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The Myth of Nuclear Safety

Academics and the Environment

NUCLEAR POWER IN CENTRAL EUROPE

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This Month's Front Cover Design : Elizabeth Moya from a photograph of police at an anti-nuclear demonstration.

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Editorial

THE REYKJAVIK CONFERENCE ON THE ENVIRONMENTAL FUTURE

Five years ago a group of very eminent scientists whose specialised work has led them to consider different aspects of the environmental crisis got together at Helsinki, at the instigation of Professor Nicholas Polunin, one time Professor of Ecology at Oxford University and now editor of the journal *Environmental Conservation*, to examine together the future of the Global Environment and hence of Man.

The proceedings of the Conference, published by Macmillans in London is still today one of the most illuminating works of reference on this subject. Last week this group, with a few additions, and a few subtractions too, met again, this time at Reykjavik.

What was new at the Conference?

The first question one might ask is whether any new information actually emerged. The answer is, very little, but this does not detract from its importance, for one detected among its very eminent and influential participants, a radical and important change in attitude to basic environmental issues.

The first issue was methodology. It was generally felt that our problems could not be understood exclusively in terms of the present reductionist approach, in particular, it was repeated over and over again, the accent must shift away from quantification. The knowledge on which to base policy decisions need not be precisely quantified. Often it is logistically impracticable to do so. Often too the important variables, by their very nature, are not quantifiable. Modern science has not really adapted itself to dealing with the behaviour of complex systems. Professor Hare, a member of the Canadian Environmental Council, pointed out that this was why climatologists had failed to predict current climatic changes: 'We were caught napping' he said 'this was because of our professional weakness . . . we neglected to consider the effects of chemicals at low levels on the atmosphere . . . we underestimated the complexity of chemical changes.' 'We have been wearing blinkers, and need a fundamental reordering of our own discipline. What is more,' Hare said 'I fully expect to hear similar confessions of inadequacy from other disciplines.' Professor Reid Bryson, of the School of Environmental Science, University of Wisconsin, fully agreed. 'We are bad forecasters' he said, 'There is only one group that can beat us and that is the economists.'

The trouble with complex self-regulating systems is that they can be disrupted by very small changes — if these are of a nature that they have not previously encountered. Very small changes, as Reid Bryson pointed out, have shifted rainfall patterns causing whole cultures to disappear. As Dr. Letitia E Obeng of UNEP also noted, an increase in temperature of 2% above average, in tropical waters, can totally disrupt a marine ecosystem, while a 3% change can eradicate most of the economically important fish in the tropics.

Can the behaviour of complex systems be fully understood with the aid of computers? Professor Flohn thought not. To take all the complicated processes involved in order to predict future weather changes "goes much beyond the capacity of our computers to handle completely." Besides climatically important events, like the eruption of volcanoes, are largely unpredictable.

It is the general principles involved that are important. One such principle is that if we are ignorant of what we are doing to our environment, then we must step more carefully.

Despair

A further change in attitude was one of growing despair. The problems we face are much worse than we thought they were. This was clearly the case with regard to man-made global climatic changes which now seem inevitable. Four years ago only Reid Bryson seemed to accept the principle that current weather changes were largely due to human activities. When he explained the drought in Sahelia in those terms (see: *The Ecologist* Vol. 3. No. 10, October 1973), he was bitterly criticised by many of his colleagues. Today the mood has changed. Of the climatologists present, Professors Herman Flohn, ex-Director of the Meteorological Institute of Bonn University, Kenneth Hare of the Canadian Government's Environmental Council and John Malone of the Holcomb Research Institute of Minneapolis all agreed that man's activities are affecting climate, and will increasingly do so. As Flohn said: 'We are just on the fringe when man-made changes are on the same level as natural ones.' The most important man-made cause of climatic change, according to Flohn, is the carbon dioxide we are releasing into the atmosphere. Since the beginning of the industrial age we have increased its content by 13% and it may rise to 20% or 30% (400 parts per million instead of 290 ppm.). What is more 'Recent investigations (Wang *et al*, 1976) have indicated that the "greenhouse effect" of CO_2 is further enhanced by

other man-made trace gases, such as the halocarbons (freons) with an atmospheric residence time of 40-70 years N_2O (from fertilisers), CH_4 and NH_3. If the further use of freons is prohibited, Flohn maintained 'the combined warming effect of these gases will nevertheless reach about 50% of the $C0_2$ alone. Due to long residence-time of the infra-red absorbing gases and their fairly rapid mixing, they will soon take the leadership in the anthropogenic impacts on climate on a global scale.'

A further important fact is deafforestation, its effect is to cause a considerable decrease of albedo. What is more it reduces the capacity of forests to absorb the carbon dioxide emitted by our acitvities. Forests in fact, rather than being a sink for carbon dioxide are rapidly becoming a source of it. The same, of course, is happening to oceans. In normal conditions as much as 50% of the carbon dioxide we generate is absorbed by them, but their capacity to do so is being reduced, partly because they are being warmed and partly too because of their acidification by man-made pollutants.

At what point will the combined effect of all these different factors lead to a climatic catastrophe? The answer is that nobody really knows. However Flohn pointed out that on at least six occasions in the history of our planet, very sudden climatic changes occurred on a time-scale of one generation or 100 years. His feeling was that 'climatic catastrophe can only be avoided if energy problems can be controlled,' which means, though he did not say it, that we must considerably reduce the level of our industrial activities. How did the other climatologists react to this? 'I have no desire to challenge this apocalyptic vision' was Hare's reaction, and nor, as it turned out, did any of the others.

Could massive reafforestation, it was asked, reduce atmospheric concentrations of carbon dioxide? According to Malone, one would have to 'treble the total biomass of the world forests to take care of the extra $C0_2$'

The mood of despair also prevailed during the discussion on the future of terrestrial ecosystems when Professor Fosberg came to read his keynote address on this subject. He warned the participants to expect 'more of the gloom and doom that they had already heard that day. Everywhere', Professor Fosberg said, 'exponentially increasing degradation is the rule.'

He deplored in particular the refusal of governments throughout the world to respond actively to the problems we face. 'I have visited the majority of the larger nations of the Earth and many of the smaller ones. In almost none of them have I seen much in the way of intelligent and effective long-term concern for the habitat of their citizens. Lip service in unlimited amounts, ill-conceived manipulation or exploitation of the environment for short-term advantages, and frantic activity to convert as much as possible of the resource-base into money in the shortest possible time: these are the patterns which I have seen almost everywhere.'

The irresponsibility of international agencies in this respect was also emphasised. Dr. Buchinger, from the Argentine, pointed out for instance that the Food and Agriculture Organisation of the United Nations (FAO) was financing a DDT plant in Bolivia and the World Bank was financing a factory in the Argentine to manufacture aerosols.

Fosberg deplored the fact that man continued to behave as a pioneer species rather than as a climax one, if he continues to do so two things are clearly predictable. 'We will modify our habitat so that it will no longer support us' he warned 'then a population crash from whatever direct or immediate cause, will follow. If this comes by atomic war it may wipe out the species. If it comes by famine or disease a few may survive to continue the existence of *Homo Sapiens*. If this happens and a few wretched survivors are left in an unfavourable and hostile environment, a severe process of natural selection will ensue.'

Dr. Ray Dasmann, ex-Chief Scientist of the International Union for the Conservation of Nature (IUCN), and an associate editor of *The Ecologist*, carried on in the same vein, 'I cannot criticise Professor Fosberg's paper,' he said 'because I agree with it. 'Dasmann then presented a highly stimulating, but equally despondent paper prepared by Professor Borgstrom, who was unfortunately unable to attend the conference. Among other things Borgstrom pointed out that, in order to understand the full extent of world over-population, we must not only take into account the population of human, but also of non-human animals. It is their combined impact which eco-systems must be able to sustain. Borgstrom coined the notion of ''population equivalents'' (PE units) in which the impact of livestock is reduced to human equivalents.

If one does this one finds that the globe is currently not inhabited by 4.2 billion humans but by 21 billion *consumers*. This is a more correct estimate of the ''feeding burden'' that green plants must carry. 'Close estimates swirling around as to the ultimate limit of the earth's feeding capabilities and arriving at figures of 15, 25, 40 up to 147 or even 900 billions,' Borgstrom pointed out 'are mostly computed with little recognition of the fact that the world, in protein terms, already carries a feeding burden exceeding 21 billion.'

Seen in this light New Zealand, often regarded as very thinly populated, is in fact almost as highly populated as the United Kingdom, especially if we substract from the latter's livestock population that proportion of it that is fed on imported food, and that is thereby causing ecological damage elsewhere. Also seen in this light, the increment to world population of a billion people, expected in the next ten years, should read ''five billion population equivalents''. This problem is increasingly serious in view of the growing ratio of livestock to man, which is now 4.2 world-wide.

Borgstrom, like many other participants emphasised the terrible destruction that modern agriculture is causing to the soil. In his words: 'Making deserts bloom is one of technology's masterpieces. Yet man has, at the same time created a five times larger acreage of deserts or some 1.2 billion hectares, whether through negligence, ignorance or sheer pressure of numbers in man and livestock. This transcendence of ecological limits is an on going process.'

Another terrible illusion is that we can go on finding

ever more land to put under the plough. As Professor Kuenen noted: 'The fact that there are some big areas left to exploit for agricultural use, implies that there is something wrong with them.' The material supplied by Dasmann, Borgstrom and others amply justified this apparently cynical observation. Indeed the world's remaining tropical forests cannot be turned into viable farmland. Their soil is very thin and totally unsuited to agriculture. All this is, of course, common knowledge, yet, as Professor Kuenen points out in spite of it 'the destruction still goes on. What has developed in millions of years, and what has been the natural basis for the existence of Man for tens of thousands of years, is disappearing in a few decades because at present we seem to have no proper alternative, at least in the minds of the politicians and big business. And soon the next problem will arise because there will not be enough fertiliser to keep the soils productive. Particularly phosphorus, which is as essential for life as any other minerals, may pose a serious problem because no mineable reserves are at present known, which will carry us much further than a few decades'.

The Position of Third World Leaders

There were only a few representatives of the Third World leadership present at the conference. Some, in particular the Indian delegate, Professor Misra, one of India's leading ecologists, and until recently President of the University of Benares, and Mr Gaekwar, formerly the Gaekwar of Baroda and now a member of the Indian Parliament, fully understood the seriousness of our problems and also fully appreciated the many unpleasant implications. Others, however, insisted on maintaining what has become the Third World's general line on these matters. As Fosberg puts it, 'Although a few of the more far-sighted citizens of Third World nations are very aware of the dangers we are all facing, this cannot be said of many of their leaders and people in positions of power. We hear in International forums biting criticism of those who, after getting rich through exploitation of their own national resources, would like to retard others from doing the same thing. Most international attempts at environmental protection founder in this sea of protest and righteous indignation — perhaps territoriality is a better term.

'What the protesters seem to want is not only the right to the benefits of modern technology, but the right also to learn the *hard way* — to make, all over again, the mistakes that the industrial nations have made and which have destroyed much of the best of their habitats. This, in my scale of values and definitions, is nationalism at its worst. It is not common-sense, which must very largely consist of the ability to observe the mistakes of others and avoid repeating them. There are people in every country that I have visited who desperately want to see their countries avoid what they observe in the wake of advanced technology. Unfortunately, few of these are elected to office or otherwise placed in positions of leadership. This is sad both for these nations and for the world.'

The paper given by Mustapha Tolba, Director of UNEP, showed that this is basically his position. In his lecture, presented by Dr. Letitia Obeng of Ghana, he explained the urgency of the world environmental situation and then made the usual exhortations which he, as well as everybody else knows, will not, and in fact *cannot*, be complied with, for basic social and ecological reasons. Thus while Tolba admits that irrigation schemes have caused salinization and the spread of water borne diseases he still wants more of them, insisting that 'when ecological and environmental principles are applied from the planning stage, these hazards can be averted and the health, well-being and productive capacity of the population can be improved.' This is a pure act of faith based on nothing else than wishful thinking. There is no evidence of any large scale irrigation scheme in the tropics that has *not* caused these, and other problems as well.

In the same way Tolba exhorts us to increase our ability to predict and anticipate the climate changes that everywhere are making agriculture increasingly more difficult, and to increase our capacity to influence these changes. This is an equally vain exhortation. As Professor Flohn and others pointed out, climatic phenomena are too complex to predict with any sort of accuracy. Besides predictions are only useful, if the situations predicted are of a nature that can be adapted to. The large-scale climatic upheavals that we can expect if our industrial activities continue to expand do not fall into this category, and to predict them can be of academic interest only.

As for the notion that modern technology could conceivably succeed in neutralising these climatic trends, this belongs to the sphere of yesterday's science fiction. I doubt if even Hermann Kahn would dare make such a suggestion today.

Action

What then should be done? The situation indeed appears desperate. The notion that we can change something may indeed be wishful thinking, as Kuenen put it 'The general theme of this conference is that we know there is no solution and we are trying to believe that there is one.' However this is no reason for *not* acting. Kuenen reminded the conference of the words of William the Silent: 'Il n'est pas point necessaire d'esperer pour entreprendre' he said 'ni de reussir pour perseverer.'

The first step is to reach agreement. Reid Bryson pointed out that it is not the politicians who are the main barrier to accepting basic realities but fellow scientists. How can politicians be expected to take the right action if their scientific advisers do not provide them with a single clear message? In this respect the Reykjavik conference was a triumph, for near unanimity was reached on all basic matters. Indeed our pathetic government experts would have been singularly out of place at this meeting.

Maurice Strong, ex-Director of UNEP and organiser of the famous Stockholm Conference on the Environment in 1972 called for political action on a world scale. Governments everywhre must commit themselves to a completely new set of priorities. 'Conservation can no longer be a fringe activity' he declared 'but a central recurring theme around which everything else must revolve. The oceans, in particular, must be

protected to prevent them from becoming: 'the ultimate cess pool of the world' for among other things they are a 'vital component in the buffeting of atmospheric processes, without which life on earth would be insupportable.'

Tropical forests too must be protected. Their exploitation 'for timber for the rich countries should be restrained and other ways found to help the developing countries to balance their financial budgets. As there is very little to be gained from agriculture on soil formerly occupied by rainforests, extension of agriculture in these areas should be abandoned as counter-productive.' The preservation of our environment, of course, also requires a reduction in pollution levels, and the conference called for ' ''*no release*'' policies for substances on the International Register of Potentially Toxic Substances.'

All these measures, however, would clearly not be possible unless we also reduce the impact of man's activities on the environment. What is required, first of all, are stringent population-control measures. 'To limit population growth will not in itself save the world from impending disaster' the Declaration reads 'but it is an essential part of the solution and its importance cannot be over-emphasised.' The conference warned very dramatically that if population growth were not controlled *'the deaths of a thousand million people from lack of food, some by outright starvation but mostly by disease caused by severe malnutrition, may well be the tragedy of the century.'*

The second measure required to reduce our impact on the environment is to abandon the goal of economic growth. The conference called for 'a fundamental new approach to economic growth — new growth (a term proposed by Maurice Strong) . . . new growth emphasises quality rather than quantity.' Its achievements must be compatible with reducing 'the demand on the earth's resources and the risks to its life-sustaining systems to levels that are fully compatible with human survival and well-being.'

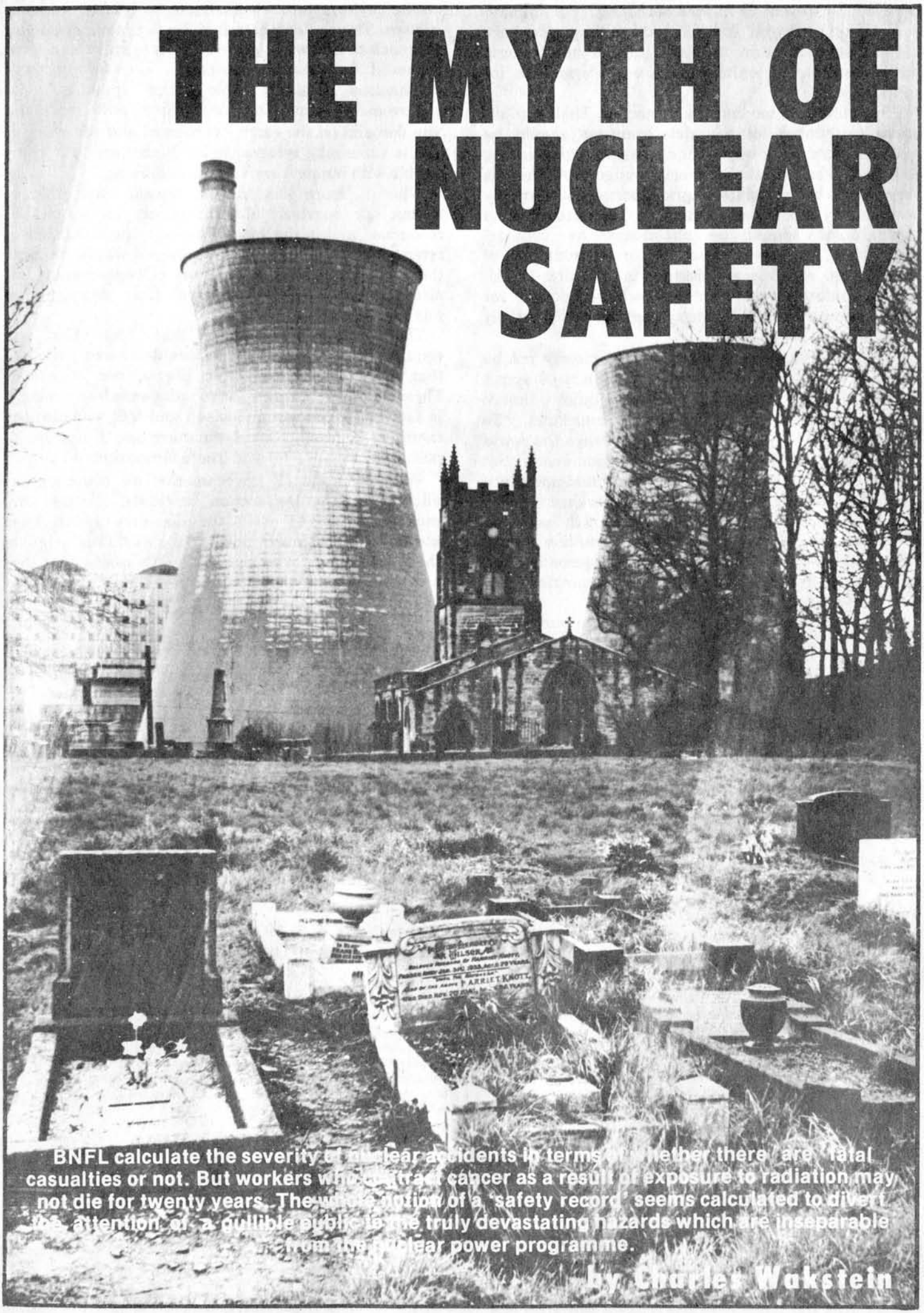
What is more this means, among other things, basing our survival 'almost entirely on renewable resources' and in the case of energy 'the transition to renewable resources must be achieved within the next thirty years not only for reasons of conservation but also to protect the environment from damage that might prove catastrophic.'

The conference recognised that 'This effort will require major changes in the incentives and penalties that motivate the economic life of our societies.' These changes, however, were indispensable. Ecology, in fact, must become politicised and this was also the theme of Kenneth Hare's summing up. 'I approve of political solutions,' he said 'there are no others.'

'We call upon all governments, all communities, all people,' the Declaration concluded 'To take immediate action to avert the disasters which loom ahead.' Can the governments of the world really ignore these warnings? Do we not all secretly realise that they are justified and that the future of our planet may depend on decisions that must be taken today?

Edward Goldsmith

THE MYTH OF NUCLEAR SAFETY



BNFL calculate the severity of nuclear accidents in terms of whether there are fatal casualties or not. But workers who contract cancer as a result of exposure to radiation may not die for twenty years. The whole notion of a 'safety record' seems calculated to divert the attention of a gullible public to the truly devastating hazards which are inseparable from the nuclear power programme.

by Charles Wakstein

Photo by Alan H. Robson.

BNFL's Safety Record

The public is continually told that B.N.F.L's 'Safety Record' is good; we hear this from the widest variety of people including Ministers, Members of Parliament,[2] newspaper editors,[3] science editors,[4] and even journalists with major science journals[5]. Someone should point out that the concept of a 'Safety Record' can be dangerously misleading unless one interprets the past correctly, and that to do this one needs only basic statistics.

People say that B.N.F.L's safety record is good because they believe there have been only two major accidents and even these didn't cause any casualties. I'd like to attack this view of safety because it misses the point completely. Leaving aside the disputed Windscale leukaemia deaths it would be more correct to say that there haven't been any deaths *yet*. But radiation-induced cancers have long induction periods — the APS study[6] talks about times as long as fifty years after exposure — and even with a large dose of radiation the chance of contracting some sort of cancer, such as lung cancer, is of the order of one in a thousand in any one year. So even over a period of thirty years, in a group of say five men, like the American plutonium workers seen in a recent T.V. documentary last year, the odds are about six to one that none of them would have died, so it's no surprise that they are all still alive, but this in fact proves nothing. The sum, if such simple arithmetic deserves to be called a sum, is simple; the odds against any one of them dying in the thirty year period are 30×10^{-3}. The odds of any one of them *not* dying are therefore 0.97 and of *none* of them dying are $(0.97)^5 = 0.85$. We are just not very likely to see deaths from radiation-induced cancers unless the dose is very large or the number of people is large like the number of people downwind of a reactor in the event of a large accident. Quite by coincidence I did this sum the night before Goss's letter implying that the NRPB had suppressed similar findings appeared in *New Scientist*.[7]

This kind of statistic also tells us that even if there had been *no* accident at Windscale that in itself would give us very little information about future safety.

But there have been accidents since the big one in 1957, in fact at least eleven; and ten of them were under the watchful eyes of the Nuclear Installations Inspectorate (NII) upon whom both Mr. Benn and BNFL say they depend:

- six leaks of radioactive waste (February 1964, January 1967, July 1969, May 1975, April 1976, and October 1976) including one (February 1964) caused by overfilling a tank,
- two fires (1975 & 1973); these are the major accidents,
- a criticality accident (1970) caused by failure to observe well-known safety precautions,
- a turbine failure at Calder Hall (1963) caused by failing to find pieces of steel shot which would have been visible to the naked eye in the steam lines,
- high levels of gamma radiation (1958) caused by personnel error, and
- a monitoring failure (1974); allowing a worker to leave the plant with radioactive material on his shoes.

The Myth of Safe Operating Experience

I'll go into four of these accidents further on, but first the view that all must be well, if there haven't been any accidents for some time, which some workers in the field call the myth of safe operating experience, is fundamentally incorrect on statistical grounds. Let's take the case of Windscale itself.

A plant like Windscale is supposed to have one million curie releases on average only once in a million years.[8] Now suppose that Windscale is in fact a thousand times as dangerous and that the probability of a one million curie release in any one year is one in a thousand. Then the probability that no such release would be seen in twenty years is $(0.999)^{20} = 0.98$. So even if Windscale were a *thousand* times more dangerous than it is supposed to be, it would be *98% certain* that we would have seen *no* big accidents in the last twenty years.

In fact even if Windscale were *ten thousand times* as dangerous as it is supposed to be you *still* couldn't tell after twenty or even thirty years; $(0.99)^{30} = 0.7$.

Indeed when you look at the famous 1957 accident, the fire in No. 1 Pile, and realise that nearly one hundred thousand curies were released after only about fifteen years of operation, and more important that the release was caused not only by design error, but also by defective procedures, and by personnel errors as well, then you really have to wonder whether there was ever any chance that BNFL could have met their implied safety goal of one such release on average in a hundred thousand years.

The myth of safe operating experience is surprisingly persistent even among scientists and engineers who should know better:

- When a box girder bridge over the Rhine at Coblenz collapsed in November 1971 the journal *New Civil Engineer*,[9] not usually hesitant to be critical, printed without comment or response in the letters columns, a statement by the builders that they were surprised because they had put up twelve spans to the same design without trouble.
- At a public meeting in Barrow in late 1975 BNFL pointed with pride to the 60 shipments of highly radioactive spent fuel they had made without mishap by rail from Barrow to Windscale. As if to mock their unjustified faith the very next one was derailed![10]

How does the statistical argument apply to the Coblenz bridge failure? Here another version of the myth is being used which says "if the technology were really unsafe then surely there would have been a failure by now." How high *would* the probability have to be for it to be very unlikely that no failures would be seen in twelve spans? Let's define "very unlikely" as a probability of one in a hundred. Then what does the probability that a span will not fail (call this q) have to be for q^{12} to be equal to 0.01? It takes no more than a slide rule or a set of log tables to work out that $q = 0.68$. Then the probability that a span will fail (call this p) would have to be 0.32. Odds of one in three of failure!

For the Barrow example we solve $q^{60} = 0.01$ for q. The fact that the exponent is 60 doesn't help much; q would still have to be 0.925, or $p = 0.075$. Odds of one in fourteen of failure!

From the Coblenz and Barrow examples it should be clear that things have to be unthinkably *unsafe* for *failures* to warn us and from the Windscale example that we are almost certain *not* to be warned even if things are *thousands* of times as unsafe as we intended.

The statistical argument has far reaching implications; it means that we can't *tell* on the basis of no failures how safe a technology is. And the situation is even worse if the technology has to be very safe; in that case it's even harder to tell. The problem is that you need lots of time, or lots of examples of the technology, to be able to make statistical inferences with any confidence. So when it comes to one-of-a-kind technologies we certainly don't have the numbers and time *won't* tell. We would need thousands of years and we haven't go them! This means that you can't tell from experience alone whether a bridge or refinery or skyscraper or chemical plant (like Windscale or Flixborough even five minutes before the explosion) is anywhere *near* as safe as you intended it to be.

As an engineer who started in the field in 1950, and even with extensive experience in quality control, I still found this surprising when I came to realise the full force of the argument; the engineering students I lectured to found it hard to believe, and there are still engineers around who don't realise it. I think this is partly because probabilistic design, i.e. design which explicitly considers the probability of failure, has not had as wide acceptance in this country as in the States.

Now these calculations may be convincing intellectually, they're certainly easy to do, but they run up against a sort of conventional wisdom which says "okay the fact that we haven't had any accidents may not tell us much, but it's all we have got to go on".

The point is that it's *not* all we have got to go on. We can tell a lot from:

1. the *character* of the accidents that have happened,
2. their causes,
3. how safety managements look at the accidents that have happened, and
4. what their approach is to safety policy.

We *do* know something from HMSO reports about the two major accidents, the 1957 fire and the 1973 blowback which was also a fire (Flowers[11] says explosion). I'll mention some of the astonishing mistakes involved in these accidents further on when discussing the attitudes of BNFL safety management.

It's hard to get solid evidence about what happened and why for the *other* accidents at Windscale. The AEA say they have no publicly available reports and shunt the request for reports to BNFL who produce nothing for three months and then send what are in effect press releases rather than engineering summaries. The DOE library takes two months, say they can't find the reports that the MOHLG sent to Millom Cumbria RDC Health Committee about the 1964 and 1967 leaks although they found them very quickly when I got permission from the Millom RDC to release them. Mr. Benn has recently asked for the reports of all past and future accidents[12] but how will they be interpreted and by whom? And how publicly will this be done?

We do however have some evidence about the 1970 criticality accident[13] and we can raise some obvious questions about the 1964 leak.

The prevalence of corrosion failures deserves another article; the Chief Nuclear Inspector for Windscale, when he attended the first private showing of my film "Caging a Dragon" at the Polytechnic of Central London in May 1976, failed to deny my explicit suggestion that the January 1967, July 1969, May 1975, and April 1976 leaks were caused by corrosion.

The 1970 Accident

In 1970 there was a criticality accident at Windscale, i.e. an uncontrolled release of radiation, caused by neglect of an accumulation of plutonium in a vessel. There were some 10^{14} disintegrations in a few seconds. The concrete shielding was thick enough for the workers on the other side to receive relatively small doses of radiation. But what was there to prevent the release from having been many times as great? Nothing, and certainly not preplanning; the significant feature of such accidents is that there is inherently no control over how much radiation is emitted. The men on the other side of the shielding were very lucky; their doses could have been a hundred times as great.

Reading the technical journal article on the accident it becomes clear, from the very fact that the engineers looking for the cause *started* by searching for plutonium solids in the various tanks, that they *didn't know* whether there was any plutonium residue in the tanks or not! If they had had neutron monitoring devices scanning each tank they would have known, and it is important to realise that this was a technique recommended by Thompson and Beckerley in the States as much as six years earlier,[15] especially in plants where the vessels were large enough to contain more than a critical mass of plutonium, as they were at Windscale.

A calculation using nothing more sophisticated than the formula for the volume of a cylinder makes it clear that the vessel in question had become nearly half full of plutonium dissolved in a solvent very much like paraffin. This had been happening over a period of two years without anyone realising it. In part this was because there were no liquid level gauges, which are standard practice for chemical plants even without risks of criticality. And worse, no one realised it was taking half the usual time for the tank to empty because the plutonium dissolved in paraffin was never leaving the tank!

Even if there had never been an accident like the 1970 one before, it would have been bad enough to continue processing fissile materials without knowing how much residue there was, what kind it was, and where it was; but there *had* been such an accident at Los Alamos in 1958 where plutonium had been allowed to accumulate inside a mixing vessel. When a new batch of plutonium bearing solution was transferred to the vessel and the man working on the process started to mix it, all of the nearly eight pounds of plutonium was dissolved off the walls of the vessel and came together in the centre of the vessel.

In a few millionths of a second there were 10 disintegrations and the man received ten times the lethal dose of radiation. I've not been able to forget the description of him staggering out into the snow and saying to the people who were trying to hold him up "I'm burning up. I'm burning up." He died less than thirty-five hours later.[16]

This accident was described in "Diagnosis and Treatment of Acute Radiation Injury" published by the World Health Organisation in 1961 and also in Thompson and Beckerley's book in 1964 where they drew attention to the tendency of plutonium to accumulate on the walls of vessels. Yet BNFL, then the AEA production group, disregarded these warnings and persisted in carrying out processing in vessels that were not critically safe, and without neutron monitoring. It took the AEA experts six years after Thompson and Beckerley to get around to asking for neutron monitoring, and then only after the 1970 accident. And where was the NII?

The 1964 Leak

In February 1964 there was a leak of radioactive waste at Windscale. A tank overflowed into the local sewage system.

BNFL's March 5th letter to me says "During a routine washout of the Chemical Separation plant using large volumes of water a tank overflowed for a short time and the contaminated water found its way into the inactive drain. This was possible because the tank in question did not contain radioactive materials while the plant was in operation."[17] But minimally sound practice for chemical engineering plant of any sort demands that "operation" be understood to include construction, startup, shutdown, maintenance, repair, emergencies, washout, etc., in other words *any* condition that the plant can get into. But then this is only common sense and perhaps because of that seems less "scientific".

In fact careful consideration of startup and shutdown conditions is an explicit part of a design checklist used by the American Westinghouse nuclear engineers and was publicly described by Green[18] at a conference at the University of Sussex in 1969, seven years before BNFL's March 5th letter. But could the overflow have been prevented?

Obviously to fill a tank safely you have to do at least three things; you have to avoid filling it too fast, you have to know how full it is, and you have to be able to shut off the flow. Take one way things could have gone wrong — say they depended on a shutoff valve to stop the flow and it didn't. That suggests that they didn't check their valves often enough to make sure or more precisely sure *enough* that they would work. Knowledgeable engineers are aware that valves, even valves for nuclear applications, are not made to high standards[19] and that this situation hasn't improved greatly over the years. The possibility of a failure should have been anticipated. The same considerations can be applied to liquid level sensors and to flowmeters etc., or to whatever else they used. And where was the NII?

The significant feature of such accidents is that there is inherently no control over how much radiation is emitted.

But there is a way around this problem — the use of redundancy. This approach has been known since the war; at its simplest it shows up in wearing belt *and* braces and in dual braking systems for cars.

The BNFL March 5th letter makes no mention of redundant systems failing in this accident and it would be tempting to assume that there were none. But this can be easily checked *if* the full engineering report of the accident is released for independent examination.

BNFL Attitudes

We do not yet know the details of the other seven accidents but we *do* know something about the attitudes of the BNFL safety measurement from an interview with Mr. John Donoghue, Manager for Safety Assessment at Windscale, which I regret to say has made me more worried about nuclear risks than ever before:

a) There is the matter of safety organisation; Mr. Donoghue gave me to understand that he can't shut down anything unless he can convince the other management that it should be done. No safety manager should tolerate working that way and the NII, who must know that things are "organised" that way at Windscale, should know better than to allow it even if there had never been any warnings of the danger of organising safety that way. But there *has* been such a warning, by Thompson and Beckerley as long ago as 1964.[15]

b) BNFL claim publicly to look at accidents in terms of whether there were casualties or not.[12,15,18] Indeed Mr. Donoghue said in interview that these should be regarded as "incidents, not accidents", and as "insignificant in terms of hazard to workers or public". He and other BNFL management and the HSE should be aware that this view of accidents has been discredited by Farmer in this country:

> "Many accidents causing small damage or even extensive damage but no casualties could have developed in some way, at some other time, into a more serious accident. Many of these events have been such that had they occurred at some other time the result could have been disastrous."[21]

Indeed a simple sum using the figures given in the HMSO report[22] shows that the order of magnitude of the amount of ruthenium released into the workspace in the 1973 accident was at most 1/20th of a curie. As the amount of activity in the vessel where the fire/explosion took place, the only vessel which was *not* washed out, was 100,000 curies, this escape represents one part in two million of the amount in the vessel. Had the escape been not infinitesimal but just *small*, say one part in a hundred, *the accident could have been twenty thousand times as bad.*

Even if no one is hurt in an accident it should be regarded as a "near miss"; there are lessons to be learnt. If these are not learned the stage is set for more accidents, as Thompson and Beckerley pointed out

in 1964:

"While there have been relatively few accidents of a serious nature involving nuclear reactors, yet each one points out certain lessons worth preserving . . . It is generally believed that the SL-1 accident (this left three men dead, one of them impaled on the ceiling of the building and happened in half a second) was the first case in which manual withdrawal (of a control rod) occurred. In reality it is the *third* case which has led to a recorded accident. Yet, partly because no one has bothered to set down the lesson, a reactor designed several years after the first such accident carried the same flaw, and a serious accident resulted."[15]

But BNFL and the HSE aren't alone in this wrongheaded way of looking at accidents; Flowers[23] and Benn[24] also share this misconception.

c) BNFL don't learn the lessons of past accidents. For example they stubbornly refuse to see that the 1973 accident is like the 1957 accident not only in also being a fire, but in three other ways[15 18] First the instrumentation was again inadequate, secondly the operating instructions were equally inadequate, and thirdly so were the emergency plans.[25]

d) Mr. Donoghue admitted freely in interview that BNFL don't have a Farmer risk function for Windscale. A Farmer risk function, usually shown as a graph, is in essence nothing more than a list of accidents of varying severity together with the probability of the occurence of each. If you don't know the odds of accidents happening then you don't have a safety policy worth the name.

Modern safety policy demands that conscious decisions be made in advance of the odds of every possible accident from the most serious one possible (*possible*, not just "conceivable" or "credible") to the least serious one, and that the engineering designers carry out calculations (these are the faulty tree calculations mentioned in the Flowers report[26]) to check that their designs will meet these odds. It is just not enough to do what seems "reasonable" in the vague hope that this will make these odds "low". Yet this is exactly what BNFL do and are *allowed* to do by the HSE/NII. This lack of a safety policy is terribly serious; these calculations are the only way we, as engineers, have of *testing* our intuitions about what it takes to make complicated systems like nuclear systems work at levels of safety that we are just *not* accustomed to achieving. Engineers who don't use these approaches are dangerously lacking in understanding of risk and are therefore dangerous people to entrust with technologies that can have such serious consequences in the event of an accident.

e) Mr. Donoghue said in interview that BNFL rely on the test of the "reasonable man" to assess their safety precautions. But that's a pretty crude test when we find BNFL doing things like these in their two major accidents:

The 1957 Fire[21]

- failing to put thermocouples in the hottest regions of the pile (Annex 1 para 15)
- letting a physicist operate it without an operating manual or detailed instructions (Annex 1 para 12)
- delaying the start of milk sampling (Annex III para 27 part 4)

The 1973 Fire[22]

- having no evacuation plans ready for the accident (para 49)
- allowing radioactivity alarms to continue going off unnecessarily, long enough for workers to take them less seriously (para 47)
- installing instruments that couldn't read the high radiation levels reached in the accident (para 3)
- failing to install a loudspeaker system to warn workers to evacuate thus forcing people to run up and down ten flights of stairs to tell them to get out and still missing four men (para 4)
- failing to check in advance the reactions of known residues with the chemicals commonly used in the process (para 35)
- allowing just one tank in the plant — the very one where the fire started — not to be washed out prior to startup (para 22)

In any case, to depend on "the reasonable man, the man on the Clapham omnibus" — the phrase is familiar — suggests that BNFL's approach to safety may go only far enough to avoid findings of criminal negligence. It should go much further.

Summary

In the face of all this BNFL continue to boast publicly about their "safety record"![15 21] Either they *know* how little the phrase means in a statistical sense and are misleading the public which would be worrying, or they *don't* know, which would be even *more* worrying.

Finally let's not forget that the BNFL safety management call these "incidents, not accidents". This suggests that they *know* that *all* their eleven accidents are significant in that they reveal inadequate practices, and that they are putting on a public face that looks a lot less worried than they really are — this in turn suggests that they think the public can be easily lulled — or that they do *not* in fact realise how significant these accidents are.

When they don't remember how many accidents they have had on a month's notice of the question, or what they were, then we have reason to worry. After all there haven't been that many and they almost go in groups: six leaks, two fires, etc. This should be easy to remember; or have there been others that the public haven't been told about? Consider how late the information on the October 1976 silo leak reached the unions *and* Mr. Benn.[23] But then Mr. Benn didn't make arrangements in advance to receive all such information. Like the 1969 leak of plutonium into the Irish Sea that the public didn't hear about until 1974.

Perhaps you can't blame MP's or some media people without special technical resources, but where is the rudimentary statistical knowledge among Mr. Benn's technical advisers, who should have managed to get it across to him by now that the idea of a "safety record" in a technology that is supposed to be very safe is near enough meaningless as to make no odds?

But more than that they should have told him that BNFL's "safety record" is in fact *not* good, that BNFL at the highest levels have a dangerously poor understanding of safety policy, and a dangerous blindness to the lessons of past accidents.

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THE STRUGGLE AGAINST NUCLEAR POWER IN CENTRAL EUROPE

by Peter Taylor

The resistance to two proposed nuclear reactors which gave rise to mass demonstrations and long term sit-ins in the upper Rhine valley in 1975, set off a series of manifestations of fear, suspicion and frustration which gained publicity and support from an increasingly broadly based sector of the public. This led eventually to the founding of a European Ecology movement capable of taking concerted action against Government plans for the expansion of the nuclear industry.

In 1975, twelve kilometers from Brokdorf, a small village on the Elbe estuary north of Hamburg, a 770 Megawatt nuclear reactor came on-stream and there was not a whisper of protest. Twelve months later, on two week-ends in November 1976, at Brokdorf itself, first 10,000 and then 30,000 demonstrators tried to occupy the newly commissioned site of a second reactor. To prevent the occupation, riot police erected steel and concrete barriers around the site and dispersed the crowds with baton and tear gas, water cannon and chemical mace, resorting at one point to attacking with low flying helicopters. There were serious casualties as the result of violence from both sides and this was widely reported in Germany and the international press. In the case of the latter, the violence seemed the only point of interest.

The Premier of Schleswig Holstein justified the violent police action by claiming the clandestine influence of 'radical elements'. He described the demonstration as an attack on public order[1]. 'Radical' is normally taken to mean 'communist' in Germany. And, as if to prove his point, he referred to the untroubled history of the 1975 reactor.

Clearly there has been a radicalisation, and a rapid one. But it is far removed from 'communist' inspiration. A political movement is under way, at present only diffuse, but a definite philosophy is emerging from an initially unstructured resentment and opposition to centralised State plans that impose upon the individual's rights, be they so simple as the right to say 'no' and be taken heed of, or as complex as the right to an unpolluted environment. There is evidence that the protagonists of nuclear power do fully appreciate the nature of this movement and that therefore the consistant use of misleading and emotive political terms is deliberate. The violence at Brokdorf certainly helps such mud to stick. We hope to show in this outline of the movement from its inception that violence is not part of its philosophy. The small percentage of 'radical elements', communist or otherwise, is of the kind attracted to any clash of citizen and state. They were not invited by the initiatives and played no part in the leadership. International press reports dwelt on this communist presence, and their financial aid from Eastern Europe (all Moscow orientated groups receive it), but paid little heed to the fifty pastors who were an integral part of the leadership. It is a sad fact that without communists and violence there would be no headline treatment, and that is exactly all that allows them a role (very few sympathise with such statements as: 'capitalism is incapable of running a nuclear state without police methods and pollution, only a peoples republic can handle it!').

In February the citizens' initiatives of the Lower Elbe fielded 20,000 at Itzehoe, a village some kilometers from the site at Brokdorf, and thereby distanced themselves from the 'radicals' who intended to storm the site. The State drafted in 6500 heavily armed border troops and there was no assault.

Brokdorf, and the scale of public involvement there, is not an isolated incident. It is the latest in a series of manifestations, cathartic expressions of frustration and discontent that have rocked Europe and are gaining in intensity with each month. But although the clashes with authority are a catharsis, the underlying movement is not. It has an origin and a development and is now highly coordinated and organised, a movement bordering on the intensity of the 1968 student unrest.

The movement has its origins in the valley of the upper Rhein near Basle. In the first few months of 1975 two reactor sites, one on the German side of the river at Whyl, the other on the Swiss side at Kaiseraugst, and a lead sulphate chemical works at Marckolsheim in France, were occupied by local people using CND tactics.[2] Up to 30,000 demonstrators were involved and the resultant police brutality brought publicity throughout central Europe.

The timing and location of the first mass demonstrations are significant, but the energetic expression of discontent was part of a much wider malaise. In the tangle of political and geographical factors peculiar to the upper Rhein the following stand out as causal:

—prior to the oil crisis, central Europe was about to launch itself into a massive spurt of industrial growth. The upper Rhein was an obvious centre.[3] It was close to major industrial regions of France, Switzerland and Germany, and it had the arterial Rhein and motorways for transport, together with ample land for development and adjacent hills for recreation. In the early 70s, nature conservation bodies were alerted to the plans for a second 'Ruhr', for the newly integrated European industries were about to restructure, and the upper Rhein between Karlsruhe and Basle had been chosen as a key area of industrial growth. There would be extensive new chemical works, oil refineries, steel and heavy machine tools, with the relocation of 100,000 jobs and a rise in power output from 2600 megawatt to 35,000 megawatt. This additional power demand was to be met by atomic reactors.

—The chosen development areas were along the flat flood plain of the river, an area that held the last stands of Auwald, a swamp forest listed as a site of national scientific importance.[4] There seemed little chance that conservationists' pleas would be heard, but they nevertheless sought allies, above all among the farmers, fishermen and winegrowers, and they set about coordinating their opposition in the Universities of the three countries.

—In 1974, in the wake of the oil crisis, the recession set in and the upper Rhein looked like gaining respite. Already extensive industrialisation had taken place in the Alsace and around Karlsruhe, only the area between the Vosges and the Black Forest had escaped with slight intrusions. But the oil crisis proved a mixed blessing. France, Germany and Switzerland decided on the immediate expansion of nuclear power in order to rid themselves of the Arab yoke, and to lay the foundations for what they believed would be inevitable recovery and future growth. Whatever the political and economic realities of this pursuit of freedom and growth, it brought sighs of relief from the heavy electrical industries and construction giants (Siemens, Bayer, Hoechst, Badenwerk), and in addition assured the nuclear industries of a home base from

which to export. Both France and Germany stood to gain considerable foreign exchange earnings in this field[5].

—Thus did geographical and political factors conspire to single out the sites of Whyl, Kaiseraugst, Breisach and Marckolsheim for reactors. In addition Marckolsheim was to receive a lead works. Of course, the upper Rhein was not alone in having reactors foisted upon it. The industrial regions to the north had their share, although the limiting factor of cooling water supplies restricted sites to the rivers and estuaries. There was however a crucial difference: the upper Rhein was still a predominantly rural area that did not want industrialisation, and the people, although outwardly conservative, had a spirit of independence and democracy.

When the first plans of impending industrialisation were made public there was therefore considerable resentment. At Marckolsheim in France in September 1974 a concerted campaign against the leadworks was started. The nearby Universities of both Germany and France cooperated, and it was the Environmental Group at the German University of Freiburg that produced the telling attack. They countered the industry's claims of 1.4 tonnes of lead dust emission per year with their own calculations that showed a likely 9 tonnes. Within days the local vineyards had united in opposition to the plant. But the townsfolk voted for the leadworks on the grounds of provision of jobs and the site was handed over to the company (Munich Chemical Works); the countryfolk then occupied the site, led by the winegrowers, the vegetable growers and the women's institute! On the German side at Breisach, another wine area, a similar division was settled democratically: the mayor resigned after a local election brought victory to non-party environmental candidates, wine-growers all, and the reactor had to go elsewhere. It went to Whyl, just around the corner of the Kaiserstuhl. But now the pressure was on, for reactor sites are not that abundant. In a secretly arranged meeting, the parish council agreed to sell the reactor company a site by the river, a nature reserve in the Rhein woodland. In the controversy that followed the village of 3000 inhabitants voted for the reactor, and for the jobs and various other inducements offered by the State, such as a sports centre, swimming pool, new roads and the planting of a new nature reserve to replace the one they would lose! But the surrounding wine-growers were not about to play ball and in February 1975 the site was occupied. The example of the French at Marckolsheim was instrumental: there was a great feeling of solidarity for the occupation there and this had lent courage. The German State reacted differently. It was immediately made clear that the occupation was illegal and a thousand extra police were put at the disposal of the local inspector. They were riot police and drilled to expect confrontation with 'left-wing extremists'. In spite of their rigorously non-violent tactics the demonstrators were harshly dealt with, water cannon was used in freezing conditions. The action was well covered by the media. An irate Premier of Baden-Wurtemburg denounced the 'left-wing, communist and other radical groups', but was made to look pretty silly by the time the media had reported in full. Branded as enemies of the State, wine-growers, women's action groups and clergymen grew somewhat bitter and the occupation correspondingly more determined. The subsequent fines and threats of damages or imprisonment had no effect. Public condemnation of the State action was widespread.

The detailed history of the developments at Whyl throughout 1975[2] and 1976[6] is central to the environmental movement that followed. Whyl acted as a focus for many thousands of discontented people throughout Germany, France and Switzerland, people who had waited half a decade since the Club of Rome's foundation for just such a focal point. These wider issues were eventually to bypass the interests and concern of the very people who had been in at the forefront of the Whyl occupation. They had been primarily concerned with their own livelihood: about whether radioactivity would contaminate their wine or whether fog induced by cooling towers would affect the harvest. Their resentment had gained its charge from the denial of rights of democratic involvement, and had been further heightened by the heavy-handed methods of the State with its police and propaganda.

Both State and Federal Government were quick to realise their mistakes, and quick to appreciate the significance of Whyl. The intervention of the churches on the side of the demonstrators and the refusal of police to clear the site a second time prevented the further use of 'communist plot' propaganda. A concerned Federal Government turned to the internationally active Batelle Institute for an answer. It came a little costly, a million Marks, but the answer from the Batelle social research unit was simple: country people distrust technology but do not like to be treated like morons because of it, nor do they like to see their democratic rights usurped. Such people were easily led astray (of which more below). This first report followed a quick change in policy. The reactionary Premier of Baden-Wurtemburg who had ordered the riot police in (cf. Brokdorf) resigned from the electricity council, lest people should suppose he had a conflict of loyalties, and he made no further public denouncements. Leaders of the now well organised Federation of Citizens' Initiatives were summoned to Bonn. And a special commission would investigate the environmental hazards for the inhabitants of the Kaiserstuhl.

Somewhat unexpectedly the Government-sponsored special commission found no grounds for concern on environmental issues: there was no danger from fog, nor from radio-active emissions. But the Whyl opponents were less than satisfied and took their case to the

court at Freiburg. On March 15 the court issued its historic verdict: the reactor cannot be built. The judges had heard evidence from over fifty experts both for and against in this the first case of its kind. The verdict astonished even the opposition, for it was founded on none of their main arguments, but on the hitherto unusable 'risks and technical failure' problem. Environmental groups had long been outgunned on this point because it was unquantifiable — and yet in this decision it is precisely this aspect upon which the judges founded their ethical decision: 'this unquantifiable risk, no matter how small, is unjustifiable when the enormous consequences of the accident are considered.' Thus the atom industry's continual demands to be treated like any other industry have been overturned — the judges have in effect called for absolute safety.

The force of this decision will, despite Federal Government assertions to the contrary, apply to all future developments and perhaps even to currently operating stations.

But if the lessons of Whyl were not lost on the Government, neither were they lost on the thousands of intellectuals from all over Europe who had either visited the site in the year and a half of its occupation(it became an international youth camp, fully equipped with an improvised lecture theatre and education courses), or had watched the events from afar.* The ecologically orientated had not only become actively involved, they had come to see the enemy more clearly. Everything they valued: woodland, birdlife, natural beauty, clean air and quiet, unpolluted water and soil — all had one enemy in common and that was industrial growth. And the lesson of Whyl was that growth had adherents. It was no longer the theoretical monster of MIT computerisations, but a political philosophy, the creed of a technocracy firmly embedded in the powerful institutions of the State and Industry.

This lesson served to break the trust of purely scientific ecologists in the Institutions of Science, and it produced the first political ecologists. And as the ecologists were awakening politically, so the political were awakening ecologically. Whyl demonstrated clearly, perhaps for the first time in Europe, that a technocracy had subverted many of the fundamental safeguards of the democratic constitution. It was the time of Watergate and the parallel was evident to many. The concern voiced recently in Britain by a Royal Commission [7], and a Friends of the Earth/National Council for Civil Liberties report [8], about the dangers to political freedom inherent to an expanding nuclear programme, had by mid 1975, become political reality in central Europe. The costs of delay were simply too great: public participation was all right, so long as they said yes. At Whyl, for example, the pressure vessels were on order from Japan a year before permission to build was ever sought.

Whyl brought other insidious developments in its wake. First a leadworks and now a reactor had been stopped. It could happen again to any industrial development that was in any way unpalatable to local inhabitants. In many cases physical conditions such as cooling water or waste disposal facilities would combine with demographic requirements (sparse population) to bring crucial developments into areas of high resistance. Alternative sites might simply not exist. There followed an extensive, costly, and exceedingly aggressive propaganda campaign. It was led by, but by no means restricted to, the power supply industries. Free brochures [9] and booklets, full-page newspaper adverts, television time: millions were spent. This propaganda makes a fascinating study in itself, but the message is basic; nuclear power is order, is growth, is prosperity, and it is also 'safe', 'clean' and 'cheap'. The propaganda is rife with symbolism designed to play on the German deep-rooted fear of disorder. This material was not meant to inform but to polarise and gain support. It has, of course, been successful. Industrial workers, their unions and parliamentary representatives, are not about to question the institutions of a growth economy that has brought them their prosperity and security.

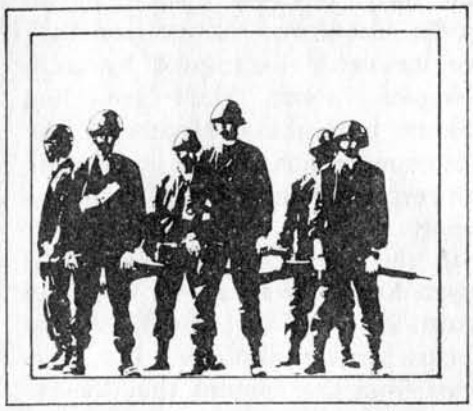
There has been little to counter this propaganda. Environmental groups have produced the odd poster and have received invitations to media chat-shows, whereupon they are inevitably harangued by technologists about their so-called emotive arguments! Meanwhile the Government has busied itself with the recommendations of the Batelle report.

In the report the Batelle social psychologists were given the brief 'attitudes and behaviour toward nuclear power stations', but it is clear from the content that the researchers were also concerned to elicit those facts that bore upon how the environmentalists were organised, how and from whom they gained their support and influence. The report singled out the 'intellectual' element quite clearly — teachers, priests, students and academics, as the 'influencing' agents. The ordinary countryfolk, winegrowers, farmers and housewives were certainly the backbone of opposition, but analysis showed that they understood little of nuclear technology, and were simply afraid, suspicious and fiercely concerned about their rights. Recommendations, all of which, for tactical reasons, have not been published, were made to counter the influence of the intellectual element.

The ensuing controversy over this 'ways-and-means study' has gone some way towards furnishing environmental groups with their first recruits from the social sciences.

The next period was a time of consolidation in both camps. The twelve months prior to the summer of 75 had seen enormous demonstrations on the upper Rhein in all three countries, and not far away, at Lazac in the Massif Centrale, the site of a proposed military training ground was occupied by 150,000 people. The latter half of the year, however, was a time of organisation rather than demonstration. Multi-disciplinary working groups founded a political ecology, and began to tackle the growth points of industry on the ground, making maximum use of the law and of participation in planning procedures. Field studies were no longer confined to academic sea-shore sorties, but developed into coordinated support groups for the citizens' initiatives; support that included

* For a full description of the occupation of the sites at Whyl and Markolsheim see *The Ecologist* Vol. 5 No. 10 December 1975.



ecologists, lawyers, sociologists and even professors of nuclear physics. These groups were University based[10], but they worked in the field with farmers, clergy, teachers and schoolchildren, women's institutes, in fact anyone with concern. The result was an impressive array of writs and court actions and objections to planning: Whyl was backed up in the courts; the fast breeder reactor at Kalkar was held up; at Esenshamm on the Weser the Bremen groups brought a court action aimed at the reactor's heating effect on the river's ecology, which had not been taken into consideration[11] at Lingen, Munich Chemical Works faced its umpteenth citizens' initiative since Marckolsheim, still dogged by the Freiburg group's statistics.

In January 1976 there was a significant change of pace. The Niedersachsen Goverment announced that three sites had been selected for the nuclear industries[12] to build a reprocessing and waste disposal plant: the Germans' very own Windscale. The number one site was in an area of peat bog, farmland and military firing range in the Emsland. As it is also an area of particular conservation interest environmental groups from nearby Universities already had good working relations with the local population and quickly became involved in the community action to oppose the plant.[13]

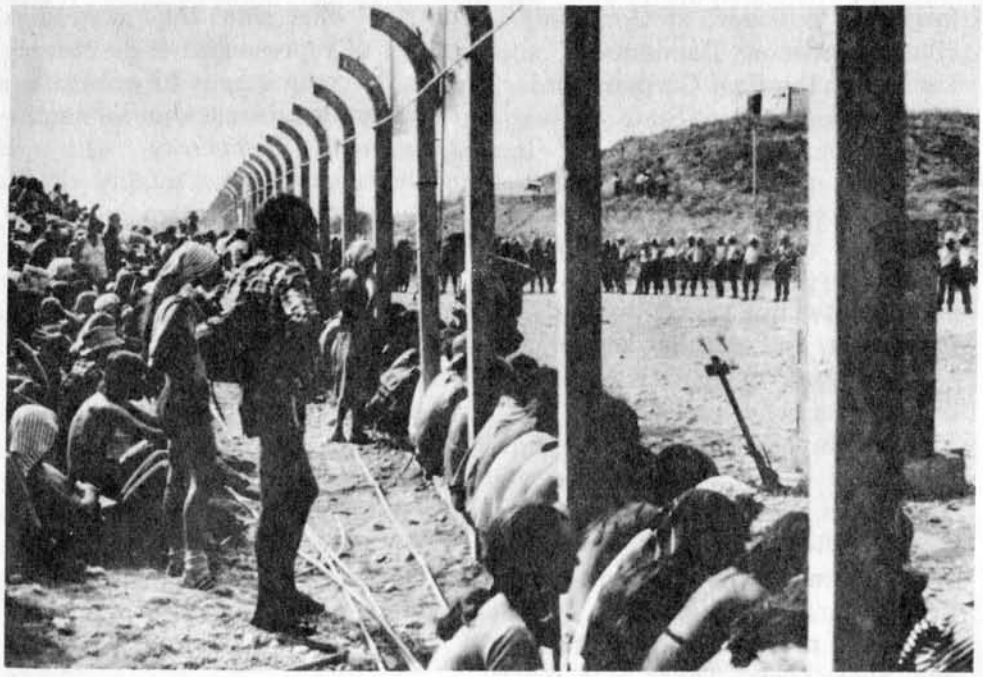
This German 'Windscale' will be 'reprocessing' in the fullest sense, that is, waste treatment together with the rewinning of plutonium from spent reactor fuel. This latter process is quite simply the raison d'etre of reprocessing and is carefully disguised under the blanket term 'waste treatment' in Government and Industry documents, thus giving it an air of necessity. That this is not the case was amply illustrated by the recent British decision to subject this part of Windscale's expansion plan to a public enquiry. In addition to embarking on the untried technology necessary for the Plutonium Economy and all that that implies for society [7 8] the plant will attempt wast disposal in the fullest sense, for all categories of waste will find their final rest beneath the plant in shafts sunk into an underground mountain of salt. This 'end solution' involves the untried technology of vitrification of the liquid waste. A report of the German technical watchdog "Technische Uberwachungsverein", Institute for Reactor Safety, in January 1976[14], could only describe this technology as 'promising', with many problems still to be solved. As an 'in-between' solution the waste would be stored much as it is at Windscale (where there have been technical failures), that is, above ground. In any case, very hot wastes have to be stored in this manner for up to a decade, whatever the final solution. Leaving aside the untried technologies and the hazards of accidents, there remains the problem of effluent in normal running of the processes. At both the British and French equivalents, huge quantities of low-level wastes (containing nevertheless a large inventory of poisons such as plutonium) are disposed of directly into the sea. This option is not open to the Germans who must develop containment technologies or alter their environmental standards. The TUV report says of the projected emission levels, that as a rule radioecological studies should be carried out. It does not say why they cannot, that the scales of time and tonnage and lack of knowledge preclude effective models for the ecosystem.

Reprocessing and plutonium production are crucial to any national expansion of nuclear power. For Germany an expansion of nuclear power is the only way to maintain a growth economy, although few ask for how long. The pressure to build is enormous. However, physical and geographical, as well as demographic requirements (sparse populations in case of accidents), narrow the choice to three sites, all agricultural and all opposed.

With this opposition in mind, the German Minister for Technology instigated a public 'dialogue' about nuclear expansion. Teams of experts from ministries and industry confronted the environmentalists in public debate throughout Niedersachsen, but especially at the sites themselves. Schools, Universities, church centres and village halls were the scenes of intense debate, debate that was for the most part technical, blinding the onlooker with the science of rems and critical masses. The active participants were few and the major ethical issues were seldom satisfactorily dealt with, instead there were the charges and counter charges of one expert against the other. But it was enough just to watch. The pattern was quick to emerge: experts who held that all problems could be solved and who embraced nuclear power without any doubts, were inevitably dependent on it for a livelihood; experts who disagreed were usually working independently of the Government or industry. The spectacle of a professor of nuclear physics locked in debate with an expert from industry about whether atomic explosions could occur in reprocessing plants was enough for most lay people to call halt. There was doubt enough on all counts and growing pressure for the Government to 'rethink'.

The Government was at a loss. It had done everything the Batelle Institute had told it to do, and yet still the locals said no. Political ecologists had succeeded on all fronts. In technical debate they had exposed the complacency of the technocrats, and in the field they had communicated the issue at stake. The enemy was growth. If one called a halt now, then 'rethink' meant alternative life styles, less material benefit. These arguments did not fall on deaf ears — countryfolk were still capable of responding to spiritual values. Resolve produced its own symbolism: on November 29 at the Wippingen site north of Lingen, 1500 entirely local people demonstrated, and to ward off any hint of 'left-wing' involvement, they proved their origins by fielding 800 tractors![15]

But that was November, after Brokdorf. The 'radicalisation' had long set in and followed events in the summer of 76 that mark a watershed. Minister Matthöfer had given



Sit-in by anti-nuclear demonstrators.

hint of the pressures that were building up. In an interview with 'der Spiegel[16] he was taxed about the hazards of nuclear expansion. He progressively dropped all previous assertions of safety and lack of pollution and admitted the dangers were real, but he went on to state his view that all dangers were relative. Disorder was a far greater danger. Growth was essential to maintain order, and as everybody knew nuclear power was essential for growth. He was disturbed by the dangers of nuclear expansion, but he was far more disturbed by the prospects of no-growth!

Minister Matthöfer demonstrated this disturbed state of mind when at a press conference in the middle of his much vaunted 'dialogue' with the people, he said to the citizens' initiatives at the three sites for the reprocessing plant:

> "we have to build this plant, and we will build it. The rights of a few must be sacrificed for the benefit of the nation as a whole. Otherwise we fall into anarchy."[17]

The rights of German citizens are guaranteed in a written constitution, and apart from democratic involvement in planning applications, they are also guaranteed the right to health. One of the risks the Minister admitted to was that of cancer from radioactive emissions.

This extra-ordinary bi-facial behaviour has at least the virtue that it can be seen. The parallel in the British situation allows the Minister (in this case Wedgewood Benn) a secret face. Benn shows concern about nuclear expansion and calls for a public debate of all the issues, and yet a cabinet committee approves in secret the expansion of BNFL's plutonium facility at Windscale, the very foundation for the Plutonium Economy that the Royal Commission called for such care in supporting. It is of course inconceivable that Benn did not sit on that committee, as in all probability did the Environment Minister, Mr. Shore, who under pressure from Friends of the Earth and other groups, eventually was able to admit there were 'different issues' at stake.

The summer of 76 saw the German Government suffering under just such concerted technical opposition. In addition to physicists, however, expert lawyers were at work. The first success was scored when Esenshamm reactor, built and ready to go, was refused permission to come on stream until the problem of waste heat was solved — the court injunction had worked against all the odds. And of the German 'Windscale', the largest such plant to be built anywhere, at a cost of 2.5 thousand million pounds sterling, the environmental lawyers were certain of one thing: it could not be built within the constraints of the existing pollution laws, in particular the 1965 emission controls. The Political Ecology Group at the University of Bremen, under Professor of Law, Manfred Hinz, prepared their case.[18]

If a date can be ascribed to the watershed that summer, it is 4th June, when the Federal Parliament ratified a much heralded 'emission control law'. The fact that this law went through four drafts before its final form, was ignored by the media, as was the rejection of those drafts due to the concerted pressure of environmental groups.[19]

The first drafts had been blatant attempts to 'update' the emission controls to allow for increased expansion and more particularly the heavy emissions of a reprocessing plant. The latter was particularly in need of relaxed atmospheric controls. A concerted action against this 'updating' fielded 25,000 letters. The Bremen group successfully challenged the industry's figures on projected emission levels, although this took little trouble as there was a plethora of contradictions and total gaps in knowledge in all data released by Government and industry.

The fourth draft marked the change. All controls were tightened! All emission levels were reduced. The Government publicity heralded the new law as going far beyond the requirements and thus as evidence of their continual pledge to put safety above everything.

There were a number of quite new clauses in the final draft. Section 1 para 33 was headed, 'exceptions to control regulations in radiation protection'[20]. This clause allowed the local authority to 'deviate' from the

controls if either 'an installation or part of an installation, or *process*, is to be tested', or 'to keep to the stipulations would involve disproportionate expense or trouble', provided that safety was guaranteed 'by other means'. Equally vague and ambiguous clauses appeared governing emissions to the atmosphere, groundwater and rivers, and to the notification procedures in the case of leakages. In all cases there was a movement of responsibility to local levels, and with incredibly vague guidelines for decision making. What for instance constituted 'testing' and for how long? What was a process? How large was disproportionate? One thing was certain, there was nothing that a lawyer could hang a case on.

This time, the thousands of protest letters, if answered at all, were answered with platitudes. Several hundred letters from the Emsland, dealing specifically, and in detail, with the escape clauses, and sent to the Ministry of Internal Affairs and to parliamentary representatives, went unanswered.[21] This episode was documented not by the national press, but by thousands of leaflets, printed by hundreds of small environmental groups throughout Niedersachsen.

In addition to the 'updating' of radiation protection for the public, the Government, mindful of its commitment to growth, also introduced a new law designed to 'simplify and streamline' planning permission for nuclear installations. Unlike previous laws in this field, environmental groups were not invited to participate in its drafting.

This cynical manipulation within a technocratic elite of laws designed to protect and assure the public is the immediate cause of 'radicalisation'. However, in contrast to Brokdorf, the opposition at the reprocessing sites has taken great pains to minimise the radical element and utilise to the utmost the machinery of local democracy. Thus, according to strict rules laid down in the constitution, the citizens' initiatives are organised as democratically run interest-groups with rights to participation. In this way each site has over 1000 fee-paying local members.

In February the site was chosen, but amazingly it was none of the three shortlisted, but a long-forgotten 'outsider' at Gorleben, a village between Dannenberg and Luchow on the East German border. The Niedersachsen State Government was instrumental in the decision and admitted to 'political considerations' in the choice. Evidently they expect less opposition from Gorleben, an area de-populated due to the proximity of the border, and one that has not, of course, had twelve months to organise its opposition.

Gorleben has benefited, though, from the other sites solidarity campaigns. On March 12, not three weeks after the decision, the citizens' initiatives fielded 15,000 people and 20 speakers, from scientists, to union leaders, farmers and housewives. There was much talk, and singing but no violence. There were also speakers from Norway, Sweden, Denmark, Holland and Britain, all of whom declared solidarity. All of this was of little interest to the international press.

At this meeting, Robert Jungk, Professor of Planning and Future Studies at Salzberg and Berlin, added a rider to his now famous Brokdorf 'police-state' speech, in that such a nuclear society would of necessity, be founded on distrust. This is a reference to the bugging, monitoring and trespass by the State security police of the head of Euratom, Dr. Traube, suspected of terrorist contacts! After failing to satisfy anyone that Traube was guilty of anything more than an unconventional life-style (he wore pullovers and kept sheep), Minister of the Interior Maihofer was lucky to avoid the dole queue himself — he survives now because the coalition needs him.[22]

There is now very little middle ground. The stakes are too high for the Federal Government to change course. Brazil has ordered a plutonium plant as a condition for buying ten reactors and for selling its prospective uranium to Germany.[23] Britain and France currently treat German waste and recycle fuel, but are unable or unwilling to carry on doing so. As part of United Reprocessors, a strong German industry is doubtless to these companies' advantage.

The lines are now drawn. In the end it will come to a trial of strength between two political movements, on the one side the centralised power of representative democracy, with its commitment to growth and on the other the extra-parliamentary grass-roots democracy with its commitment to the quality of life and the rights of the individual. For the moment the extensively decentralised nature of German parliamentary democracy is all that separates the citizens' initiatives for environmental protection from a major clash with the machinery of a police state as happened at Malville. It would be foolhardy to try and assess the outcome, but one thing is certain, that without its Windscale, the German atom-industry is finished.

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VIEW FROM ... THE Ecology Party

How to Make "Ecological Policy"

Many people put questions to the Ecology Party regarding its policies: they tend to fall into two groups — those who laugh and ask "How do you make an ecological policy on (for example) education?" and those who, it seems, can hardly wait to see our manifesto as though it will contain some great, original and definitive answers to ecological problems (it doesn't).

One simple point might clear a lot of apparent mystery. The fact that, unlike other ecological groups, we are dedicated to take ecology to the polling stations and gain power to operate ecological policies, does not mean that we are different in any other way. Our beliefs are the same as those of other conservationist groups, and the policies we would apply are just those which other groups are putting forward. We are different in the way we seek to achieve our aims, but not in the aims themselves.

Ecological policy making is a job we can all do in our own armchairs. All you need to do is take the Party's two basic principles — Ecology and Democracy — plus any area of government policy and an appropriate policy will very often suggest itself quite quickly. In education, for instance, ecological constraints are hardly involved: teaching is labour intensive rather than energy or materials intensive, and there is certainly no ecological reason why large amounts of labour should not be used; it is, after all, a renewable resource. Schools do have to be heated and lit, of course, which indicates a need for double glazing, solar panels and perhaps a slightly longer winter holiday, and some pupils use a lot of energy in travelling to distant schools, which indicates a need for a larger number of smaller schools which pupils can reach on foot or bike.

Any reader who hadn't previously thought about the implications of ecology for education will doubtless now have food for thought. And a little thought will soon show how there are areas where a consensus opinion may be reached almost immediately (solar panels) and others where views will be more diverse (smaller schools would presumably not be able to offer such a large range of subjects).

The questions to be answered, basically, are "Does this policy help us to pass on to following generations a substantial and secure way of life, rather than a bunch of betting slips?" and "Within this first constraint, is the policy one which the majority of people in Britain can support or at least assent to?" Only if both questions can be answered positively is a policy really fit for the manifesto.

The preceding points should answer our most well-worn question "Is the Ecology Party Right or Left?" We are all, unfortunately, so accustomed to the bickering between Left and Right that we tend to assume that every new party must have some blistering new statement to make on it. We haven't. In attempting to gain the support of the majority of the people for zero-growth policies we must take a stand where all moderates from the 'centre right' to the 'centre left' can agree with us. And taunts from extremists that being moderate is having no views at all cut no ice — standing on dry land is not the only alternative to drowning.

Of course there *are* contentious policies. Defence is one which currently receives a fair amount of discussion within the Party. And of course, many of our policies will take years or decades to implement — restructuring our economy is not a simple five or ten year job. We need all the time we've got left between now and when the oil gives out.

We hope we don't need more time than that.

Cut out and Return

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ACADEMICS & TH

A CRITIQUE OF THE AUSTRALIAN NATIONAL UNIVERSITY

by Bria

Can a conventional educational establishment teach the ecological approach to the problems society faces today? This is unlikely because of the structure which divides knowledge and learning into separate and water-tight disciplines. British universities have not yet attempted it. Even when they teach 'ecology' they still, to all intents and purposes, use the reductionist approach, while 'environmental sciences' means something different wherever it is taught; too often it is only another label for urban planning or pollution control.

"When to speak is unpopular, it is less pardonable to be silent than to say too much" — *H.C. Coombs*

In the wake of widespread public concern about environmental problems in the rich countries of the world, many academic institutions have begun promoting research in this hitherto neglected area. The Australian National University's Centre for Resource and Environmental Studies (CRES) can be seen as a manifestation of this new academic interest.

CRES is the only academic organisation in Australia devoted almost entirely to research in environmental and resource areas. Its current annual budget exceeds $600,000. Although not the first year of its existence, 1976 was the first year in which CRES had more than a skeleton staff. This account is based on my experiences as a research assistant in the applied systems analysis group in CRES in 1976.

My object here is to argue that CRES, because of the disciplinary training of most of its members and because of its organisational structure, is largely unsuited and indeed in many ways unable to tackle environmental and resource problems from any deep and critical perspective. Because of this, studies done in CRES serve mainly to justify policies and practices serving the interests of powerful groups in society — elites in government and industry primarily — who have no real concern about the environment.

The existence of CRES as an organisation may give the illusion that substantial effort is being devoted to a search for fundamental solutions to environmental problems. Therefore it may be that the most serious actual function of CRES is to help to co-opt the environmental movement. (Of course, serving the interests of powerful groups in society and co-opting the environmental movement are not conscious or intentional aims of most CRES members.) For these reasons, this critique is not meant as an attempt to influence the development of CRES, but a warning to activists — in and out of academia — of the dangers of leaving to academics the search and struggle for change in society which strikes at the roots of environmental problems, rather than treating symptoms.

Reasons for writing a critique

I am writing this critique as a result of my interest in the political function of institutional arrangements in society, and my belief that a drastic change in these arrangements is necessary if what is potentially best in human culture and community is to survive and prosper. I believe that showing the workings of organisations is one way of alerting people (outsiders mainly) to the need for different structures which are more directly responsive to the self-expressed needs of the populace.

I believe that organisations and individuals should continually subject themselves to critical internal and external appraisal as to goals, methods, and the need for change. Needless to say, this does not occur in the large majority of organisations or individuals. This account is my attempt to say to a wider public what I was discouraged from saying within CRES.

It is perhaps unfair to single out CRES for criticism, since it is not really any worse than most other organisations. But that does not mean that the criticism is any less valid.

It is true that my position at CRES (renewable annually) was not renewed, so that it may be claimed that I have a grudge. My perspective is different. The previous year I had planned to write a critique of the School of Physics at Sydney University, but in the end I did not. That I am writing about CRES may show that there is something worth saying about it. Besides, several friends have urged me to do it. I particularly appreciate the sympathy and encouragement from those, including a dozen or so members of CRES, who commented on this article for me.

Another encouragement for this attempt is knowing many people, with much more damning information about other organisations than anything I say here about CRES, who are afraid to speak out because of their careers. And it *is* a risk to speak out: in my experience, the response of organisational hierarchies is to attack those who express unpalatable ideas, rather than to consider the ideas themselves.

E ENVIRONMENT

CENTRE FOR RESOURCE AND ENVIRONMENTAL STUDIES

Martin

This is not so in the case of Australia's National University's Centre for Resource and Environmental Studies (CRES). This represents a novel and interesting departure and employs some of the most distinguished figures in the field of Human Ecology and Natural Resources. However, as the author of this illuminating article points out, it has not really succeeded in shedding the shackles of the age of reductionism and quantification from which we are only now beginning to emerge.

* * *

My analysis will have three components. First, I will analyse the disciplinary backgrounds and approaches of the three main research groups in CRES: resource economics, applied systems analysis, and human ecology. Second, I will look at CRES's organisational structure, and finally at the actual actions taken by members of CRES and by CRES as a whole.

The resource economics group

"The purpose of studying economics is not to acquire a set of ready-made answers to economic questions, but to learn how to avoid being deceived by economists —"
Joan Robinson.

The resource economics group is the largest research group in CRES, consisting in 1976 of a professor, three research fellows, several research assistants, and a secretary. Virtually all of those on the research staff are economists by training, and most seem to follow the approach of neoclassical economics.

It is being increasingly recognised that neoclassical economics is a remarkably unsuitable discipline for treating environmental problems. There are several reasons for this.

First, environmental quality is owned by no one, and cannot be bought and sold on the market (though market operations are sometimes influenced by environmental factors, mainly via laws). Air pollution, urban blight, and artificially-induced climate change are 'externalities' to economists: annoying effects not regulated by the market. Because they are not easily put into a market model, they tend to be ignored or downgraded, and usually are introduced into economic analysis in a significant way only after outsiders (non-economists) forcefully emphasise their importance. It is no surprise that economists have been and remain conspicuous by their absence from environmental movements.

Second, environmental costs and resource shortages must be introduced into economic analysis in an after-the-fact manner. This is because the value of environmental quality and of scarce resources results partially from public perceptions rather than the operations of economic processes. Awareness of the dangers of excessive use of pesticides or wasteful exploitation of petroleum resources certainly was not due to economic analysis. The best the economists seem to be able to do is plug new values into their analyses long after most of the damage has already been done.

Third, economic theory assumes that money and the things it can buy provide a comprehensive measure of people and their values. Yet anyone familiar with practical psychology, religion, politics, anthropology — or who has observed what makes people tick — will realise that what people value most in life may have no price (or an unrealistic price) on the market. Take for example the traditional Aborigines, whose relationship with their land is an integral part of their rich culture and is of overwhelming importance to them: *no amount of money could ever compensate these Aborigines for the loss or destruction of their land and the culture it sustains.* Similarly, other people find personal relationships, art, ideology, or religion of predominant importance in their lives. The economic approach simply cannot treat these factors in any satisfactory way. By translating people's values into economic measures, economists downgrade and obscure the possibility of patterns of social, political, and economic development based on other values.

Fourth, and most important, the economic perspective does not readily lend itself to any evaluation of policies and actions based on radically different values. Economic analysis can be applied to the economic system as it presently operates (or rather, as it is thought to operate), but becomes even more dubious when applied to hypothetical alternatives. This is because many of the tools of economic analysis — from supply-demand curves to the compensation principle to regression analysis — are much less useful if used to describe an economic system based on different values. The basic problem is that economics builds the values of the present system into its models, and thereby promotes these values to the exclusion of alternatives.

Let me give an example of the

limitations of the neoclassical economic perspective. Economists find it natural to justify the current transport system based on private motor vehicles. They argue that if people wanted bicycles instead, they would buy them in the marketplace, and if they wanted better public transport they would demand it through elected representatives. (More precisely, automobile use will reach a level constrained by factors such as the price of petrol, waiting time for parking, and commuting time, all of which serve to limit or encourage demand.) This argument ignores political and institutional effects, such as the massive promotion of cars through construction of roads, production of petrol, and development of suburbia designed for cars, and the political and media influence of manufacturers of cars, roads, and petroleum products. The idea of incremental market change downgrades the 'externalities' of pollution, resource exhaustion, medical care for accident victims (not to mention death and suffering), and lack of proper exercise. It is quite possible that *if* there were an extensive system of bicycle paths and rapid, clean, efficient public transport, if cities were designed and living and workplace relationships structured to minimise transport needs, and *if* an ethic predominated which encouraged a clean environment and good health rather than material possessions, *then* people might consider cars to be about as useful as helicopters are now. The idea of incremental market change obscures this possibility.

These then are some of the reasons why traditional economics as a discipline is not suited for treating environmental problems from a deep critical perspective. Perhaps it is not impossible for economic theory to adapt to treat these problems (as some of the studies of steady-state economics have suggested), but it is probably harder to do this than to start afresh without knowing traditional economic theory.

What then of the CRES resource economics group? In my opinion, most of the work produced by this group has suffered from being within the traditional economic perspective. The interesting thing is that members of the group will tell you (in private) about the limitations of economic theory — they are not naive. But when it comes to making a study, this awareness of limitations is translated into caveats; the essence of the work reflects the basic orientation of the discipline.

One study performed by two group members concerns the "economics of environmental services". This refers to people's "demand" for clean air, quietness, or a stable climate, and the guarantee or supply of such "services" by the private and public sectors. The approach taken in the study is to look at money spent to protect "environmental amenities". It turns out that most of this money consists of government expenditure for sewerage and garbage collection, industrial expenditures for pollution control, with a small amount for other things such as treatment of air and water pollution. Once one has the expenditure figures, one can play around with values of this spending as a fraction of GNP and fit it to various simple models as a function of population density or per capita income. On the technical side one may quibble with the approach, for example by pointing to political considerations involved in provision of sewerage. But the main thing that strikes me is how blind this approach is to social and political solutions to problems of environmental amenity. For example, the "service" of garbage collection might be replaced by promotion of recycling (for all non-biodegradable materials) and composting. Naturally this would require a change in social expectations (people would frown on dumping of refuse as they now frown on shitting in the road), in marketing practices (companies would have to promote something besides convenience in foods and glamour in appliances, such as wholesomeness and durability), and in political control (community groups could most efficiently oversee recycling and composting activities). These sorts of changes just do not fit in the neoclassical economic framework.

The whole "environmental services" perspective is built on the assumption that any improvement in environmental quality entails a corresponding reduction in the benefits from material production. I brought up the possibility that by eliminating some wasteful packaging, production costs could be reduced and the environment improved at the same time. It was argued by the economists that if people bought the highly packaged product, then the surplus packaging *must* be providing some service to them!

Whatever the economists may think, I feel that the possibility of the elimination of pointless packaging — as well as of eliminating planned obsolescence, manufactured demand, and institutionalised 'necessities' (offices which are used a fraction of the time, energy-expensive machines and buildings) — shows that the environment and the standard of living could be improved at the same time. For example, if appliances were designed to be easily repairable by the user, and designed in components so as to be useful for diverse purposes, then availability of goods could be increased with a decrease in production and in environmental impact.

A second basic difficulty with the resource economics group's approach to "the economics of environmental services" is the implicit assumption of equal distribution of incomes. Neoclassical economists typically utilise the compensation principle; in the case of this study the assumption is that the demand for environmental services will reflect a willingness to pay for them, or to be paid for accepting the disamenity. But what a person is willing to pay depends on that person's ability to pay. (The group's study mentions this limitation of their analysis in a single sentence; the analysis carries on with the assumption of equal per capita incomes.) Since if anything the environmental costs of growth fall on the poor in a community, the compensation principle introduces a hidden inegalitarian value judgement. Moreover, this approach does not encourage the systematic search via research and development for alternative technologies (such as recycling), but instead focuses attention on ameliorative tactics based within existing institutional structures.

In summary, the resource economics group's study of "the economics of environmental serv-

ices", by assuming that "the flow of material goods" and "environmental amenity" are inevitably opposed, and by implicitly assuming that people have equal amounts of money to "demand" their "environmental amenity", obscures rather than elucidates any solution to environmental problems other than cosmetic, incremental changes.

Another subject studied a bit during the year was beach sand mining. Suffice it to say that the economists automatically think in terms of taxes to be imposed on beach sand miners during certain phases of the mining cycle. The approach of the Fraser Island Environmental Inquiry, which recommended against mining on Fraser Island due to its unique ecological characteristics, is alien to economists: the only way such a stance can be integrated into their approach would be by setting certain prices to infinity. From the economist's point of view (using cost-benefit analysis) a more rational way to measure the value of beach sands would be to determine what amount companies would pay to mine them, and what the populace would pay to protect them. Such an approach is of course again flawed by the inadequacies of the compensation principle: it ignores the differences in wealth and political power between those who would exploit the beach sands and those who would protect the island's ecology.

A more fundamental analysis of the question of mining beach sands must look at what the minerals in the sands are used for, whether making extra bright paints or making cladding in nuclear reactors. Perhaps if as a community we promoted suitable changes in life-style (such as not painting the building in which CRES resides with bright white paint inside and out) then the difficult decisions about mining Fraser Island would not need to be made. But economists do not look at changes in life-style, since the economic system automatically takes into account the 'demand' for white paint and other products of beach sands.

Finally, let me make a few comments about econometrics, which is studied a bit in the resource economics group as well as in the applied systems analysis group. Econometrics is a mathematical offshoot of economics: it takes equations generated by economists and determines existence and uniqueness of solutions, finds methods for solving the equations and for testing the solutions, etc. Econometrics can be fun (like all mathematics) and you don't even have to know much about economics. The basic problem is that econometricians do not (and perhaps cannot) question the assumptions underlying the economic equations which they analyse. Indeed, to question them would be to undermine the source of their livelihood. Aided by the apparent lack of values in econometrics, this unconscious incentive to justify one's occupation makes it easy for econometricians to carry on with their work without worrying about what purpose it ultimately serves.

Traditional Aborigines' relationship with their land is an integral part of their culture . . . no amount of money could ever compensate for the loss or destruction of their land and the culture it sustains.

The applied systems analysis group

"The worst of him is that he is much more interested in getting on with the job than in deciding whether the job is worth getting on with." — *John Maynard Keynes.*

The applied systems analysis group consists of a professor, a research fellow, a couple of research assistants, a programmer and a secretary.

The basic orientation of the group is that of control engineering, set by the background of the head of the group. Control engineering can be considered to be the study of policies for managing systems (which often are uncertain and erratic) to obtain a desired output. In its actual practice, control engineering usually leaves unquestioned the purpose of the system being studied, and concentrates on making that system work efficiently. For example, study of the simple control mechanism in a thermostat obviously does not lend itself to questioning the desirability of heating a room or a roast. Unlike neoclassical economics, whose concepts actually hinder a deep critical approach to environmental problems, the concepts of control engineering (like those of most of applied science mainly serve to help one *ignore* the possibility of such an approach.

The most acclaimed tool in the applied systems analysis group's repertoire is an elegant and effective way for statistically analysing a series of data points. This and other related techniques have been used in the past to study water quality in rivers in England, and a similar project was sought in Australia for the group. The research project eventually undertaken was a study of water quality in the A.C.T. The project involves the use of existing river flow and other data, the gathering of data on nitrogen and phosphorus and the like in the rivers, and the modelling of the water quality mathematically. The project relates to the Lower Molonglo Water Quality Control Centre (LMWQCC), which will treat most of the sewage produced in the Canberra area. The LMWQCC is capable of removing virtually all the nitrate and phosphate from the input water, but this promises to be a very expensive operation. The aim of the study is to show whether it is acceptable to *reduce* treatment during periods of high river flow so as to cut costs, while still maintaining satisfactory water quality downstream from the treatment plant.

Thus the study is designed to show how to *minimise* the amount of sewage treated, and will provide technical justification for any policy that does this. But aside from this, the basic approach (modelling) does not get at the root of the environmental problem, namely at the source of the effluent itself. An alternative approach would be to look at changes in sewage disposal methods, principally involving recycling of human wastes at the household or community level (the technology has been around for

decades), along with stringent controls on industrial wastes. This alternative approach would have to look at community expectations, institutional pressures for centralised disposal, and changes in land use. Adopting such an alternative approach would mean that $45 million treatment plants would not be required. It would also mean that fancy statistical techniques of control engineering would be unnecessary for modelling water quality. So it is not surprising that such alternatives are not studied, nor seriously mentioned nor perhaps even thought of, by control engineers. It is not only economists who have a vested interest in their ideas and their tools.

The human ecology group

"It is striking how rarely the scholars (devoted full-time to the pursuit of truth) lead the struggle for change" — *George Lakey.*

The approach of the human ecology group seems to lend itself much more readily to a study of fundamental environmental problems rather than environmental symptoms. Therefore it is significant that the group was not originally intended to be part of CRES; the association came about in late 1975 due to personal and political factors in the university.

The human ecology group consisted in 1976 of a professor, a research fellow, several research assistants, two Ph.D. students and a secretary. In its previous location the group had been involved in a major study of Hong Kong, involving and coordinating a number of outside researchers in this project. During 1976 this project was in its write-up stage, and plans for a new major project — similar studies of Adelaide and Lae — were under way.

The approach of the CRES human ecology group includes aims such as improving knowledge of the ecology of human settlements as a whole, especially in terms of flows and uses of energy and materials; understanding relationships between properties of the environment and energy and resource flows, and the health and well-being of the people; and understanding adaptation to detrimental environmental influences. A fundamental belief underlying the human ecology approach is that a comprehensive description in an ecological way is essential to understanding the interaction between the total environment and human experience; and that the primary object in such a description is the improvement of human well-being within this total system.

The concepts used by the human ecologists clash strongly with those used by the resource economists. For example, the resource economists tend to assume (with qualifications) that human well-being increases with GNP, whereas the human ecologists question the wisdom of increasing use of energy and materials and technological construction of the human environment as a strategy for the long-term promotion of human welfare.

The human ecology approach encourages looking at alternatives.

Unlike neoclassical economics, whose concepts actually hinder a deep critical approach to environmental problems, the concepts of control engineering . . . mainly serve to help one ignore the possibilities of such an approach.

For example, in the agricultural sector of Hong Kong, there is an increasing switch to the use of artificial fertiliser, which uses more energy and resources (oil) and causes a major water pollution problem (due to human excrement entering potable catchment areas). The resource economists probably wouldn't concede there is any problem as long as GNP is increasing; they might be concerned with the effect of oil prices on productivity and the balance of payments. The applied systems analysts might be interested in the water pollution, mainly as a modelling exercise (where should the sewage be dumped to cause the least problem?). The human ecologists, on the other hand, would focus attention on the insignificant increases in yield due to switching to artificial fertilisers, on the marginal increase in economic return to the individual farmers and therefore on the questionable return to society from this development. They would seriously investigate the alternative of recycling human and animal wastes back to the land as a source of fertiliser, which also reduces energy and resource use and pollution, and as well promotes a more equitable and satisfying life-style.

The actual work of the human ecology group is far from perfect, which is I suppose inevitable since it is to a large extent breaking virgin ground. Some of the studies might be called prophetic statements: they contain little detailed analysis. When the latter is made, it tends to be over-whelmed by data (on energy flows or health statistics), which often obscures important social and cultural factors. The excessive concern for collecting and analysing data in situations where its meaning is not clear or is misleading (and where fewer numbers and more insight might be better) may stem from the researchers' background in the biological sciences, or worries about attacks from the other more mathematically-based groups in the academic community.

Though the approach of the CRES human ecology group provides some very useful concepts, it suffers (as I see it) from a strong downgrading of institutional and political forces in society. In the human ecology group's conceptual framework covering population ecology, there are for example links between the total environment (which includes biotic components, culture, etc.) and life conditions (which includes personal environment, personal behaviour, etc.). There is no explicit mention of institutional factors linked with political and economic vested interests in society: such things as production processes, design of an urban area, and community services, all influenced strongly by government and industry. These factors, admittedly, are contained in the human ecology conceptual framework as aspects of the total environment and aspects of life conditions. But roads, telephones, buildings and working conditions do not spring up on their own, but reflect the interests of powerful groups in society.

It seems to me that in terms of

trying to get to the root of environmental problems, it would be better to include institutionalised political and economic forces as entities in themselves. Air pollution from automobiles may be affected a tiny bit by changed personal behaviour on the part of a few individuals, or by changes in cultural values; but much more influential would be changing to other areas the investment by industry in automobile and petrol production, or altering the promotion of automobile transport by government departments through road construction and town planning.

Another example of the lack of a critical political dimension in the human ecology group's conceptual framework is their categorisation of groups in society which affect energy use and the technological environment in general as (1) promoters (for example, oil and lumber companies and associated government departments), (2) government, (3) community, and (4) environmental reformers (such as Friends of the Earth). As an explanation of how energy and resource use gets out of hand, this categorisation seems plausible (promoters are influential and numerous, reformers can at best block changes), but it is superficial because it does not get at *why* so many people are paid to promote energy and resource use and so few are supported to promote alternative strategies.

Some members of CRES feel that the approach of the human ecology group is insufficiently rigorous — certainly less rigorous than the approach of the other two groups. This is quite true if one is talking about deriving conclusions from statistical tests on data. This sort of rigour is not what the human ecologists are trying to achieve (or not, in my opinion, what they should be trying to achieve). Much of the criticism seems to be based on a lack of understanding or communication about the aims of the human ecologists. A more valid criticism could concern the consistency, coherence, and robustness of the human ecology conceptual framework. here I only note that the human ecologists give much more critical attention to their framework than the other groups give to theirs, and if it is more amorphous it is also probably more sound. Many are prepared to admit that the assumptions of neoclassical economics are riddled with holes, and that control engineering consists of a set of techniques posing as a philosophical approach. Rigorous results obtained using erroneous or narrow assumptions are hardly worth having.

* * *

It is worth noting here that in the work of the research groups, the absence of features challenging the status quo of environmental policy-making in an open or extensive way may be considered to be a tactic for achieving change. Resource economists may feel that they can only affect policy (of the government) by using conventional economic ideas; applied systems analysts may feel that they must work within the current model for sewage treatment; and human ecologists may feel that the explicit presence of political factors in their conceptual framework would alienate potential patrons. These are the terms in which researchers justify their current activities.

However, if significant change in the forces now determining social change is desirable, then someone must lead the way. Piecemeal efforts will only reinforce or streamline present patterns. As in the case of the tools of neoclassical economics, working on the basis of current values tends to reinforce those values, whatever the intention of the user.

Furthermore, seldom is there any attempt to *try* a more dramatic and forceful approach towards change. Unless this is done (and it *is* done by some), then any claim that one must work within the system is merely rationalising a support *for* the system.

* * *

In summary, resource economics concentrates on antidotal measures and uses methods of analysis which hide the possibility of alternatives, and which promote business-as-usual (a continued assault on the environment): traditional economic concepts are ideally suited to downgrade environmental problems. Applied systems analysis concentrates on technical solutions to technical problems, and so ends up treating symptoms rather than getting at causes: control systems concepts encourage an ignoring of the causes and solutions of environmental problems. Human ecology concentrates on environmental and human well-being factors with some insight, but fails to offer the conceptual tools needed to promote change in social policies affecting the environment: even the understanding of the problems is hindered by lack of consideration of political and institutional factors.

(There is also another minor aspect of CRES's activities, a small master's course starting in 1977. The content of the course is likely to reflect the orientation of the research groups, and its structure is likely to reflect CRES's organisational structure. Fortunately one can be more optimistic about the students.)

CRES's organisational structure

The relationships between people in an organisation strongly influence its ability to treat different types of problems. The organisational structure of CRES is such as to make it very difficult to treat environmental and resource problems in a way that involves the values, skills, and interests of the community as a whole, or even of all CRES members.

CRES is extremely hierarchical. The following major classifications can be discerned: head of CRES (''the director''), professors, research fellows, Ph.D. students, research assistants, secretaries, and maintenance workers.

CRES is also highly compartmentalised. Each research group is concerned almost exclusively with its own research project or projects. Attempts often are made to expand the domain of these group projects, but attempts to develop common projects meet a monotonous apathy. Not only is co-operation lacking, but there is little sytematic effort by CRES members to understand the perspective of groups other than their own.

It is well known that the environmental movement has had its basic impetus from the community at large; it has not been spearheaded by government officials, industrialists, or academics (although some of the latter have been instrumental in providing information and stimulating awareness). This is only to be expected, since it is workers and con-

sumers who suffer most from environmental degradation and resource depletion, and whose lifestyles are affected by technological innovation. Any serious attempt to provide fundamental solutions to environmental and resource problems (at the level of control over production processes, design of human settlements, forms of human interaction, and equity) must involve people at a grass-roots level. The values of people can only be expressed if they are given access to information, given a real say in community planning, and given the opportunity to organise and sort out their ideas and wishes.

CRES is the antithesis of a democratic organisation designed to serve the community. To begin with, its hierarchical structure makes it very difficult for any real communication to occur within the organisation. Messages can go up the hierarchy, and requests can go down, but there is very little give and take. The basic patterns of research and organisational action are dictated by the few people at the top.

A few examples may indicate the effects of the operation of the CRES hierarchy. Firstly, a proposed course on "mathematical modelling of the upper atmosphere" was not approved because it was "too controversial" to discuss in it the effects of Concorde exhausts on stratospheric ozone. The person who vetoed the course never even condescended to speak to the proposer about the issues concerned: the decision was passed down via an intermediary.

Secondly, in one of the research groups it is official policy that any work done in CRES or published with a CRES affiliation must first be vetted by the head of the group, or someone he may specify. Of course others in the group have no right to censor the leader's work in this way.

Finally, secretaries are often discouraged from attending seminars of general interest, by explicit statement or feeble excuse (the need to tend the phones). Some of the leaders of CRES quite clearly want to keep secretaries in their subordinate place.

In CRES the exercise of power does not arise from people being forced to do certain things, but through selective encouragement and discouragement of specific actions and attitudes. The lack of overt incidents does not mean that the effects of organisational hierarchy are any less important.

CRES's organisational structure has ill effects from the view of achieving full and free discussion of environmental problems. Because environmental studies are relatively new, those high up in CRES have no more expertise or experience in environmental matters than those at the lower echelons. In other organisations, such expertise and experience can serve as a justification for an imbalance of decision-making power. In CRES even the appearance is illusory.

It is perhaps no coincidence that attitudes to the environment and to organisational responsibility get almost uniformly more conservative the higher up one looks in the CRES hierarchy. This may partly be due to an age differential; more likely it is due to the greater professional vested interest associated with a safe academic career involved in the higher positions. Whatever the situation, the rigid structure provides a barrier against 'radical' ideas getting seriously considered or acted upon by CRES personnel.

CRES as an organisation makes few if any attempts to promote community involvement in and consciousness about environmental problems, and about the fundamental social and political choices involved in their solution. And needless to say, there has been no attempt to get input from community groups concerning what research CRES should be doing.

The leaders of CRES look mainly towards government and industry as sources of problems and as users of CRES expertise. Publications by CRES personnel mainly consist of internal reports (for selected distribution, as to government departments or academics who judge CRES) and papers for technical journals.

This orientation of CRES towards government and industry is strongly linked with the promotion by the leaders of CRES of studies which do not challenge existing approaches to environmental problems. For example, the head of one of the research groups in looking for a problem to apply the group's techniques, struggled mightily to get strong involvement with government departments. At one discussion meeting, a government official involved noted that academics were in a good position to question fundamental features of the problem as defined, since they were tied to no special contract or guidelines. This brought no response from the head of the CRES group, who had made every attempt to involve the group in a programme tied down to particular aims.

If I have talked here more about the leaders of CRES than about the secretaries and others in the lower ranks, it is not because the contributions of the former group are greater or their opinions more valuable, but because they have more power over resources and people. It is my experience that those in the lower echelons as a rule have a more personal and practical concern about the environment, and as well relate more easily to the community. For these reasons, the CRES secretaries (for example) could greatly improve on the present direction of CRES in terms of considering the environment and the people rather than cultivating academic aloofness and currying favour with business and government.

Actions by CRES

More revealing than stated or inferred aims of an organisation are its actions; therefore I'll comment on actions (or lack of action) by CRES members and by CRES as an organisation.

It may be argued that the habits of individuals are not relevant to their work as professionals. But most people expect that the difference between stated precepts and actions should not be too blatant: for example, this expectation may be one reason why so many doctors have stopped smoking. On the level of minor individual actions, quite a number of CRES members have tried to be environmentally conscious of their lives: riding bicycles to work or around campus, turning off lights, saving on paper. Another group seems to have different preferences: for example they use a car even for the shortest trip, and invariably use the lift instead of the stairs. It is notable that the former

group is primarily composed of lower ranking members of CRES, while higher ranking members are almost entirely in the latter group.

As an organisation CRES has done almost nothing about the local or general environment by word or deed. The only attempt was a proposal, initiated within CRES, to institute about ten new parking spaces near the building in which CRES resides. The rationale for paving over more of the campus is based on a simple value judgement: it is more important for certain (important) members of CRES and visitors to CRES to save 5 or 10 minutes (otherwise spent walking to a parking area further away) than it is to maintain or improve the environment near CRES. And completely left out of the picture is the possibility that instead of agitating for more parking lots, such effort could have been spent encouraging use of the free university bus service, or pressing for better cycling facilities.

A significant contingent of CRES members supported this move (a few opposed it). Many of the CRES staff were prepared to say that their research was so vitally important that the 5 or 10 minutes saved by a parking lot was well worth any cost involved to the environment or in the promotion of a more automobilised society. However, the proposal was blocked by the university administration. The Assistant Vice Chancellor as well as planners in the university bureaucracy strongly opposed the proposal; they thought that in this case the environment was more important than the convenience that might be created.

It is clear that alternatives such as bike paths can never get off the ground as long as personal interest is pursued through institutional actions which do not challenge the existing contexts in which personal decisions are made. But it is encouraging that there are members of the university bureaucracy who are environmentally conscious and progressive, at least more so than a strong faction at CRES has shown itself to be.

Besides this parking lot example, there is little CRES has done in terms of action. What is noteworthy is the lack of interest or encouragement from the top of the hierarchy for any discussion or even mention of possible statements, initiatives, or actions on environmental matters. Of course, agreement on such actions would be difficult, and almost certainly a drawn-out process of evaluation and argumentation would be required — which itself would be quite valuable. It would not be so upsetting that no actions had been made if it were not also true that either lack of interest or active discouragement greeted any proposal for study of such actions.

At one stage I advocated (at the only general staff meeting during the year) that CRES (or members of CRES) could: (a) put out a statement deploring the lack of thought about the environment in the planning and construction of the building in which CRES resides, calling for close attention to resource and environmental considerations in planning and construction of further university (or other) buildings; (b) put out a statement encouraging bicycling and walking on campus, and opposing further accommodation to the car; and (c) in general reflect on the relation between the things CRES studies and its organisational actions. This emotive proposal got a polite reception; the essence of the response was that no such initiatives would come from or be encouraged by the top. I had not expected agreement with my suggestions for CRES action; but it might at least have been hoped that discussion would have been encouraged.

Why is CRES the way it is?

Most of the leaders of CRES tend to look down upon arguments by environmentalists, and ignore them. As one CRES member astutely pointed out to me, what they could do is say, "Admittedly some of the arguments of the environmentalists are weak. But because the environmentalists have so little power and so few resources to promote their case, and because the companies have so much power and resources, let's direct some of our research effort towards making the environmentalists' arguments *better*." The leaders of CRES are in a position to do this; the tragedy of the organisation is that they don't.

It is always easy to blame particular people for the inadequacies of an organisation. But it is probably more useful, if also more difficult, to trace the inadequacies of the organisation to structures in society. It is likely that the few people who were influential in setting up CRES conceived of environmental research as an academic pursuit oriented towards the needs of government and industry. Similar attitudes probably were held by those who were influential in choosing individuals, with particular personalities and particular disciplinary backgrounds, to direct research in CRES. And once the professors were appointed, their attitudes and orientation to the environment were vital in selecting further staff.

Resource economics concentrates on antidotal measures and uses methods of analysis which hide the possibility of alternatives and which promote a continued assault on the environment.

So it is not surprising that most of the staff have had no long or pressing concern about the environment, and may have been more interested in other problems (such as international trade or time series analysis). Nor is it surprising that individuals were chosen who preferred a strong hierarchy.

CRES probably closely approximates what its sponsors and leaders, unconsciously and underneath all the rhetoric, expected it to become. If this is disappointing, one should not blame the members of CRES, but the structures in society that helped generate an organisation which now serves the interests of those structures. Perhaps the lesson for activists is not to expect any more than this from academia.

My view of the environment

It is only fair that I spell out the perspective from which I have analysed CRES. There is a wide

range of orientations within the environmental movement, and my own view (presented in simplified form here) will necessarily be a minority one. But of course the critique here can still be revealing to those who look at things differently from me.

While the actual degradation of the environment and depletion of resources are very important in themselves, I believe these issues can form a more significant function as catalysts for social and political change (which simultaneously accomplishes change in attitudes toward the environment). There are many things wrong with current social, economic, and political structures; foremost among the consequences of these structures are war, poverty, alienation, decision-making by elites (lack of participatory democracy), and racism. Environmental and resource problems easily can be seen as another of the major consequences of these structures.

There are two basic approaches to the solution of these problems. One is to continue with the same basic social, economic, and political structures and try to solve the problems within the structures. War is to be prevented by more defence spending, poverty is to be alleviated by economic growth, alienation is unmentioned (it's the price of progress), decision-making by elites is to be made better by getting better elites, etc. The basic approach to the environment through these structures is the technological fix: pollution is alleviated by spending on anti-pollution devices.

The second approach is to promote drastic changes in the present social, economic, and political structures, to develop new structures which do not have the same disastrous consequences for humanity. War would be prevented by dissolving the nation-state and discouraging militaristic thinking; aggression would be met by non-violent resistance. Poverty would be attacked by designing an economic system that served the needs of the people, rather than the needs of profit and power (less production of luxuries, less planned obsolescence, etc.). Alienation would be alleviated by putting people in control of their own lives to a much greater extent: workers' control in production, community control over urban planning, student control over education, etc.

The approach to environment and resources based on structural change involves changed life-styles (less private ownership and more communal goods, such as a switch from cars to public transport and bicycles), a changed economic system (recycling, goods provided according to need, emphasis on tools that can be made and controlled by individuals or small groups), and a changed political system (so that environmental assessemnts can be made by the affected community).

Cleaning up the environment alone is not necessarily going to alter the present social, economic, and political systems (if it is conceded that cleaning up the environment in more than a superficial way is possible within those systems at all). The value of environmental consciousness is that it can lead in a direct manner to awareness of the structures which cause many of the basic problems in society. Furthermore, environmental problems provide a useful lever to promote radical change in the system which causes these as well as the other major problems in our society.

The basic difference between the two approaches then is concerned with *which* solutions to environmental problems are promoted. The technological fix, the cosmetic alteration of the current system, can serve to reduce the visibility of the problems. A change in societal structures, on the other hand, can get to the root of the problems, and at the same time begin to challenge the institutional bases of other major problems in society.

RECYCLING AND OFFICIAL APATHY
A Critique of Active Inactivity in the 1970's

by Keith White - Hunt

Clearly those who govern us are well aware of the problems created by our profligate use of diminishing natural resources and of the urgent need for action in the field of reclamation and pollution control. Reports and white papers abound, but what steps have so far been taken by the Government to implement practical policies to this end?

The following statement is an extract from *Sinews for Survival,* a Report concerned with the management of natural resources in the U.K., published by the Department of the Environment in 1972:

> "We have been driven by the evidence we have assembled to the conclusion that to devote our resources to the achievement of the highest possible growth rate, as conventionally measured, is no longer desirable. *Many of the natural resources of the World, and particularly those that are peacefully available to Britain, are finite.* Even with a static population they may well be insufficient to provide the raw material for the rate or the kind of economic growth and increased affluence which is almost universally assumed to be desirable for the next 100 years. If populations continue to grow as forecast, some resources are probably insufficient for the next 50 years; that is within the lifetime of most young people." (page 3)

The above is further supported by the line of argument put forward in the Report, *Pollution — Nuisance or Nemesis*, also issued by the Department of the Environment in the same year.

> "Unfortunately, mankind is not content with a constant level of material consumption but has come to believe that a continually increasing one is necessary. It is here that our acute danger lies. This steady increase in consumption causes an acceleration of the *conversion of resources into pollutants.*" (page 9, para 33)

It would appear, therefore, that the Government is fully cognizant with the problems associated with the 'Limits to Growth' hypothesis, as suggested by the above statements and, again, quoting from *Sinews for Survival*:

> "Governments on both National and International levels should encourage manufacturers to produce goods which last longer and be designed in such a way that the resources they tie up can be readily *recovered and used again*". (page 28)

The purpose of this article, however, is to consider to what extent there has been real practical activity on the part of the Government in this field, especially, that which is likely to have made a positive contribution towards solving some of the problems involved and in this particular case to the promotion of the recycling of waste materials.

The First Report of the Royal Commission on Environmental Pollution recognised the benefits of recycling and considered that "much more attention must be paid NOW and in the future to the reclamation of valuable raw materials from domestic (and industrial) waste". That was in 1971; what has been done since?

In March 1971, the M.P. for Smethwick asked in the House of Commons if the Government was prepared to foiiow up the statements made by the Royal Commission on Pollution, with a similar body for reclamation.

In answer to his question, the Government spokesman stated that "although the value of reclamation to the economy was appreciated, (Shades of Sir John Eden) it was for industry to develop its own processes to best exploit the commercial

advantages of reclamation and recycling".

In a message from the Secretary of State for the Environment (Peter Walker) to the National Industrial Materials Recovery Association at their conference at Sheffield on the 18/19 November 1971, he said:

> "We in the Government are fully aware of the problems of waste disposal and reclamation . . . *The Working Party on Refuse Disposal* recommend the Government to consider whether in the national interest more intensive recovery from waste material should be done . . .
> . . . we shall be bearing these recommendations in mind and watching for any opportunities which arise in which the Government can properly play its part."

Yet the Working Party's Report would seem, at first sight to have overlooked the important subject of reclamation, for the total amount of space given to this subject in a report of 200 pages is confined to 4½ pages!

It would seem that the 'cause' of reclamation was inhibited since it seemed to fall between two stools. The Department of Trade and Industry was supposedly responsible for reclamation as an Industry, with presumably, the Department of the Environment being in charge of anti-pollution and conservation activities. Tossed like a shuttlecock between two Ministerial Departments undoubtedly prevented reclamation gaining a firm foothold in active governmental policy.

In his presidential address at NIMRA's annual general meeting in November 1972, the Rt. Hon. George Darling M.P. in referring to the growing need for reclamation of waste materials from all sources called upon the Government to give official backing and support to a comprehensive programme of research and development concerning this problem. He also repeated the well known fact that despite there being plenty of ministerial and political declarations of intention, little ACTION on the right lines had been forthcoming.

Government policy continued to put emphasis on waste disposal rather than reclamation. The stock reply about work being carried out at Warren Spring Laboratory continued to roll off official tongues — as if it had been specially set up to deal with every aspect of reclamation research and was an ever-expanding centre designed to solve all the Country's waste, pollution and recycling problems, when in fact it had been in existence a long time as a Mintech unit to help industry generally, not specifically on reclamation problems. Although extremely useful work has been done by this body it only represented an advance guard and not the army of resources needed to meet the whole reclamation problem head on.

In an address made to the *Financial Times* conference on pollution in 1973, by the Secretary of State for the Environment, this time Geoffrey Rippon, nowhere was there any reference, even in passing, to the important part that recovery could play in combating pollution.

Our European neighbours, with the same high standard of living as Britain, have had Government sponsored national organisations concerned with waste recovery for many years*. Government in the U.S.A. has likewise quite extensively involved itself in wast recovery** Britain — the First Industrial nation*** — however, has been singularly as slow in this field, as she has been in too many others, in more modern times.

Given the background of what can be done to extract recoverable materials from waste, for conservation, anti-pollution and economic reasons, the recently passed 'Protection of the Environment Bill' is dreadfully disappointing. It imposes on local authorities a duty to prepare plans for waste disposal and to license and supervise the tips where the waste is to be dumped. The only reference to treatment and recovery of materials is in half a sentence buried in a sub-paragraph which says that a plan should state 'the methods of waste disposal, either by reclaiming substances from it or otherwise . . .' That's all, and it is woefully inadequate.

What is needed is an entirely new approach. The Bill should say it shall be a duty of each local authority to ensure that all industrial waste is processed for recovery of materials and to make it clean and inert for disposal, or for use as energy, fuel or road fill or other useful purpose. And for domestic refuse there should be an obligation first on the collecting authorities to obtain as much separation as possible and then on the disposal authorities to process the separated waste.

There are, of course, difficulties that the authorities would face if such duties were imposed on them. They would need considerable guidance, a tremendous amount of technical information and assistance, and a reasonable time scale to get their methods, equipment and machinery operating, and above all the financial aid that would have to be provided. But financial aid could be regarded as investment, for the proper treatment of waste could possibly pay for itself, provided the social costs were included in the calculations. The cost of disposing of waste would have to be met anyhow, and the income from recovery and processing would in that sense be a real gain.

The Deposit of Poisonous Waste Act (although not really concerned with domestic refuse), illustrates the same point as the above. All it does is to tell us where the poisonous waste is or has been dumped. It ignores completely the necessary requisite of a constructive policy (i.e. as far as recycling is concerned) — it does not legally enforce the treatment — making harmless and *extracting whatever may be of value in the waste* before it is dumped.

Some individuals or groups with the true 'Capitalist-spirit' might argue that the collection disposal and

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* Also — the cost of refuse collection and disposal in Paris is among 213 factors taken into account by the Government of France in calculating the cost of living index. It only amounts to about one-quarter of 1 per cent of the other 212 factors but not so long ago it took on a new significance, for as the cost of living index approached a point at which the Government was committed to sanction an increase of 5 per cent on basic labour wages, they decided to postpone the fateful day by providing the people of Paris with a free refuse service.

This is one way of bringing home to the 'man-in-the-street' at least an idea of the 'social cost' of 'throw-away' consumption.

** With the establishments of such institutions as the Environmental Protection Agency, support for the U.S. Bureau of Mines' research into recycling domestic refuse; and, support for the general idea of recycling, with the Solid Waste Disposal Act, 1965, which emphasised the need for recycling; and embodied more fully in the Resources Recovery Act, 1970.

*** i.e. historically, in that it was the first country to experience an Industrial Revolution'.

possible reclamation of domestic refuse should be, and would best be, tackled by free enterprise.

As champion of the free-enterprise system, the United States offers some good examples. The town of Middleton, Ohio, recently signed a three-year contract for $1 million with a private collection firm that will save the city an estimated $350,000. Chicago is also using a private firm to process some of its refuse and other cities that have turned over all or part of their garbage business to private hands are Boston, Omaha, Detroit, Dallas and Charleston, South Carolina.

Kansas City, Missouri, in co-operation with the Midwest Research Institute (MRI) is also involved with the Union Electric Company in a programme to use domestic refuse as a percentage substitute (approximately 5% boiler fuel) for coal, in generating power.*

On the other hand: in Europe's newest (and also communist) country, the German Democratic Republic (which has relatively few natural resources apart from lignite and potash), recycling and re-use of waste materials for her industries is seen as an economic priority, making it possible to reduce imports in many fields.

Collection of such materials from domestic and industrial sources has become a well-organised activity which already is yielding annually more than 5 million tonnes of metal scrap (mainly iron and steel), 450,000 tonnes of paper (providing about 40 per cent of that industry's basic material) and 100,000 tonnes of textiles. The equivalent of 50,000 tonnes of waste oil is being regenerated each yer as fuel oil and lubricants. Industrial ashes including lignite (brown coal) are today incorporated into building materials.

Glassworks make use of 60,000 tonnes of broken glass yearly. (It is not, however, generally re-employed in the manufacture of bottles. Demand for the latter is partly met by systematic collection of old bottles — up to 450 million a year.)

New methods of recycling used materials and extracting raw ones from waste are under urgent examination. It is expected, for instance, that iron ore concentrates can be extracted from lignite filter ash. Another area being explored is the use of plastics combined with rubber from old tyres in at least two appl'cations: as an insulating material for flats and for production of new tyres.

To economists in the Republic, intelligent recycling is no stop-gap measure but "a high-priority requirement". They stress that it means not only scrap-collection campaigns but also officially sponsored research and development which will lead to re-processing in special installations.

However, even if profit motivated companies were to be used as the instrument by which the problems of refuse collection, disposal and reclamation are solved, Government would still have to actively involve itself: initially, to promote such schemes; continually, to ensure that maximum efficiency in all three spheres, but particularly the latter, is maintained.

The involvement of the Government is essential if the problem is to be considered — as is necessary — in its wider context, that is, the overall planning aspect, e.g. in making such decisions as to whether we will use fuel to mine iron ore in Australia, transport it to this country, make steel from it and tin cans from the steel, 750,000 tons per year of which will end up on the rubbish tip, or do we reclaim, perhaps using less fuel in the process, and use the fuel saved to bring food to this country etc?

Similarly, returning to the issue raised by the above quote from *Sinews for Survival*, page 28, Government involvement would be necessary if a policy of 'resource management' were to be adopted. If the throughput of raw materials was to be minimised both to conserve non-readily available resources and to cut down pollution, private industry would have to have an economic incentive to be conservative of materials and energy and to recycle as much as possible.

Fiscal measures would, therefore, probably be necessary, such as suggested in *A Blueprint for Survival*, reproduced below:

> "(a) A raw materials tax. This would be proportionate to the availability of the raw material in question, and would be designed to enable our reserves to last over an arbitrary period of time, the longer the better, on the principle that during this time our dependence on this raw material would be reduced. Like (b) below, it would also penalise short-lived products.
> (b) An amortisation tax. This would be proportionate to the estimated life of the product, e.g. it would be 100 per cent for products designed to last no more than a year, and would then be progressively reduced to zero per cent for those designed to last 100+ years. Obviously this would penalise short-lived products, especially disposable ones, thereby reducing resource utilisation and pollution, particularly the solid-waste problem. Plastics, for example, which are so remarkable for their durability, would be used only in products where this quality is valued, and not for single trip purposes."
> (*The Ecologist*, January 1972)

In July 1974 the importance of recycling would at last seem to have been officially recognised by the Government. Mr. Gordon Oakes, Under-Secretary of State at the Department of the Environment took on the mantle of Britain's Minister in charge of waste recycling. The Department said that Mr. Oakes had a personal interest in the importance of recycling, an interest shared by the then Secretary of the Environment, Mr. Crosland, who said that he saw the task of tackling recycling both as a contribution to fighting pollution and helping the economy.

So recycling now had its own minister and therefore official recognition. But what is needed is not an interest in the matter, but a conviction in the necessity of its application.

With the collapse of the market for waste-paper at the beginning of 1973, the need for Government involvement, in this case for a scheme to store surplus waste paper

* One aspect of this, however, is especially important and pertains to more than just the relative economic efficiency of different economic systems.
Governments committed to a free-enterprise economic system may view this in itself as a value or resource too great to be sacrificed (since the encouragement, establishing and probably enforcement of a widespread policy of recycling is likely to necessitate considerable Government interference with both industry and the consumption patterns of individuals alike).

etc. and thereby generally help iron-out large fluctuations in the market, was further deomonstrated.* Such a scheme has the support of the British Paper and Board Industries Federation but despite the fact that an Advisory Group on Waste Paper Recycling was set up in 1974 under the Chairmanship of a junior Industry Minister, Mr. Michael Meacher, there would seem to be little immediate help for such a 'stock support' scheme being implemented. An official of the Department of Industry said that the cost would run to several million pounds and that there was no provision for such a scheme in current legislation (the then forthcoming Industry Bill was to include appropriate powers but these were not then thought likely to come into force until at least the autumn of '75).

Such wild price fluctuations obviously hit hard private enthusiasts, commercial firms and local authorities which are engaged in recycling schemes to a greater or lesser degree and do nothing to encourage such activity.

While laudable, in that further attention has been brought to focus on the 'recycling problem', the Green Paper published in September 1974, could still be likened, to a great extent, to a mastiff with no teeth — demonstrating further the vacillation of the Government in this field.

It can only be hoped that the role of Government in the ambit of recycling will from now on be in the provision of practical propositions, plans and policy and not a plethora of platitudes as in the past.

* A similar situation has arisen in the past with respect to the supply of and demand for scrap metal.

The Insanity of Secrecy in a Nuclear Age

by Arthur W.J. Lewis, M .P. Chairman, Parliamentary All - Party Committee for Freedom of Information

Using the blinkers of secrecy to conceal from view the pitfalls of a plutonium economy can constitute a form of criminal insanity.

The great debate upon the future of nuclear power as a means of satisfying Man's energy requirements ought to be the best informed of all debates. But obsessional secrecy regarding matters relating to atomic energy will transform the public debate in this country into an irresponsible farce.

The Official Secrets Act operates as a form of censorship on information crucial to the making of wise decisions of the use of nuclear fuels.

Sir John Hill, Chairman of British Nuclear Fuels Ltd. and also Chairman of the United Kingdom Energy Authority, can sift the information released to Parliament and to the public in such a way as to steer the debate in the direction in which he decides it should go.

In America the Freedom of Information laws have been used to obtain data which has led to President Carter calling a halt to the nuclear programme.

But in the UK as Sir Brian Flowers has warned us, the authorities skulk behind the Official Secrets Act to conceal facts which might reveal our commitment to nuclear power to be a mistake.

Scraps of information leak out which throw considerable doubt upon the wisdom of having allowed hazards to come into existence which cannot be removed.

Quite by chance we discover that the Windscale installation has been pumping 1 part in 65 of all plutonium produced into the Irish Sea. This activity has been in progress for 20 years but the Official Secrets Act enabled the Authorities to get away with this excessive degree of pollution. While plutonium was being pumped into the Irish Sea from Windscale we were being reassured that plutonium would not be used as a nuclear fuel unless it could be contained.

Sir John Hill blandly justifies this gross contamination of the environment by saying that the publis wish to have cheap electricity. He explains that it would be costly to contain the plutonium.

We are told that the background radiation is only increased to a marginal extent by allowing radioactive isotopes to enter the environment. But we are not told that these isotopes are concentrated by biological processes and enter the food

chain in high concentration. The data we are given are sifted to suit the authorities. The Official Secrets Act is used to monitor what we are allowed to know so that no serious objection can be raised against a commitment to nuclear fuel as a source of energy.

The whole idea of nuclear power as put to us by the Authorities is that it is the only way to produce cheap electricity. But we now discover that to make electricity cheaply from nuclear fuel cannot be safe.

One of the most unscrupulous methods of gaining support for the supposed wisdom of committing the nation's resources to the development of nuclear power is to mislead the working man into believing that there are no hazards involved.

The working man who is offered the plushy luxury of operating a nuclear power plant as an alternative to risking his life in a sweaty hell-hole of a coal mine, is an easy touch for the carefully doctored information presented to him by Sir John Hill. A worker at Windscale who is assured that radio-active waste pumped far out to sea will lie forever as a harmless component of the ocean bed, is unlikely to pay heed to those concerned about pollution. This worker is not told that tide and current will bring the waste product back to his own doorstep and even onto his breakfast table.

A Welsh miner may relish the laver bread that is a national dish, but he is not informed of the biological processes which concentrate radio-active waste in the seaweed gathered for a creation of this delicacy.

The myth of cheap electricity from nuclear power is spread about to rouse public opinion against the scaremongering ecologists. But no-one informs the consumer of electricity that he is already paying 7p in the pound to cover the interest on money already squandered on a single defunct nuclear power station.

Dungeness B was to be built in 4 years at the cost of £50 million and was to be the first in line of a new breed of super-nuclear power stations. Thirteen years later with the consumer £200 million poorer Dungeness B is still cold and likely to remain cold for ever more.

That is only one catastrophic bloomer that we know about, but we know enough to suggest that there are bigger and better bloomers in the pipe line. The failure of Dungeness B means that the grandiose plans for nuclear power which hinged on the successful development of that type of power station have come to ruin.

The technology does not exist which can make the commercial exploitation of nuclear energy a viable proposition. And yet it is now planned to forget the failure of Dungeness B and forge ahead with a new scheme to build super-super power stations on the model of Dounreay. Official secrecy prevents people knowing the full insanity of this project. Dounreay has never beenan unqualified success. We have no reason to suppose, on the basis of the experience at Dounreay — a pilot plant that was nevertheless subject to all sorts of technical failures — that a vastly more complex and fully commercial breeder reactor can at present be a practical proposition.

Billions of the taxpayer's money will be invested in this project, we shall be lucky if 50p in the £ is not the price we shall have added to our electricity bills to service the loans for fast-breeder reactors which may never come into commission.

There is only one antidote to folly of this magnitude. It is to replace the obsolete laws of secrecy with Freedom of Information legislation. Then all the facts related to nuclear energy can be available for public debate. Decision will then be made in the light of a full understanding of the implications of putting all our eggs into the nuclear basket.

There are no figures available on which to price the overall cost of our nuclear programme. All we know is that it runs into many billions of pounds and has sucked dry the nation's capacity to develop a viable source of energy.

The whole of the energy reservoir of the North Sea is liable to be dissipated in the creation of a new generation of nuclear power stations. The most optimistic estimate of their capability is that a successful nuclear plant will have a working life of 30 years. Six of those years will be required for the production of the power needed to build the plant. At the end of those 30 years there will be no North Sea reservoir of energy to provide for the building of the next generation of nuclear power stations.

Environmentalists are anxious to invest in the creation of benign energy production without depleting our mineral resources. Using the heat of the sun as fuel, the weather in all its forms, the tides and so on is the obvious answer to anyone who who feels responsible for future generations.

Sir John Hill is happy to bequeath to future generations the unsolved problems of nuclear waste disposal because he claims the alternative is to bequeath them a planet with all its mineral resources exhausted. Sir john carefully omits to tell the British people that his use of the Official Secrets Act to determine what information they are allowed to have access to, enables him to divert every available research resource into the nuclear basket. Our commitment to nuclear energy starves out of existence all the other alternatives. Sir John Hill says he is all in favour of solar energy etc., etc., provided that these schemes can operated without the money he needs for his nuclear development.

A solar panel will outlive a nuclear power unit by many years. An optimum nuclear power unit will consume at least one fifth of its own output in the energy required for its creation. The solar unit will only require one fiftieth of its output for its own creation.

The 200 million pounds already poured down the drain in the creation of the defunct power station at Dungeness might have been used to procure power and energy from the tides with which to warm posterity for generations to come, at virtually no cost and with complete safety. We only know bits and pieces of the sorry saga of nuclear energy but we know enough to realise that secrecy hides an insane muddle.

We owe it to our grandchildren to restore *our right to know*, and to restore it now. We urgently need Freedom of Information so that, possessing all the facts, we can take a fresh hard look at our commitment to atomic energy.

Time is not standing still and we must demand that the full facts are available to us all *now*.

Report

A Dozen Eggs "Cost" 10,000 Liters of Water

A report on the UN Water Conference in Argentina — March 1977

The cheaper a product (or service) the greater man's temptation to waste it. This seems particularly true of water. In most parts of the world water is either gratis, or comes at an insignificant cost. For instance, the share of water in the total factory *cost* of manufacturing industry varies from 0.01% to 2.5% — with an average of 0.4%. The percentage is slightly less in the cooling process of energy plants.

Therefore, the prices which consumers pay for water-intensive products, do not properly reflect the cost of water withdrawal, purification, pollution and "scarcity". Quite a few experts assert that the world could avoid an impending water crisis,[1] if governments were to charge the water-using industry (and households and farmers!) a price commensurate with:

(a) the opportunity cost of water (pollution)

(b) the cost of high level effluent treatment

(c) the relative usefulness of the water-intensive process

(d) the relative scarcity of water at the location of processing

These experts propose, for instance, that a dozen eggs should be costed, not only in terms of dollars, yen or francs, but also in terms of their water-input. In many industrial countries, the water cost of a dozen large eggs comes to 10.000 liters, including of course the cost of cereals used in the chicken feed.

Likewise, the water "cost" of a kilo of wheat amounts to 1.500 liters, a kilo of rice 4.500 liters, and a kilo of prime beef 30.000 liters. In the United States, a ton of steel requires 150.000 liters, a ton of paper 300.000, viscose rayon 800.000, synthetic rubber 2.000.000, and a ton of streptomycine requires 4.000.000.000.000 liters. These data vary from one industry to the next and from one country to another, but reflect the magnitude of the water requirements.

The advocates of "free" water argue that there is no real shortage of water in the world. The proponents of a high price (or tarriff) for water retort that water is unevenly distributed and too much contaminated in the process. Both schools of thought may be correct. Their assumptions deserve a brief appraisal.

There is no water shortage in the world

The water supply comes from basically two sources, which are in a way interconnected. One source is surface water: rivers, streams and lakes — of which there are some 120.000 km^3. The other source is groundwater, of which there may be some 8 million km^3. However, most groundwater lies at a depth of more than 750 meters: presently beyond man's economic or technical reach. Estimates for the readily available amount of groundwater vary between 0.2 million km^3 and 2 million km^3 — but most experts keep the estimate close to the low figure. (One km^3 equals a trillion liters or 265 billion gallons).

The connecting water supply is the daily hydraulic cycle[2] which amounts to 1.100 km^3. About 270 km^3 reaches the earth, but most of this is absorbed directly by plants and trees, or evaporated before man can use it. The portion of the water cycle which can be directly used by man amounts to some 70 km^3. That alone would yield 17,000 liters per person per day for each of the world's 4 billion people — *if* water were evenly distributed (which, is not the case at all).

It is therefore accurate to assume that the total mass of fresh water available to man, presently and in the future — when new techniques will be available — is more than ample for humanity as a whole — even should our planet "house" 10 or 15 billion people. Floods and droughts, however, point to the acute problems of water *distribution.*

The skewed water distribution

Water is distributed unevenly over the regions, the seasons and the years. Chile's Atacama desert in the north receives virtually not a drop of rain whereas the southern Bio-Bio province is rain-soaked all year round. The Indian farmer depends upon the monsoons which normally come down from July to September. The baked earth with the recently sown seeds avidly absorbs the rainfall, until his farmland looks like a flood. However, without such abundant precipitation, his crops might die in the scorching sun. In fact, when the monsoons are late or very low, his grains and pulses may well perish.

The world's average annual rainfall amounts to almost one meter. However, Hawaii's Mt. Waialeale receives as much as 13 meters a year, whereas many regions receive only 20-40 centimeters a year. Droughts in England and California, during 1976, demonstrate how water shortage can hurt regions which normally are well supplied.

In some parts of the world, citizens relax in scented, blue swimming pools — whereas the *average* African rural woman walks 4 kilometers a day, every day[3] to fetch water for her family. In extreme cases, such as Burma's central dry region, the women villagers walk 6 hours a day, every day, to fetch their water, for which they must often pay. Thus, the perennial problem of water lies in its duality (surfeit or scarcity) as well as in its economics. However, the producers of water-intensive goods in Western Europe and the Eastern U.S. are right in assuming that water saving efforts will not replenish the aquifers under the Sahelian Belt nor provide the Middle East with desalted water.

A right price for water?

Water can of course be transported — subject to economic constraints. Presently, water is transported in tankers from Norway to Holland. The technique of carrying water in giant floating bags (dracons), towed like barges, is practised already. There are projects to use water grids — pipelines which have the same function as those transporting petroleum or natural gas. There also exists a plan to use water supplies from Alaska to irrigate Canadian prairies as well as some western U.S. states and the arid north of Mexico. The visionaries anticipate towing entire icebergs to semi-arid countries of lower lati-

tudes.

In addition, some experts believe that the heavy users (and polluters) of water *can* pay for those who have no or insufficient access to (safe) water — by levying a tax, or establishing a tariff. They maintain that industry cannot for ever withdraw water freely from the mainstream, nor that most households can for long remain without water meters. Proponents of a high water tarriff are more concerned with water scarcity. At least, such was the generally prevailing sentiment at the water conference.

It is not easy to envisage how the price or tariff should be determined, and how steep the progression should be. The Ruhr co-operatives in West Germany levy a fine on waste effluents. The more waste, the higher the fine. It is of course easier to establish the degree of pollution than the relative usefulness of the process in which water is being used.

The cost of water pollution

Water pollution has various causes — all of which may come to determine the cost of purifying water as well as the tariff for not doing so:

a) organic sewage materials from human and industrial wastage

b) organic chemical substances: detergents, weed killers, pesticides

c) manufactured chemicals, metals, metal compounds, salts and acids

d) infectious agents from hospitals, slaughter houses, tanneries, large cities

e) radioactive susbtances, heat, soil and mineral particles

f) nitrates and phosphates which feed algae and water weeds in excess, thus destroying the natural purification capacity.

A high water price, it is thought, will render water treatment as well as water conservation financially attractive, if not compulsory. Of course, whatever the result, the price of water-intensive products (eggs, paper, rayon, synthetic rubber) would be substantially increased, except in industries where re-cycling and the sequential re-use of water have all but unlimited potential. The new "pricing" policy of water-intensive products may well follow a pattern proposed for energy intensive products and services[4] — which deserves priority attention by all those concerned with water management.

To that end, water pollution will have to be measurable and comparable. For some time it has been expressed in "biological oxygen demand" (BOD), but of late it is more and more expressed in "PE's"[5] or "population equivalent". For instance, thus measured, three important US industrial sectors cause almost as much water contamination as the entire US population produces in sewage. These industries are: chemicals (105 million PE's), foodstuffs and related industries (80) and pulp and paper (45). Their ability to pollute, and to purify effluents would be greatly reflected in their final plant cost, if a steeply progressive water tariff were enacted.

Water economics

In actual fact, of course, the economics of water management reach far beyond pollution. If water must be husbanded judiciously — for whatever reasons — the future water economics may have to take into account 5 basic aspects:

1. To increase the efficiency of the use of water: by recycling water: by re-using it sequentially: by reducing waste.
2. To enhance the quality of water by purifying sewage: by keeping wastewaters away from river-basins and lakes: by separating toilet wastewater and other household waste-water.
3. To expand the yield of water in the environment: by desalting water: by reduction of losses in the evaporation process: by modification of the weather pattern.
4. To improve the distribution of water: by constructing surface reservoirs: by protecting the soil of natural watersheds: by carrying water from surplus to deficit regions.
5. To expand the use of underground storage: by artificially refilling aquifers: by connecting different reservoirs: by deepening the pumping potential.

Water economics become quite complex in the case of shared river basins — one of the prime concerns of the water conference. Many rivers in Europe, Latin America, Africa and in a good part of Asia cross political borders. A river like Russia's Tiszna is shared by four other countries. The Amazon river, Mekong delta and Plata basin are shared water resources. Water economics also enter into the settling of disputes between upstream and downstream users, between fishermen and manufacturing industries, between farmers and powerplants, between megalopolis and the surrounding rural regions.

Cross-border water economics will comprise cost-benefit analyses of drainage and irrigation electric power production, flood control, industrial and domestic consumption, recreation and watershed management. The water-cost in cotton, corn, coffee and copper in one country may well be determined by a number of factors which are determined by neighbouring nations. As in the case of petrol, water management will reflect the interdependency of nations and regions — which in itself should lead to joint planning and action.

In a good part of the world, water is a matter of life or death. Half a billion people are believed to suffer from water-borne diseases. Many of them are unfit for work. In developing countries, urban squatters are worse off than villagers, if only because high-density living causes water-related diseases to spread more swiftly and less mercifully. Spreading of such diseases would render co-operative water management mandatory. Modern water economics as briefly outlined above, may not come into force until there is a consciousness that in the next generation water may turn out to be more precious than petroleum.

André van Dam

NOTES

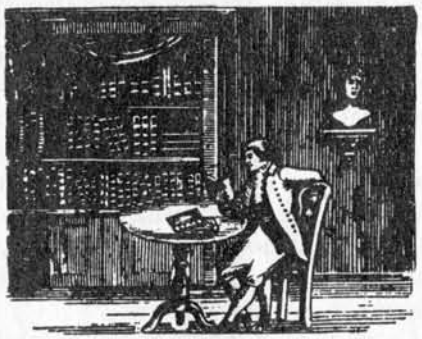
1. United Nations Water Conference, Argentina, March 1977 — which the author attended on behalf of the Society for International Development, Washington D.C.

2. The daily water cycle is the never-ending movement of water, evaporating from the surface of the earth to the atmosphere — to precipitate back to earth in the form of hail, rain and snow. This replenishes the rivers, lakes and aquifers, as well as the oceans. The daily water cycle acts as the world's one giant desalting plant.

3. "Water, women and development", Centre for Social Development, United Nations, 11 February 1977.

4. "Energy, growth and altruism", Dr. Bruce Hannon, Mitchell Development Corporation, Houston, 1975.

5. One PE equals the amount of waste which exhausts from surface waters 113 grams of oxygen per day in the process of decomposition.



Books

Ecological Consequences

THE COLUMBIAN EXCHANGE: BIOLOGICAL AND CULTURAL CONSEQUENCES OF 1492, by Alfred W. Crosby, Jr. Greenwood Press. $11.95 cloth; $3.45 paperback.

Columbus's discovery of America ended an isolation that had lasted for almost ten millenia. During that period, the life-forms in the New and Old Worlds — from micro-organisms to the largest mammals — had evolved in almost complete independence; inevitably, the ecological consequences of renewed contact were profound and far-reaching.

Probably the best-known of these consequences is the slaughter of the American Indians by the endemic diseases of Europe, to which they had no resistance. According to one contemporary observer, "the Indians die so easily that the bare look and smell of a Spaniard causes them to give up the ghost." Enraged Indians kneaded infected blood into their conquerors' bread, but to little effect.

The microbial traffic was two-way, however. Before 1492, there are no recorded cases of syphilis in the Old World, nor has examination of skeletons revealed syphilitic injury; but in the sixteenth century, widespread epidemics of the disease were reported, and its symptoms — as would be expected of a new disease — were extremely severe. Professor Crosby thinks it likely that Columbus and his successors first brought syphilis to Europe.

The successful exploitation of the American continents by Europeans would not have been possible without a total transformation of the local ecosystems: the flora and fauna were rapidly "Europeanized". As the Spaniards advanced, the decimation of the Indian populations was matched by an explosive growth in the numbers of domesticated animals. (To an extent, the two trends were related: both Indians and animals relied on the same foods.) Hogs, cattle, and horses — none of them native to America — quickly adapted to the new environments. Many went wild, preceding the human influx into the interior, and providing a ready source of food on its arrival.

Iberian crops were cultivated wherever they would grow, while indigenous American crops such as the potato were given a much wider distribution. European grasses, an unintentional introduction, flourished to such an extent that today there are whole meadows entirely lacking in grasses of pre-Columbian native stock.

Accompanying all these changes was an increase in soil erosion: the ox-plough and other intensive methods damaged the surface structure of the soil, and the large animal populations led to over-grazing. The grassland plains of America had constituted an untapped store of biological wealth, accumulated over the millenia, but within a century much of their riches had been depleted.

The American Indians, having few domestic animals, had developed very productive plant foods. The adoption in Europe, Africa, and Asia of such American foods as the potato, the sweet potato, beans, maize, the tomato and manioc led to a larger and more reliable food supply. Maize, for example, prospers in areas too dry for rice and too wet for wheat; it has a very short growing season; and, like other New World crops, its demands on the soil differ from those of Old World staples, so that it can replace the fallow period in the crop-rotation cycle. Professor Crosby argues that the availability of such foods was an important factor in the quadrupling of the world's population in the last three centuries; if so, this must be among the most significant consequences of the Columbian exchange.

This short book leads the reader to appreciate more fully the ecological context of human history: it is recommended. Certainly, it deserves a better fate than that assigned to it by an American reviewer: "to serve as a source of anecdotes to enliven undergraduate lectures."

Bernard Gilbert

Education for Culture

PROPOSAL FOR A NEW COLLEGE by Peter Abbs and Graham Carey. Heinemann Educational Books. £1.50.

MASS CULTURE AND MIMESIS by Peter Abbs. TRACT 22. The Gryphon Press, 38 Prince Edward's Road, Lewes, Sussex. 60p.

The distinction between culture and civilisation was drawn by the German Romantics, who opposed the organic life of the former to the mechanical organisation of the latter. Peter Abbs and Graham Carey make use of the distinction in contrasting the vision of an experimental college, whose activities are focused on the study of symbol and meaning, with a critical survey of institutional education directed towards technical and mechanical goals. From first hand experience they emphasize the inadequacy of the teacher training college. There the neglect of the existential and cultural needs of the student contributes to the filling of the resulting vacuum by commercial mass-culture. "That the colleges see no conflict between education and mass-culture, that they remain complacent before the dangerous division between knowledge and culture, between dry fact and debased feeling, is in itself a massive indictment of the whole system." The indifference of the colleges in this respect, of course, is a reflection of society's indifference.

It is, I believe, an unanswerable indictment and one which Edgar Z. Friedenberg's studies of American education confirm. In *Mass Culture and Mimesis* Peter Abbs traces the same pattern in secondary education. The adolescent is culturally starved in his school with its "neutral unimaginative accumulation of fragments of knowledge." With the exception of occasional inspired teaching, probably at variance with the system, culture is available only outside the classroom and it is the bogus popular culture of pop-music, X films and television comedies. By tacit agreement school caters for the mind while mass-

culture caters for the emotions. The worlds are separate and most adolescents accommodate themselves to the split as if it were the most natural thing in the world.

The division of knowledge and culture, however, is an expression of an unhealthy dissociation of sensibility to which T.S. Eliot notably drew attention. The disharmony between technical sophistication (ever more and better qualifications) and cultural immaturity with its varieties of inadequate and standardized emotional responses — sensational or sentimental — leads to a frustration for which violence offers the simplest release.

Contemporary education has excluded the key to cultural transmission, the assimilation of symbols through mimesis, whereby the values of the community are organically absorbed by each individual. As a result, the domain of culture has fallen into the hands of new priests and prophets, the advertising copywriters and commercial agents. The vacant spaces of educational boredom cry out to be filled and they are there to do it. But theirs are chaotic symbols expressive of conflicting pseudo-values of the non existent pseudo-community.

Mass Culture and Mimesis provides evidence for its thesis. It will not convince those who maintain that mass-culture is an option which the individual can freely reject. Nor will it convince those for whom culture itself is no more than a palliative or entertainment, a relaxing diversion to the real life of utility. The ideal, according to the author, is a balance between the communal values of traditional culture on the one hand, and the freedom of individual initiative and knowledge on the other. To achieve this balance there must be a shift towards cultural education. "What is required is a creative act of mimesis, a transforming of the best of the past in the light of our tormenting circumstances."

Proposal for a New College embodies such a transformation. The authors examine four previous experiments in providing a "great good place" where knowledge and culture, instead of existing apart, might fertilize each other and bear fruit. They are the Cistercian abbeys of Yorkshire, Ruskin College, the Bauhaus and Black Mountain College in U.S.A. The chapter "Antecedents" is suffused with a discernment of a steady passion which is rare in polemical writing. The past comes to life with a simplicity and lucidity that is totally different from the literal and technical reconstructions which embalm it. The vision of a new college, in a memorable insight, is that of "a second Bauhaus, dedicated to the articulation of another concept of man, post-industrial man . . . being closer to nature, exploring and celebrating inward space and time." Thus do the authors elicit a continuity and development from the best of pre-industrial and industrial education to a post-industrial successor.

The heart of the book is the chapter entitled "The Cultural Community." In it the lines are clearly drawn between two opposing conceptions of man: cultural man, *homo symbolicum* and technological man, *homo faber*, the man of material civilisation. The essential man is not the tool maker of received anthropology, the evolving technologist of Marxist and capitalist versions of Darwin, the manipulator of unambiguous signals. He is seen rather as the man who, through symbols, can internalize external objects and give them further meaning — the word "further" offers a fascinating point for discussion — in so doing. At the same time he creates community through shared symbolic meaning. The proposed college would emphasize the integrative power of symbolic activity and study to fuse the disparate areas of knowledge and experience, thought and emotion. As such it would continue the finest work of the Romantic Movement at a time when the triumphant industrialism with which it contended has begun to concede and give back some of the occupied territory gained in the nineteenth century.

Peter Abbs and Graham Carey have assembled a vision compounded of many of the best elements of our heritage and our time, a vision remarkable for its assurance at a period when recognized leaders muster less and less assurance. It is a vision which encourages genuine openness that does not pretend to certainty. If hope is a resource to be conserved, then only those who are used to squandering limited resources will dismiss *Proposal for a New College* without a careful examination of its premises and its practical suggestions for implementation.

Thomas Merriam

The Primrose Path

THE CLEVER MORON by R.S. Scorer. Routledge and Kegan Paul. £3.95.

There can be not the slightest doubt that we are clever. We are very clever indeed. To prove it, there are mountains of data growing at an exponential rate, as testimony to the cleverness with which we are able to measure anything. Also, we are rich, richer than any people have ever been, proving not only that we are clever, but that we are successful as well. We have come to prize success above all else and have invented an academic discipline — economics — to measure success and to devise ways of increasing it.

The trouble is that as our cleverness has grown our wisdom has not grown with it. We have become the clever morons that provide Professor Scorer with his title. We do what we are capable of doing, whether we need to do it or not. If it is possible it must be done. So planners make self-fulfilling prophecies based on the simplistic extrapolation of trends and as we adjust our lifestyles to accommodate innovations, so they become necessities. We are caught in a blind race to some destination of which we have not the slightest conception, and we are close to losing the ability to pause, to look at the map, to change direction.

Prof. Scorer's diagnosis is not new, but his book is a valuable and timely contribution, for the view is gaining popularity that our present progress is acquiring counter-evolutionary overtones. If, in years to come, our attitudes must base themselves on evolutionary imperatives, this changes everything and Prof. Scorer's views, which appear iconoclastic today, could become the new orthodoxy. He points out that our age is characterised less by the originality of its discoveries than by its talent for mass production and consumption. The truly original people — he mentions Faraday and Einstein — are often outsiders.

Evolution proceeds from occasional successful mutations. So we should take new ideas seriously, but without being gullible, and we should view with caution those who simply repeat what is known in order to amass data.

Data is generally suspect, not least because we have so much of it that those who collect it and those who interpret it seldom meet. They occupy separate disciplines. Thus it becomes almost impossible to question the numbers themselves; they must be explained as they stand, no matter how bizarre the explanation. There are many examples. Fears of an imminent ice age, expressed in 1974, used information that had been available for a century to reach unjustifiable conclusions. Changes in industrial activity and in climate have been adduced to account for figures that in fact resulted from new, and inadequately tested, laboratory equipment.

It is a little strange, then, that Prof. Scorer accepts the rates of world population growth and resource depletion that indicate a need for change, for of all data these are the least reliable. In many countries demographic projections are made on a 3 per cent sampling of the population and it is not many years since agricultural development plans were geared to an assessment of dietary protein requirements that were 300 per cent too high. When it comes to assessing potential mineral resources, the best figures available are no better than guesses.

Yet his argument does not fall, for he is concerned with attitudes. If it can be shown that industrial production can continue to expand into the distant future, can it be shown that as a result we will be any happier, kinder, more free, or that human evolution will have been accelerated? Will greater wealth enrich us? By our standards, Bach and Mozart lived in dire poverty. Would our level of prosperity have helped them? A tiny fraction of it could have prolonged Mozart's life, but it would still have left him poorer than the average European or American worker of today.

Prof. Scorer offers no solutions. There are no panaceas, and the demand for them is one of the causes of our predicament. If a question cannot be answered we assume either that it has been formulated incorrectly or that it is unimportant. We allow only those questions to which we have answers and since our search for answers tends in a particular direction it is hardly surprising that all our solutions encourage us to continue along our present primrose path, only faster. The solution to the potential shortage of fuels is not thrift but fusion; the solution to over-centralised power is not the strengthening of small communities, but the building of still larger empires. The moral — for Prof. Scorer is a moralist and proud of it as he should be — is that people, families, communities, are all different. That is their strength and we should rejoice in it. What threatens them most is success, as we have come to conceive of success.

Michael Allaby

Use Less Live Better

LOW-COST, ENERGY-EFFICIENT SHELTER (Edited) Eugene Eccli Rondale Press £4.94 ($8)

THE SOLAR HOME BOOK, Bruce Anderson with Michael Riordan Cheshire Books £7.50 ($12)

Both these books are tributes to the real, and growing army of N. American owner-builders willing and able to use what has been learnt from a decade of ecology and alternate energy. In marked contrast to the pattern in England, or most of the rest of Europe, the books review many 'realtime' examples, as well as pontificate, predict and advocate. The reason for this is as much geographical as cultural: there is still a little space, cheap land, and easily-obtained building material in N. America. And while America's culture is basically as voraciously urban-industrial as Europe's, it still contains subcultural elements extolling the virtues of 'doing-it-yourself', and living away from the energy and consumer-crazed crowd.

Eugene Eccli (founder of Alternative Sources of Energy magazine) devotes the first four chapters of his book to the practical, basic, initial steps the owner-builder must go through: finding land, understanding building codes, getting through or over these, finding finance, and understanding the traditional-historical solutions to building problems. While books such as Rapoport's 'House Form and Culture' look more widely at the cultural solutions to housing needs, which could be summarised as 'learn to do without, and enjoy not having to gouge complex materials from Mother Earth', Eccli does give some attention to high-mass pueblo building, and to the US 'colonial' house. A really thorough analysis of just these (which Eccli does not enter into) would show how very poor was the European colonial house form in contrast to the Indian. By almost any criterion, but especially thermal comfort and performance, the colonial house is a loser.

The colonial American house, reworked in today's paper-thin particle board, ply, and timber, and cut down to a one-floor cube, forms the basic stock of N. American housing today — from El Paso to Edmonton. Because its thermal performance is so atrocious, and because of cheap energy and the N. American desire to reproduce European climates in another and very different continent, this house form is responsible for billions upon billions of wasted Kilo-Watt hours per year.

But this is in no way necessary — as both Eccli and Bruce Anderson show very convincingly. From the choice of construction materials, construction methods, siting, fenestration, internal design, and on to the very important choice of comfort standards and servicing methods come a host of possible energy savings. As any systems theorist will affirm: information saves energy, and by putting in plenty of information at the design and construction stages much energy will be saved when the building operation stage is reached.

While Eccli's book is a step-by-step review of all the stages involved in building energy-efficient homes, and includes a brief chapter on solar heating and cooling, Bruce Anderson's book is a whole-hog solar house book. Treading a delicate balance between the heavily theoretical (a favourite of English writers, starved of any real examples) and the 'do your own thing' ramblings of the alternative establishment, it shows the very many ways that solar energy can and is being used in the home. The book

starts out with analyses of the USA's first solar houses — the 'Model T' examples — and goes on to the present stage, which in the same metaphorical vein could be called the early post-war Chevrolet. That is, solar buildings are still a bit expensive and cumbersome by comparison with production line, flimsy, subcolonial homes, that require less than a 1000 man-hours to throw together. But they have come a very long way in a short time, and the basic constructional and operational systems have been shaken down to a relatively few, fairly well proved, active and passive systems.

Anderson's book uses this 'primal' duality to separate solar systems using collector plates heating air or water (active), and those using the building fabric and/or fenestration to achieve a large reduction in energy demand (passive). Many examples of these two categories of solar building are given, with extensive analysis of the performance, cost and operating factors.

Of course nothing will come even from such excellent books as these as long as people can pretend there is either no energy crisis, or that it won't affect them personally. To date British and EEC politicians have much preferred to wallow in conceit and arrogance — which no doubt reflects their voters' as well as their own culture — when it comes to energy. In the US and Canada this is certainly not the case: and once more N. America is setting a trend which Europe will, much sooner than later, have to follow.

Andrew MacKillop

THIS MONTH'S AUTHORS

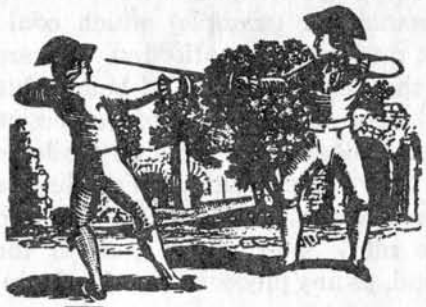
Dr. Charles Wakstein
Spent ten years in the US nuclear weapons industry before taking a post-graduate course in England. For the last three years he has worked as a freelance film maker and journalist with special reference to the field of nuclear safety.

Peter Taylor
is organiser and co-ordinator of the Political Ecology Group in Oxford and is pursuing post-graduate studies at the Institute of Anthropology at the University of Oxford.

Brian Martin
emigrated to Australia from the U.S. to avoid conscription. After completing a Ph.D. in theoretical physics at Sydney University he worked in 1976 at the Australian National University's Centre for Resource and Environmental Studies.

Keith White-Hunt
is a visiting lecturer at the School of Technological Management at the University of Bradford. He has carried out a comprehensive survey on methods of use for recovery of waste materials in domestic refuse.

Arthur W.J. Lewis
is an M.P. and Chairman of the All-Party Committee for Freedom of Information. He has contributed major articles to many periodicals on the abuses of secrecy.



Letters

What is Reality?

Dear Sir,

The monotonous plaints about science, positivism, objectivity, reductionism, etc. appearing in *The Ecologist* are becoming tedious. Thomas Merriam's "The Disenchantment of the World" is an example.

The ineptness of recent Bible translations, he seems to think, are due to a current world view from which symbolism is banished. It is questionable whether the translation errors are due to an attempt to make the Bible understandable to modern man, since they would not have made the mistakes mentioned by Merriam if they'd fully comprehended the subject themselves. I should imagine that the translators would be more acquainted with the symbolism of their religion than with science — but maybe science is more powerful medicine. One wonders, nevertheless, why some of the most stimulating and imaginative writing is being done by scientists or science interpreters.

It is a matter of relief and gratitude that people no longer need to lead lives burdened with terror of demons in caves or thunder as "an angry god." The true enemy is the evil in human nature, and surely there is plenty of symbolism in The Bomb. It is a matter for excitement that the boundary between life and non-life is disappearing. The old symbols of the unity of creation accrue new significance, but we are free now to contemplate nature with an awe more befitting its grandeur than was possible when our minds were limited by primitive animism. We may be environmentalists now, not Nature-worshippers, but science has given us the security and leisure

to develop scruples about killing animals (for example) which could not previously be afforded. We are in the happy position of being able to take advantage of objective meteorological information while in no way diminishing our ability to perceive the Creator in the sun and the rain. After all, it's all in the mind, as any physicist could tell you.

Yours faithfully,
Peter H. Edwards,
Blaxland East,
Australia.

Tom Merriam writes:
Mr. Edwards' contemplation of nature and perception of the Creator in the sun and the rain confidently presume a belief in their existence. If it's all in the mind, as any physicist since the time of Immanuel Kant can tell you, then any sort of reality outside the mind is problematical. The social outcome of this doubt, in moral terms, is egotism. Only the self is truly believable. The environmental outcome of this doubt is a gross abuse of man's earthly home.

Participation through symbols counteracts the nihilism that underlies a world of pure Kantian phenomena by giving us an experience *of a reality outside our ego, a real contact with the elusive* noumena. *This is why primitive men, with all their burden of fear of demons, are more real than most of us.*

Ultimate Destination

Dear Sir,

What arrangements does ecologically-minded Man make for the disposal of his remains? I find myself distressingly far from ecologically-minded; I do regard my substance as one of Earth's resources worthy of respect as such when no longer called to serve its designed purpose. There must be a fitting way of completing the cycle; I cannot think what it is. Full fathom down in a consecrated acreage cannot be the ecological answer. How does the ecologist say?

With Good Wishes,
Yours faithfully,
Kenneth Hardy,
Leamington Spa.

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PUBLICATIONS

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SECOND-HAND AND OUT OF PRINT BOOKS on Ecology and Conservation are included in my list on self-sufficiency. Send large S.A.E. to Julia Kemp, 290 Hughenden Road, High Wycombe, Bucks.

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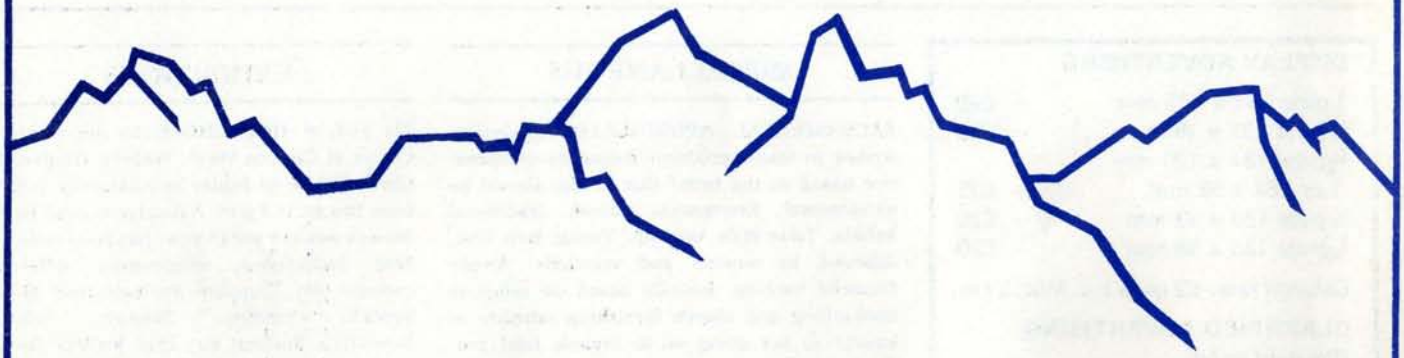

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