blatent waste of energy and raw materials?

Mr W. E. Garrett (Wallsend) introduced into the House (25 January 1972) the impressive economic arguments for adapting the Continental Standard for walls and roofs. In reply, Mr Paul Channon, Under-Secretary of State for the Environment, stated that no action was envisaged to improve standards for reasons other than health and safety, and that "The Government are not convinced that thermal insulation would be the solution to what is a much more complex problem". Whilst agreeing that building design is indeed a complex subject, it is simply ludicrous to ignore the fact that improved insulation would, by itself,

(*a*) Save considerable amounts of money

(*b*) Save large quantities of declining fuel resources

(*c*) Improve comfort for the poorer old people who need the maximum benefit from the fuel they use

(*d*) Contribute directly to reducing condensation and damp risk, saving considerable expenditure on repair and redecoration.

In the United States, President Nixon, in a Special Environmental Message to Congress on 8 February 1972, said that he was directing the Federal Housing Administration to reduce heat loss in federal housing by one-third in single family houses and 40 per cent in apartments. The fuel savings which will result from the application of these new standards will, in an average climate, exceed in one year the cost of the additional insulation required.

Next month I will cover some of the more recent advances made to either heat or cool industrial and municipal premises.

Towards a unified science

The Selection of Relevant Data

The notion that the "mind"—by which I presume is meant the "cybernism"—is at birth a "tabula rasa", is inconsistent with the nature of its role as an integral part of a control mechanism.

A rudimentary model of the system, reflecting the experience of the species as a whole, must be inherited by each generation. This model will be postulated by the sub-system at birth as a representation of its system, and data will be detected and cybernised (organised within the cybernism) to the extent that it might serve towards confirming or invalidating it.

The cybernisation of data, and the mediation of an appropriate response, will then serve to modify the model so that it will furnish an ever more accurate representation of the system.

The detection of data and its organisation into information is consequently best regarded as a series of processes designed to bring about successive reductions in the errors or deviations from the optimum course, or "creode"[1] that will enable the sub-system to maintain a stable relationship with its environment, i.e. with the larger system of which it is part, by bringing about a compensatory series of improvements to the representational ability of the model on which such actions are based.

There is no reason to suppose that the collation of scientific data should occur in any other way. It may be objected that this is contrary to the very principle of experimentation that is considered to be at the basis of modern scientific method. This is not so. The role of experimentation is precisely to determine as objectively as possible the validity of a previously established hypothesis. What it is contrary to, however, is blind random experimentation which, outside financially overendowed laboratories, has no counterpart in the "natural" world. If this is true then scientific theories, rather than being reached "inductively", in accordance with empiricist theory, must be regarded as *postulated*.

In this way, Le Verrier postulated, by purely mathematical means, the then unknown planet Neptune as an explanation of certain otherwise inexplicable disturbances of the other planets. Later, "... when the German astronomer Gelle directed his telescope to the spot in the night sky that had been figured out by Le Verrier, he saw there a tiny speck that changed its position slightly from night to night and the planet Neptune was discovered (1846)".[2]

Dirac postulated the positron as the most elegant way of explaining certain atomic phenomena inexplicable in terms of existing variables.

Epicurus and his disciple Lucretius postulated the atom, and Bohr postulated the modern version of this ancient hypothesis. Watson and Crick proceeded in the same manner when developing the genetic code, as is revealed in the latter's book, *The Double Helix*.[3] These discoveries are well-known. There is a tendency, however, to regard them as scientific curiosities—and as exceptions to the general rule that science develops inductively by the meticulous examination of impartially accumulated data, in accordance with the empiricist thesis. *On the contrary, it can be shown that they are merely striking examples of what is the only possible method of science.*

If this were not the case, what would be the point of acquiring knowledge? In what way should a specialist be more capable of solving a problem pertaining to his speciality than the layman?

There is no reason to suppose that scientific explanations can take any other form; and this must be true for all the disciplines into which science is at present divided.

Thus, in the field of psycho-analysis, the existence of the unconscious, the theory of the Oedipus complex, the concept of repression were simply postulates to explain certain aspects of pathological mental behaviour observed by Freud during his clinical practice, and the data that he collated served but to confirm their applicability, while that subsequently gathered by his antagonists served, on the contrary to invalidate them.

In the field of psychiatry, neuroses were postulated by Pavlov to explain the strange behaviour of the dogs that he frustrated experimentally. Schizophrenia, psychoses, manic depression, are all hypotheses postulated to explain related types of mental disorder. And so we can go on ad infinitum, and include in our list all the basic laws of science at all levels of complexity: the famous first and second laws of thermodynamics, Newton's gravity, Darwin's natural selection, Einstein's relativity, are all hypotheses postulated in like manner.

Each offers that explanation that appears to fit in best with available information, all of which was collated directively for its relevance to the hypothesis in question, or to its predecessor or rivals—but only accidentally at random, i.e. in accordance with empiricist method.

Edward Goldsmith

References:
1. Waddington, C. H. *Strategy of the Genes* George Allen & Unwin.
2. Reichenback, Hans. *The Rise of Scientific Philosophy* p. 102.
3. Watson and Crick, *The Double Helix.*

Down to Earth

by Lawrence D. Hills

Power Without Glory

All through the past electricity strike, the miners' strike, and right back through power cuts and load shedding to 1935, the monster electric motors, thicker than bass drums, driving the pumps that pour a hundred million gallons of sewage a day into the mighty Mogden Sewage Works, have spun without faltering. For they are powered via 15 dual-fuel engines totalling 10,700 h.p. by the methane gas provided by the 1½ million Londoners whom Mogden serves.

This 480 cubic feet of gas a year from every citizen's personal contribution to the pollution problem, does more than power everything at Mogden from mighty pumps to typists' tea kettles. It dries 1,100 tons a year of sewage sludge to "Morganic" which is an excellent garden fertiliser, especially for lawns, which it feeds at about a quarter the delivered price of lawn-sand. And it provides enough surplus methane to sell for £12,000 a year to industry for use in various chemical processes for which it is superior to North Sea gas because of its purity.

So great is this demand that there is a strong temptation for the Greater London Council to sell all the methane at a price that makes it too good to burn, and run the whole works on mains electricity to save the ratepayers' money. Then the monuments to British engineering in 1935, which would cost millions to replace at today's prices even from Japan, could rest with their brass gleaming and their green paint lovingly renewed, until once more the power stations are picketed, and they must thunder again. For even if strikers down tools, they still pull chains.

The obvious development is to make more methane by adding pulverised domestic refuse to increase the available energy, which is never more than enough to run the sewage works with a small surplus, which adds up to a large one with a giant plant like Mogden. The work of Dr. S. A. Klein at the University of California has shown that this is possible, at a lower capital investment than incineration. He found that dustbin refuse with the plastics, metals and glass removed, if pulverised and pumped into the digester with raw sewage, released 90.8 per cent of its energy. Brown paper and cartons gave up to 94.6 per cent, newsprint 44.3 per cent, and wood shavings only 4 per cent, which stopped the process; they were undigestible.

The resulting liquid sludge would be enriched with all the potash from the timber that made the paper, until it would become a balanced fertiliser, either for direct distribution by tanker or drying to a product more saleable than Morganic which contains only a trace of potassium. The engineering problems are those of modifying existing digesters to take the added materials, with agitators to keep the mixture even. A plant near to a chemical factory paying more than a power price for methane would be of priceless value in winning new knowledge for our fuel-hungry future. The new British process for making building board from mixed plastics would combine well with this development of municipal composting that could pay commercially when fuel costs double.

The problems of methane gas generation are interest on capital and the cheapness of competing fuels, *while they last.* At present generators can only pay in extreme isolation, as in parts of France where 1,000 are reputed to be in operation, and the 2,500 running in India where cow dung has always been used for cooking, and the addition of farm wastes via a generator produces a better manure in terms of welcome fertility as well as fuel.

Britain's first farm methane gas plant was built by Dennis Tollemache in the early 1950s on a Gloucestershire farm so isolated that the electricity installation charge was £500. The Tollemache plant consisted of a concrete tank divided into three compartments, each covered with a metal gas collecting lid, a small "gasometer", and a device for burning an average fifth of the production, mostly in winter, to keep the tanks at the 86°F. that the bacteria for anaerobic digestion need.

The production was 300 cubic feet a day (equivalent to £2.75 worth of bottled gas today), enough for cooking, generous heating of the old farmhouse with gas fires, bath water, and lighting. Because of the advantages of switching on over mantles and matches, a 1½ hp four-stroke petrol engined generator was installed for lighting, which also ran a circular saw and a feed mixer. The fittings were all standard Calor gas type, and the plant ran successfully for many years, until mains electricity arrived as the area became less isolated.

It fed on pig manure plus extra straw, for there was at the time £13 worth of petrol equivalent in a ton of dry wheat straw, and the charges were stacked outside the compartments for a preliminary heat before they were forked in to the next one ready for a refill. The bulk of the straw and manure was reduced by about a third from breaking down 40 per cent of the cellulose, 30 per cent of the hemicellulose and 20 per cent of the lignins, and the spent charge contained 25 per cent more nitrogen, three times the phosphates and about the same potash as the manure that went in, because it was concentrated by the loss of the material expended in producing the gas.

The methane process saves all the minerals, but takes out the energy that keeps manure piles steaming, or burns to waste in heating compost heaps. There is still enough left to power the life of the soil from bacteria and fungi to earthworms and the birds that eat them and fly on the energy that goes back to the land in humus.

The Tollemache plant cost £500 in 1952, which inflation would make £3,000 today. Interest on capital at seven per cent on this sum is far more than enough to pay for electricity to do all the jobs that the methane did, while the wages of the man to fork the manure in and the spent charges out would alone be more than the electricity bill. This is why there are rumours of cars running on pig manure, but no commercial methane gas generator on the market, and why sewage and dustbin refuse that must be handled anyway, offers the best prospect for further development of this vitally important process.

As in every field of conservation, our need is for research in time to produce workable answers before the problems of waste and pollution overtake us. Methane gas offers mankind a new way of living on our income from the sunlight on the living leaves and yet preserving the humus and plant foods our soil must have if it is to stay alive.

Friends of the Earth Newsletter

DTI Fraud

On 27 March 1972 Mr. Anthony Grant, then Parliamentary Under-Secretary of State for Trade, replying to a question from Mr J. Johnson MP (Kingston-upon-Hull West) about the conservation of endangered species of animals, said "With effect from midnight 27 March, imports of furs, skins, rugs and coverlets obtained from the tiger and the snow and clouded leopards will be prohibited. Imports of such goods obtained from all other leopards and the cheetah will continue to be permitted, but only where we are satisfied that they have been legally exported from the countries of origin, in accordance with local conservation requirements."

This encouraging first step, although far from being the conservationist's idea of a comprehensive approach to the problem, was seen by everyone at the press conference as the end of British complicity in the demise of three cats at least. The DTI apparently took a different view for the actual wording of the DTI Order reads as follows:

"On and after March 28, it will no longer be possible to import under the Open General Import Licence the following:

Raw, tanned or dressed fur skins (other than tanned or dressed fur skins assembled in plates, crosses and similar forms) or rugs or coverlets made from fur skins of the following species:

Clouded Leopard (*Neofelis nebulosa*)
Snow Leopard (*Uncia uncia*)
Leopard (*Panthera pardus*)
Tiger (*Panthera tigris*)
Cheetah (*Acinonyx jubatus*)"

The important difference between what Mr Grant said and did, is to be found in the documents quoted above. Mr Grant *said* that "furs, skins, rugs and coverlets" obtained from (for instance) the tiger would be banned. By using two separate terms "furs" and "skins", the public servant responsible for Trade convinced the public that the ban was a comprehensive one—that it would cover what the public understood it to cover, i.e. goods which are made up from tiger skins, as well as un-made up tiger skins. In that tiger skin coats are furs and made of tiger skins, both of which were to be banned, there appeared to be control of the importation of tiger skin coats. This was the way Mr Grant's announcement was read and this was the way it was intended to be read.

However, the actual Order appears specifically to exclude skins made up into plates, let alone coats. And when Friends of the Earth asked the DTI whether this was the case, we were told that the ban does not cover fur coats: the controls covered two things:

(*a*) raw fur skins
(*b*) rugs and coverlets

However, the DTI now inform us that the "total ban" announced by Mr Grant is no such thing: it does not cover plates, let alone coats.

What was reported by all the Press as a meaningful step in the right direction, was actually an enormously successful public relations exercise, which will result in made up coats coming into the country, rather than raw skins. The only thing that has changed, is that millions of people now believe that the U.K. has outlawed the importation of tiger skin (and snow and clouded leopard skin) coats.

We have done no such thing. The campaign goes on.

Copies of the updated Endangered Species Manual can be obtained from FOE at 10p plus postage.

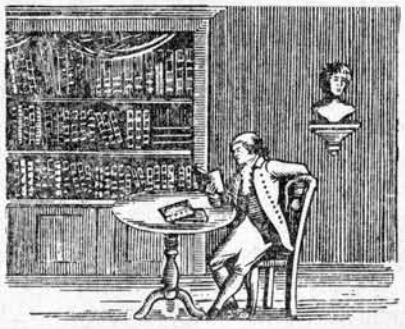
More news

This newsletter was originally designed to provide some sort of link, however, weak, between a small group of people in London and its 1,500 individual members scattered throughout the country. Over the last few months the position has changed drastically as FOE members now number 3,000 and are rapidly organising local "cells" to facilitate attacks on local issues. These groups are the deciding factor in any FOE National Campaign and as such we attempt to service and help them to the best of our ability. For many other members who are still isolated and not a part of any organised group, such preferential treatment may at first seem unfair but FOE must impress upon any dissenters that it is only through absolute necessity that we are unable to give an ideal personalised service. 3,000 letters every two months would seriously impair our financial position not to mention the mental health of our staff.

Population Stabilisation is (appropriately) a very small group of people dedicated to creating greater awareness of the population problem by unique methods. At the end of 1971 they undertook a case study of the London Borough of Southwark and brought to the attention of the council the problems created by the lack of free contraceptives and family planning clinics. This line of approach was used in various other boroughs by their rapidly establishing cells throughout London and the regions and resulted in their first victory in March 1972 when the London Borough of Westminster began to issue free contraceptives as a direct result of PS pressure. They need help and support and would welcome a line or two from anyone interested in helping in any way possible. Contact Rosamund McDougall or Colin Hines at 18 Bridstow Place, London W2 (Tel: 01-229 4950).

The Packaging Campaign is still very much alive. Having had such a successful Packaging Day on 25 March and a favourable response from the Conference on Packaging and Litter on the 27th, Graham Searle has written to Eldon Griffiths (the Parliamentary Under-Secretary of State for the Environment) to establish the exact terms of reference under which the promised Government Working Party will work. Typically, the Department of the Environment has deemed it necessary to delay a reply to Graham's letter which has forced us to write again with, at the moment, no response. Most of our groups, notably those in East Anglia, are continuing the campaign and are making their presence felt in town after town throughout the area with embarrassing regularity. Many other groups are following up the campaign by writing to supermarket managers and asking them for justification of their policies. Some replies lead to open debates between interested parties and provide good campaign material.

Peter Wilkinson



Books

All's wrong with the world

CAN MAN SURVIVE? by Hugh Montefiore. Fontana.
POLLUTION AND THE DEATH OF MAN—THE CHRISTIAN VIEW OF ECOLOGY, by Francis A. Schaeffer. Hodder and Stoughton.
FROM HERE TO WHERE? Report on an exploratory conference. David M. Gill (ed) World Council of Churches.

"Conservation" some people say "is a religious issue" and amen to that. The ecologists are pointing to the state of the environment, the economists to the difficulties in doing anything about it and the politicians—are waiting for public opinion to force them into action. But whatever the issue it comes back in the end to the need for man to do something about himself and this is where the Faithful—and others—need to take a hand.

It is therefore a pleasure to see works on the environment by Christian writers beginning to appear. There are also those who would say that the teachings of Christianity have contributed towards the present state of things with all this "be fruitful and multiply" and "subdue the earth" business. If there is a common theme in the books listed above it is that Christianity must admit to its contribution to the process of environmental degradation as well as play a part in putting things to rights.

The book by Montefiore is probably the best of the three. It is readable, logical and makes an attempt to get to the roots of the problem. As a university lecturer in the New Testament for nine years and vicar of Great St. Mary's, Cambridge, for seven, Montefiore must be regarded as a self-made man as far as his knowledge of conservation is concerned. His first lecture (part I of the book consists of the text of three lectures which he gave at the Queen's University, Belfast, in 1969) presents the facts of the environmental situation and shows wide reading.

His study of the subject gives Montefiore little grounds for joy. He finds the writers unable to offer much hope for the future or suggest acceptable ways of overcoming our problems; in some the attitude amounts to one of resignation. He takes up the implied humanism which is evident in some of the works and finds it wanting. "When it comes to the crunch—will men be prepared on merely humanistic grounds to alter deeply settled habits and convictions? Personally I doubt whether a purely humanist appeal to mankind is likely to succeed. It is more likely that posterity will have to take its chance—and we know what that means."[1]

Montefiore finds his hope, not unnaturally, in a purposeful faith in God and a revitalised Christianity. Taking Koestler as his guide he redefines "original sin" as the mental split between man's faith and reason, emotion and intellect. This is merely putting into other words the Christian definition which has come down the ages, but this of course is the point: he shows that this is where Christianity can play its part making man whole so that his moral awareness is not left way behind by his intellectual ability. Semantic sleight of hand to enable the Christian to get in on the act? I think not.

Montefiore realises that more than "whole" men are needed, for if Christianity is to play its full part it must find a new eternal perspective, it must give to men a new vision of things to come, so sadly lacking in much contemporary theology. At the end we are left with the inevitable question—can the church do it or will it continue to be overtaken by events? On present showing the institutional church needs more than a call to action if it is to succeed.

If one can take his simplistic, fundamentalist theology, some good stuff can be found in the work by Schaeffer. For example one can readily agree with him that the Christian's preoccupation with man—God and man—man relationships down the ages has left little room for consideration of the man—nature element. Like Lynn White[2] his patron saint is St. Francis of Assisi and he would have us all (quite rightly I feel sure) refer to members of the family *fagaceae* as brother oak or sister beech.

Schaeffer also has a go at the "isms" and that which goes for Christianity in certain places. Not for him the pantheism (so he says) of Edmund Leach and Fraser Darling, for pantheism lowers man rather than raises the rest of nature. Neither will he accept a heavenly sort of Christianity that is no earthly use and does not give a right God-man-nature relationship. Good stuff to hear from a fundamentalist for, of all camps within the Christian field, his is probably more "heavenly" than most.

Schaeffer puts it differently from Montefiore by defining the Fall as the time when man became divided from God, from others, from nature and also from himself. But he is at one with him when he calls for a spiritual healing which is necessary in order that man may use rather than abuse nature and work with rather than against his brothers. The place of the Church, he says, is to act as a "pilot plant", an example to the world, or as Christ put it a leaven in the lump. Almost within the Christian radical tradition this stuff, and more acceptable to many younger Christians than the middle of the road philosophy by which the majority of Christians are still identified.

The conference report by Gill shows the same kind of weaknesses common to much other World Council of Churches literature of this type. Inevitably a conference made up of clerical and lay representatives drawn from all over the world, has all shades of opinion

[1] See p. 53.

[2] See "The Environmental Handbook", p. 3.

represented within its ranks and a report which reflects all sides of the discussion cannot at the same time present conclusions which are clear cut or satisfy any one group. The situation was made even worse in this case, for there was a division between the lay "specialists" who spoke on the problems of ecology, urbanisation, computers and the rest and the theologians who tended to talk in generalities. One had the feeling that neither side really understood the other.

It was disturbing to see that some of the delegates still appeared to be fighting the old science—religion battle which for most Christians came to an end many years ago. It was clear that nothing revolutionary was going to come out of the conference when the economists present were saying that it was not too many people, nor too much economic growth, nor the chase for profits and progress which was at the root of the trouble but "external diseconomies". I suppose for Western economists to break away from their belief in growth and profits would be like expecting Christians to renounce their belief in God—except that some are even doing this these days.

Although this book fails to bring us any blueprint for action, it does allow us an insight into the problems raised by an international interdisciplinary conference discussing the pros and cons of the environment.

It is good to see Christians entering into the debate, even if they are so far unable to give the world the message of hope it is seeking. One of the weaknesses of so much conservation writing is the lack of hard study of the problem of man as a person and ways in which he can be changed so that posterity is assured. The sociologist and the psychologist should have something to offer in this field but if this really is a spiritual problem that confronts us then the theologian ought to have something useful to say. We might even be led these days to cry "God help us", and if nothing comes back from this then we really are doomed. Of course if you are a Christian then the "Doomsday" could be called the Great Summing Up of All Things to which the faithful have always looked forward—if you still believe there are places called Heaven or Hell to go to when it is all over.

J. K. Pamoin

Coming events

26 August—Wildlife Gala Day, to be opened by former Miss World and now Miss World Wildlife at The Grange, North Rode, Congleton, Cheshire at 2 p.m. An action-packed programme, it includes a free draw for all purchasers of programmes (whether they attend the event or not) for a week's holiday for two in Paris, Amsterdam or Brussels. Admission Programme is 10p.

23 August–3 September—The International Water Conservancy Exhibition (Jönköping) organised in collaboration with the National Swedish Environment Protection Board, the Swedish Association for Water Hygiene, the Swedish Water and Air Pollution Research Laboratory and the Water Purification Group within the Swedish Association of Metalworking Industries. Further details: R. D. Sherman, Exhibition Consultants Ltd., 11 Manchester Square, London, W1. Tel 01-486 1951.

15-17 September—Is Construction Destruction? J.L.O. Conference 1972 will be held at the University of East Anglia, Norwich, and will investigate environmental problems from a building and architectural angle and pose possible solutions. The forum includes: on Friday p.m. a talk by Dr. John Davoll, Director of the Conservation Society Associate Editor of the Ecologist with the film 'Limits to Growth'. Further information: Michael Oliver, Administrative Secretary of the J.L.O., Institution of Heating and Ventilation Engineers, 49 Cadogan Square, SW1.

Feedback

1 Venereal disease

The National Commission on Venereal Disease recommended to HEW this week that the Federal Government step up its efforts to stamp out venereal disease. The 80,000 cases of infectious syphilis and 2.2 million cases of gonorrhea in 1971 are considered to be epidemic. The commission says Federal funding for VD control should be increased from the present $12.9 million to $46.1 million next year. They also recommend that schools begin coeducational programmes about VD no later than the 7th grade.

Source: *Science News*, Vol. 101, 8 April, 1972

2 11 Million unemployed by 1980

More than 11 million of Africa's 160 million working population will be unemployed by 1980 if present trends continue according to an FAO projection. The estimate was obtained by comparison between both the projection of employment opportunities offered by the whole of the economic sectors and the projection of the population considered as potentially and economically active during the period 1970-1980.

Source: *Ceres—FAO Review*, Vol. 5, No. 2, Mar-Apr. 1972.

3 Nuclear outlook

Nuclear power plants are in operation or under construction in more than 20 countries. Total world nuclear power production is expected to grow from its present 24,000 MWe to 345,000 MWe by the year 1980, and to 4,260,000 MWe by the year 2000. The output in developing countries is expected to increase from the present 500 MWe to 22,500 MWe by the year 1980 and to 790,000 MWe by the year 2000.

Source: *WHO Chronicle*, Vol. 26, No. 6, June 1972.

4 Heavy metals in the Severn Estuary

The Severn Estuary appears to be highly contaminated with heavy metals. A report published in the *Marine Pollution Bulletin* shows that zinc concentrations in certain marine organisms in the Portishead/Avonmouth area are 80 times above the level at present regarded as safe.

Cadmium levels in the same area in the shell fish fucus have been found to be as high as 220 ppm, and in patella 550 ppm. 2 ppm wet rate is regarded as acceptable in the US which means roughly 10 ppm dry rate. The levels decrease down the coast and are about 15 ppm in fucus and 30 in patella at Hartland.

Concentrations of lead in the Severn Estuary are also well above permissible levels. Thus at Portishead 8.5 ppm were also found in fucus and patella. This is more than four times higher than the present permissible level in this country. (See Statutory Instruments 1961.)

One wonders what these levels will be when the Severnside plan is implemented, and an extra 500,000 people, plus factories and power stations are allowed to increase the pollution load. It also makes one wonder how far we are away from a serious Minamata-type accident.

Source: *Marine Pollution Bulletin*, Vol. 3, No. 5, May 1972, and editorial comment.

5 Poultry disease

"During the last ten years or more I have become aware of several diseases which have become much more prevalent, particularly since the intensive breeding of poultry has been established. I have been looking at the 'innards' of poultry for many years and I am sure that I did not see some of the diseases which are nowadays almost an everyday occurrence.

"In older birds, particularly, a disease known for want of a better phrase as 'Avian leucosis complex' is very common these days. There are various types of this disease:

1. Visceral (big liver disease)
2. Neural (fowl paralysis)
3. Ocular (grey eye)
4. Osteo-Petrosis (marble bones)

"The origin of this disease is still not quite understood. Some authorities attribute it to a viral infection, others to an abnormal increase in blood cells and others to neoplasms or milliary tumours.

"A disease affecting young chickens is known as 'chronic respiratory disease' and has become important because of the economic loss particularly in commercial broiler plant areas. CRD, sometimes known as 'air saculitis' infection, although it does not cause great mortality, does cause severe loss in weight and condition. The disease is caused by a pleuro pneumonia-like organism which once in the brood is very difficult to eradicate.

"The viscera of these birds is covered with a slimy, false membrane and the heart sac is thick and white.

"Many other diseases are still found in the inspection of poultry—oedema or dropsy of the belly cavity (often associated nowadays with leucosis;

tumours—both in the viscera and in the muscle; black head in turkeys; obstruction of the oviduct; breast blisters or abscesses; perosis and other infections of the joints—the list is almost inexhaustible.

"Salmonellae are often associated with some disease of poultry of which pullorum or bacillary white diarrhoea, is probably the most common as far as the poultry keeper is concerned. *Salmonellae typhimurium* and *Salmonellae thompson* are both widely distributed in turkeys and ducklings and these organisms are often the cause of food poisoning in man.

"The two notifiable diseases of poultry are fowl pest and Newcastle disease and anybody engaged in an establishment where there is live poultry should look out for symptoms of these two diseases.

"Though diseases have changed dramatically over the years, there is a considerable number of diseases of poultry which can cause a hazard to health. More so, when we take into account disease such as leucosis or lymphamatosis where the actual cause of the disease is still not understood. Even though diseased poultry may be sterilised by subsequent cooking, and this may be wishful thinking, I see no reasons why the public should have to eat sterilised abcesses or tumours."
By R. S. Barber, F.A.P.H.I. Senior Meat Inspector, London Borough of Islington.
Source: *Environmental Health*, May 1972, Vol. 80, No. 5.

6 Crime

A report on crime which covers England and Wales (excluding the Metropolitan area) shows that crime has risen by 16.4 per cent last year. The total of indictable offences was 1,309,503: 74,664 higher than in 1970 —which represents a 6 per cent increase. Of this 39,258 were violent crimes against the person. Offences against property involving violence increased by 4.6 per cent.

There is an 18.5 per cent increase in shoplifting to 104,424 cases. The only consolation is that crime detection, according to Sir J. Mackay, is improving.
Source: *Guardian*, 19 June, 1972.

7 Victory for the Environmentalists

The Environmental Protection Agency has ordered the banning of DDT for almost all uses in the USA, though it could well be used at home for the control of pests affecting sweet potatoes in storage, green peppers and onions. These, however, account for less than 1 per cent of the 14 milion lb of DDT sold annually in the US.

Mr Ruckelshaus, the director of the Agency, said that DDT was "an uncontrollable, durable chemical that . . . collects in the food-chain and is passed up to higher forms of aquatic and terrestial life."

"There was compelling evidence," he continued, "that DDT harmed fish and bird life and a possibility that it could cause cancer in man. The economic benefits from the use of the pesticide did not outweigh its dangers."

Unfortuntately nothing has been done to stop the export of DDT to other countries. This is running at £26 million a year. At a press conference in London at the American Embassy, Mr Ruckelshaus declared that he had no control over US exports of this chemical. It is up to other importing countries to make their cost benefit analysis to determine whether the use of DDT was justified.
Source: *The Times*, 15 June 1972.

8 Fertilisers, cigarettes and cancer—a link?

It may be the fertilisers used in the growing of tobacco plants that are the link between cigarette smoking and lung cancer. This suggestion is made by John W. Rhoades and Donald E. Johnson of the Southwest Research Institute, San Antonio, Texas, writing in the scientific journal *Nature* on 17 April; and their own research findings are supported by those of a team at the Eastern Marketing and Nutrition Research Division of the US Department of Agriculture.

The probable carcinogen is N–dimethylnitrosamine (DMN). N–nitrosamines are known to cause cancer. They are formed by the combination of nitrate and/or nitrite with amines. Amines occur naturally in biological systems, thus the addition of nitrate or nitrite to the environment, or to the tissue of any plant or food product is possibly hazardous to health. For many years, however, it was believed that the risk to human health was minimal because so far as was known N–nitrosation reactions, which lead to N–nitrosamine formation, occurred only with a certain group of amines that are not very common. The US Dept. of Agriculture team has discovered that the reaction also occurs with more common amine groups. This would suggest that the formation of N–nitrosamines may be accelerated by the addition of nitrate to the environment in the form of nitrogenous fertilisers.
Source: *SPAN*, No. 60, June 1972.

9 Organic substitute for DDT

"Garlic may provide an insecticide as effective as DDT and a bactericide that kills bacteria on which penicillin has little effect, according to Mgr David Greenstock after eight years research sponsored by the Henry Doubleday Research Association. Having isolated the oil of garlic, emulsified it and added a spreading agent, its insecticidal properties were then examined. In field trials, the most satisfactory emulsions achieved an 89 per cent kill of aphides, a 91 per cent kill of *Yponomeuta malinelus*, a 95 per cent kill of *Hylema antiqua* (onion fly), an 88 per cent kill of *Thaumetopoea pityocampa*, and an 82 per cent kill of *Colaspidema atrum*.

When tested for its toxicity on animals, some strange results appeared. Hens were less prone to bronchial infections and egg yolks darkened in colour, rabbits were more resistant to myxamatosis and intestinal infections."
Source: *SPAN—Soil Association News*. No. 60, June 1972. (The full report, *Garlic as an Insecticide* by D. L. Greenstock and Querubin Larrea, is obtainable from the Henry Doubleday Research Association, 20 Convent Lane, Bocking, Braintree, Essex. U.K. price 12p post free.)

Letters

New Myths for Old

Dear Sir,

Gerald Foley's article ("New Myths for Old", *The Ecologist*, February 1972) does a disservice to the conservation movement: one might appropriately jibe that the paper would have been better left on the tree! His assertions, virtually devoid of factual backup, are exactly the kind of "hysteria" that *Nature* sees fit to deride; they are unlikely to assist the "converted", still less to cut any ice with the ilk of Lord Stokes.

The present strength of the conservation movement lies in its heavy foundation of incontrovertible scientific data, and journal articles which add to this foundation are invaluable, constituting a concrete stick (excuse the mixed metaphor!) with which to beat vested interests. I am not remotely interested in the Dublin night-life that Mr Foley writes of: I *am* interested in credible costed analyses of the alternatives to the present structure of the nation's transport system, for example: intensive subsidised public transport versus urban road "improvement", subsidised car-carrier trains versus motorways, horse versus motor power for delivery work, perhaps a national 25 m.p.h. speed limit, or even State restrictions on mobility: I want facts, figures and references.

I should add that I personally agree with most of Mr Foley's views, but I see no virtue in preaching to the converted and feel that a less committed reader may well be alienated by the aggressive phraseology.

On another matter, might I suggest that you publish a brief biography of the author with each article, thus establishing their credentials?

Sincerely,
Peter S. Excell,
51 Ashgrove,
Bradford 7, Yorks.

Courses in Human Ecology

Dear Sir,

Further to your guide of courses in human ecology published in Vol. 2 No. 5, you may wish to add the following courses which will be available from the Open University in 1974 (commencing Jan.)

The Earth Resources & Environment ½ credit
Ecology ½ credit

Although no formal qualifications are necessary to enrol for these courses, intending students would be well advised to take a preparatory course in 1973.

Yours faithfully,
R. B. Turner,
9 The Forum,
Chidham Park, Havant PO9 1DR.

Antiseptic countryside

Dear Sir,

Frank Fraser Darling, a man whom I have held in high esteem in the past, has rather puzzled me recently. He welcomed *A Blueprint for Survival* because it was a sane document while condemning hysterical conservationists who are supposedly giving the movement a bad name. Who are these people? He has also stated that he is in agreement with the plans to rear red deer in captivity. I agree with him when he says that we need "wild meat", but for how long will it be wild? Food additives to increase meat production are widely used; can we guarantee that they would not be used in this context? Profit maximisation is no stranger to farmers and surely this is farming. The question of raising wild animals in captivity needs looking at very carefully. Culling wild populations in the absence of natural predators is one thing, this is quite another.

Fraser Darling has also said that conservationists should be content with what we've got with regards to particular wild life species. In other words, be content with foxes and forget that we once had lynx, wolf, brown bear and other carnivores. The fact that we only have plenty of foxes is due to the resilience of these animals and because their natural competitors are gone, could also be forgotten.

We are now teaching children that ecological diversification is a crucial factor with regard to stability. In this country we can point to our often antiseptic countryside and remind them that Man with gun and Man with axe replaces the functions of those animals man has exterminated, so that we have to control deer numbers, forestry, water levels etc. The old continuing idea that the British countryside is in a healthy state should be buried once and for all when diversification is obviously not apparent.

Many countries in Europe are now reintroducing wisent, beaver, boar etc. in suitable localities but in Britain we have a Forestry Commission which has recently re-exterminated boar introduced into a Scottish woodland and we have a leading conservationist apparently telling us to be satisfied with our degraded land and implying that diversification should not be our aim. Please explain yourself Sir Frank.

Yours sincerely,
Ed Sones,
Cowley Wood,
Nr. Parracombe, North Devon.

Phosphates in detergent

Dear Sir,

In connection with our correspondence with Mary Anne Baker (May), we are sorry that a magazine like *The Ecologist* should use words like "irresponsible", "false and reprehensible" about a statement on detergent phosphates which is the view of the Government Standing Technical Committee on Synthetic Detergents.

Here is what that Committee says in its 12th Annual Report, published in 1971:

> "We have devoted considerable time and effort to a study of the problems attributed to phosphate residues derived from detergent products and their relation to the processes of eutrophication. We have concluded that no significant problem has been shown to exist in the UK and there is as yet no case for recommending specific treatment to remove phosphate from sewage effluent, although suitable processes are available." (para 98(j)).

We hope you will publish this letter to set the record straight and also to draw the attention of your readers to the work of the Government Standing Technical Committee on Synthetic Detergents whose 13th Report is shortly expected.

Your faithfully,
D. S. Hudson (Company Secretary),
Procter & Gamble Ltd.,
P.O. Box 1EE,
Gosforth, Newcastle-upon-Tyne

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